Q. Hydro indicates at RAP Appendix B: Planning Criteria and Study Methodology, page 8-9 of 57 that:

> "From an energy perspective, it is also necessary to decouple the two interconnected systems. Further analysis has been completed to define the operational relationship between LIL flow, Island Interconnected System demand, and Maritime Link flow. Under normal system conditions, the amount of energy that can flow over the LIL to the Island is limited by the interdependencies with the Maritime Link and Island load. This interdependence exists because both HVdc links must work together using RAS that will suddenly reduce their power flows (runbacks) to transiently regulate system frequency in the event a contingency occurs on the other HVdc link. This LIL to Maritime Link relationship has less of an impact on the amount of power that can be absorbed on the Island than the amount of UFLS that is available and would be triggered following a bipole trip. The amount of available UFLS is directly proportional to the total Island load. As a result, it is now confirmed that there are restrictions on the amount of energy that is able to flow from Muskrat Falls to the Island, resulting in the recommendation to consider the two regions independently when assessing firm energy requirements."

Hydro represents the above relationship in Technical Conference #3 presentation slide 47 (Maritime Link (ML) – LIL relationship).

a) Please provide a copy of any third-party reports or analysis commissioned by Hydro related to assessing the limitation represented by the Technical Conference #3 presentation slide 47.

b) Please describe what is meant by "it is now confirmed that there are restrictions on the amount of energy that is able to flow from Muskrat Falls to the Island" and indicate the specific process, timing and form by which Hydro arrived at or received this confirmation. Please provide a copy of any internal reports or memos that document the confirmation process.

A. TransGrid Solutions Inc. ("TransGrid") was hired by Newfoundland and Labrador Hydro ("Hydro") in 2017 to conduct a series of operational studies for the Lower Churchill Project ("LCP"). The purpose of these studies was to establish operational limits for all LCP major assets including the Labrador-Island Link ("LIL"), Maritime Link, Muskrat Falls Hydroelectric Generating Station, Soldiers Pond synchronous condensers and the 315 kV transmission system in Labrador. A key objective of these studies was to quantify the LIL to Maritime Link relationship for the various stages of LIL commissioning. Hydro's intent has been, and continues to be, to modify the under frequency load shedding ("UFLS") scheme as LIL commissioning progressed and the asset proved to be more reliable, which would coincide with a lower probability of a LIL bipole trip and the subsequent UFLS.

The first study establishing the LIL to Maritime Link relationship, "Stage 4D LIL Bipole: Transition to High Power Operation," provided as IC-NLH-011, Attachment 1, was completed in April 2020[1] and was based on the historic UFLS scheme, that was in place at the time. This historic scheme was established to ensure the reliable operation of the Holyrood Thermal Generating Station. Additional analysis was performed by TransGrid in March of 2021 in their study "Redesign of UFLS Scheme for High Power Operation," provided as IC-NLH-011, Attachment 2. This analysis has since become outdated and no longer relevant, and Hydro has updated the LIL transfer limits associated with the UFLS scheme as detailed below.

Hydro worked with Newfoundland Power Inc. ("Newfoundland Power") to expand the UFLS scheme following the completion of the LIL testing performed in the summer of 2022. This LIL testing confirmed the functionality of Maritime Link runbacks,[2] which are vital to maintaining system stability following a LIL pole or bipole trip. The successful commissioning of Maritime Link runbacks permitted an increase in LIL power transfer that needed to be supported with the expansion of the existing UFLS scheme. Once this UFLS scheme was designed with support from Newfoundland Power, Hydro worked with TransGrid to establish the new LIL transfer limits associated with the re-designed interim scheme which was implemented in October 2022. Since October 2022 the UFLS scheme has remained unchanged. However, the LIL limits associated with this interim UFLS scheme, and therefore the amount of energy that can be sunk to the Island Interconnected System, continued to evolve. The most recent LIL limits that are currently being used were incorporated into Hydro's firm energy analysis performed for the 2024

[1] Originally filed as part of the "Reliability and Resource Adequacy Study — Operational Studies — Stage 4," Newfoundland and Labrador Hydro, April 15, 2020, att. 1.

[2] A Maritime Link runback is a sudden reduction of Maritime Link exports with the purpose of increasing system frequency following an under-frequency event triggered by a LIL pole or bipole trip.

Resource Adequacy Plan. These LIL transfer limits are provided as IC-NLH-011, Attachment 3. As Hydro continues to refine its analysis and operational parameters with neighboring utilities, models will continue to be updated.

Hydro is continuing analysis and operational discussion with neighboring utilities in an effort to further expand the UFLS and implement a "Final UFLS scheme." TransGrid is currently in the process of performing this analysis and Hydro expects results by the second quarter of 2025. Any further modifications could enable the potential for more LIL energy to be sunk on the Island Interconnected System, thus reducing the firm energy requirement identified in the Minimum Investment Required Expansion Plan.

Engineering Support Services for:
RFI Studies

Newfoundland and Labrador Hydro

Attention: Mr. Rob Collett

Stage 4D LIL Bipole: Transition to High Power Operation

Technical Note: TN1205.71.07
Date of issue: April 7, 2020

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1. Executive Summary

Operational studies are underway to determine the system operating limits of the Newfoundland and Labrador Hydro ("Hydro") Island Interconnected System ("IIS"). To date, several stages of operational studies have been performed to identify Labrador Island link ("LIL") and Maritime Link ("ML") transfer limits for the phased monopolar approach, with the LIL monopole operating up to a maximum of 225 MW.

Stage 4 is the final stage of operational studies and includes the 900 MW LIL bipole, the Muskrat Falls ("MFA") generators, the Soldiers Pond ("SOP") synchronous condensers and the ML.

This report investigates the period in time where the system is transitioning from low to high power operation on the LIL. LIL and ML transfer limits are determined for this period in time as more equipment comes into service.

As equipment is being brought online, the following considerations/sensitivities are considered in this report:

- Operation of the Holyrood ("HRD") Thermal Plant was considered
- Number of SOP synchronous condensers in-service (1 or 2)
- LIL operating as monopole or bipole
  - Without frequency control
  - Without 2 pu 10-minute overload capability for loss of a pole
- Number of SOP and MFA filters (needed to meet IEC harmonic distortion limits)

1.1 LIL Transfer Limits

The contingencies that define the LIL transfer limits are loss of the LIL bipole and loss of a LIL pole. LIL transfer limits for the transitional period are shown in Figure 1–1 (ML frequency controller in-service) and Figure 1–2 (ML frequency controller out-of-service).

Loss of the LIL Bipole
Ultimately, the UFLS scheme will be modified/re-designed during the final Stage 4 operational study to allow increased LIL transfer limits while ensuring that the system remains stable after shedding the 58 Hz block of load, as per Transmission Planning Criteria. However, during the period when the system is transitioning from low to high power operation, the existing UFLS scheme will remain in place, therefore LIL transfer limits are needed to ensure that the system remains stable following the loss of the LIL bipole. The frequency criteria used in this study allowed the 58 Hz block of load to be shed if the LIL bipole is lost, as long as the system recovered well and in a stable manner following the loss of LIL bipole. Note also that if the LIL bipole is lost, the ML (if exporting) will runback[1].

[1] If the ML is exporting less 150 MW or importing less than 170 MW, the ML response would be limited to frequency controller action. If the ML is exporting and is runback, no further support is provided by the ML frequency controller.

Loss of the LIL Pole

Transmission Planning Criteria for loss of a LIL pole are defined to ensure that such an event will not cause the IIS frequency to drop below 59 Hz and will not result in UFLS. The LIL will ultimately have a 10-minute 2 pu overload rating; however, during the period when the system is transitioning from low to high power operation, this overload capability will not be available. Rather, the LIL's capacity for pole compensation will be limited to 1 pu DC current. It is noted that the ML is equipped with runbacks or frequency controller action to provide support in the event of the loss of a LIL pole.

With the use of ML runbacks or the operation of the ML frequency controller, the IIS frequency remained above 59 Hz for loss of a LIL pole under all operating scenarios, with the exception of peak load conditions. Under peak load conditions, except for the case with the ML exporting 500 MW, the loss of a LIL pole was more limiting than loss of the bipole. The LIL transfer limits were reduced accordingly for these peak load cases in order to ensure IIS frequency remains above 59 Hz if a LIL pole trips.

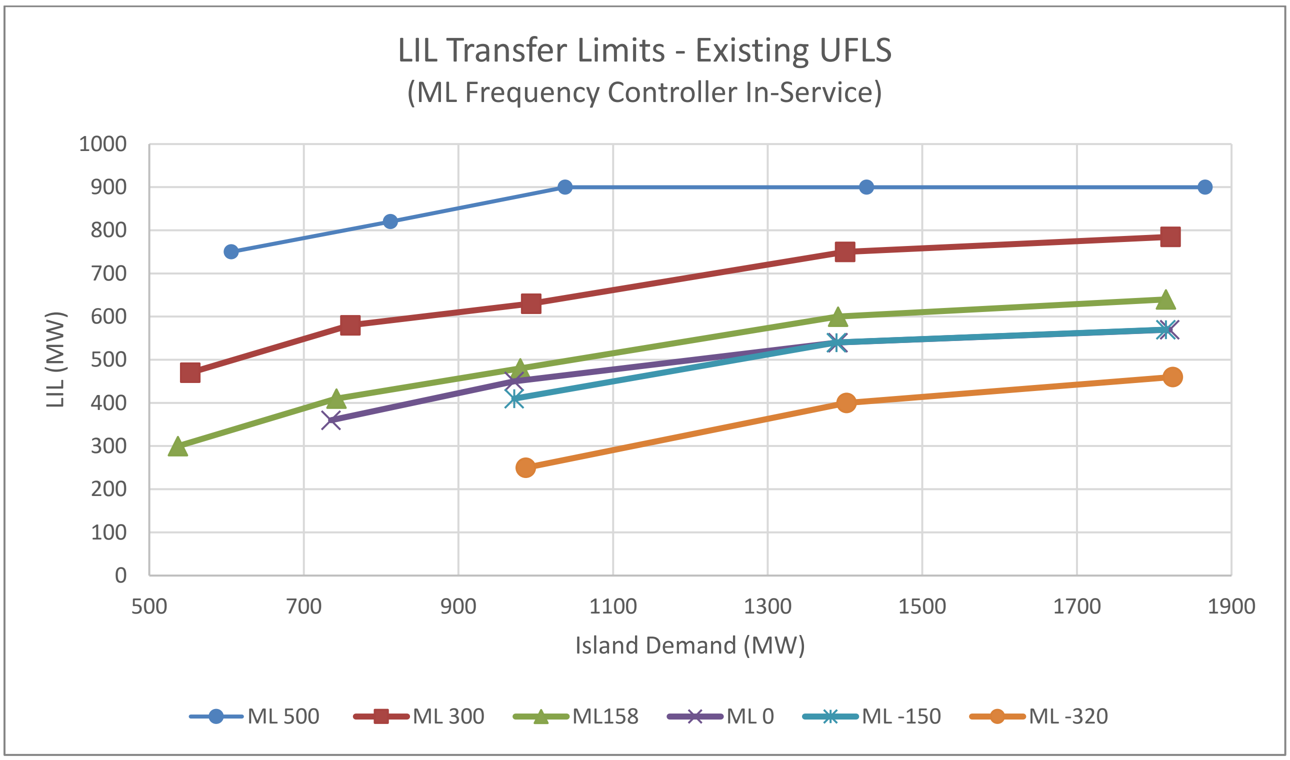

Figure 1–1. LIL Transfer Limits (ML Frequency Controller in-service)

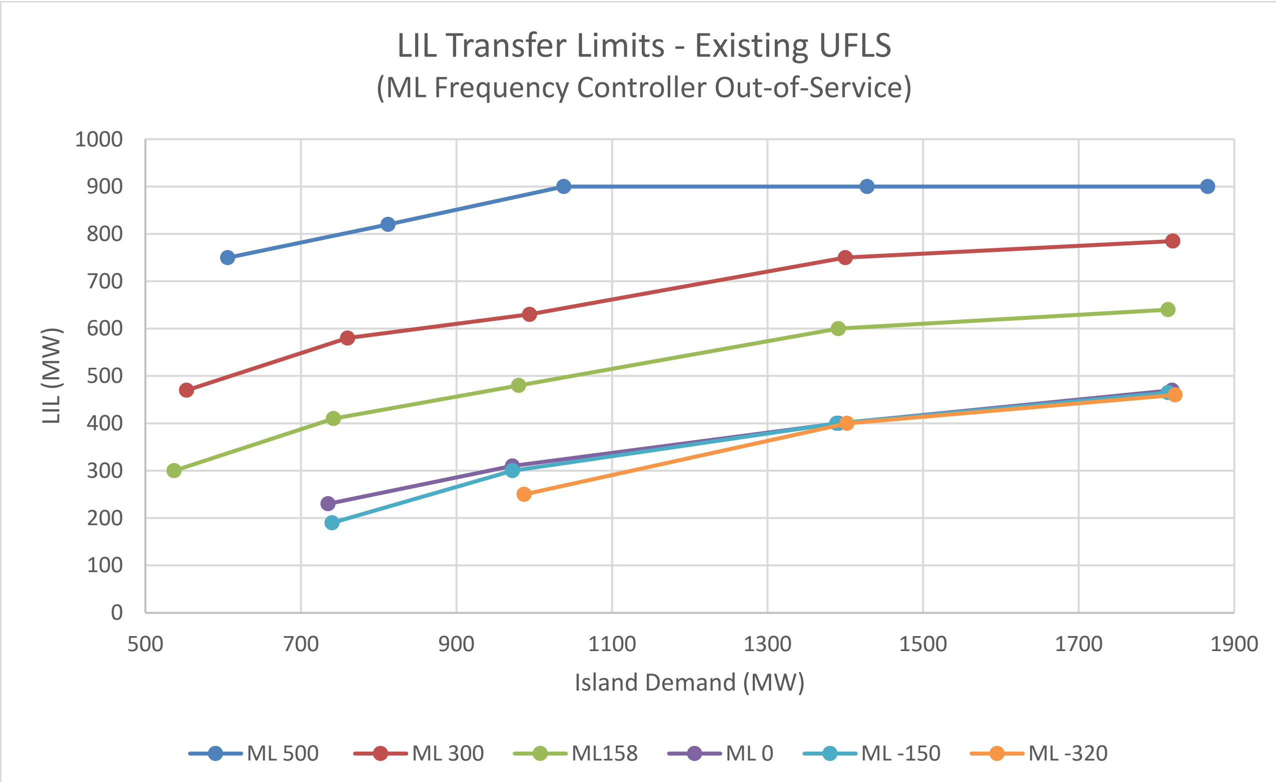

Figure 1–2. LIL Transfer Limits (ML Frequency Controller out-of-service)

1.2 ML Transfer Limits

As per Transmission Planning Criteria, loss of an ML pole (when importing) should not result in UFLS and frequency should remain above 59 Hz. UFLS is allowed for loss of the ML bipole; frequency is allowed to dip below 58 Hz as long as the system recovers well after the 58 Hz block of load is shed. If exporting, frequency should remain below 62 Hz for loss of an ML pole or bipole.

1.2.1 Without use of LIL Runbacks or Run-ups

ML transfer limits without the use of LIL runbacks or run-ups are show in Figure 1–3. This figure assumes that only HRD unit 3 is in-service as a synchronous condenser during ML export (no HRD units dispatched as generators). Figure 1–4 depicts the ML export limits[2] with 1, 2 and 3 HRD units in-service and dispatched as generators.

[2] More restrictive ML export limits are needed when HRD units are in-service in order to limit the decrease in power output to 15 MW per HRD unit in response to the system overfrequency that occurs when the ML bipole is lost.

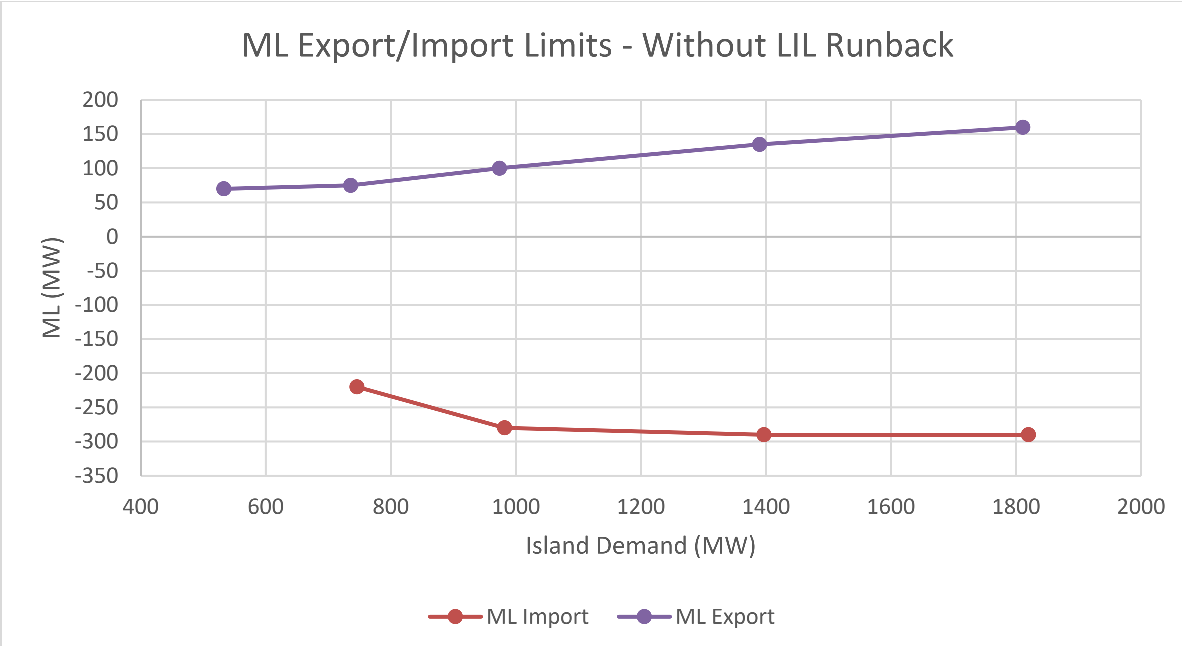

Figure 1–3. ML import/export limits, without LIL run-ups/runbacks or frequency control (no HRD units dispatched as generators).

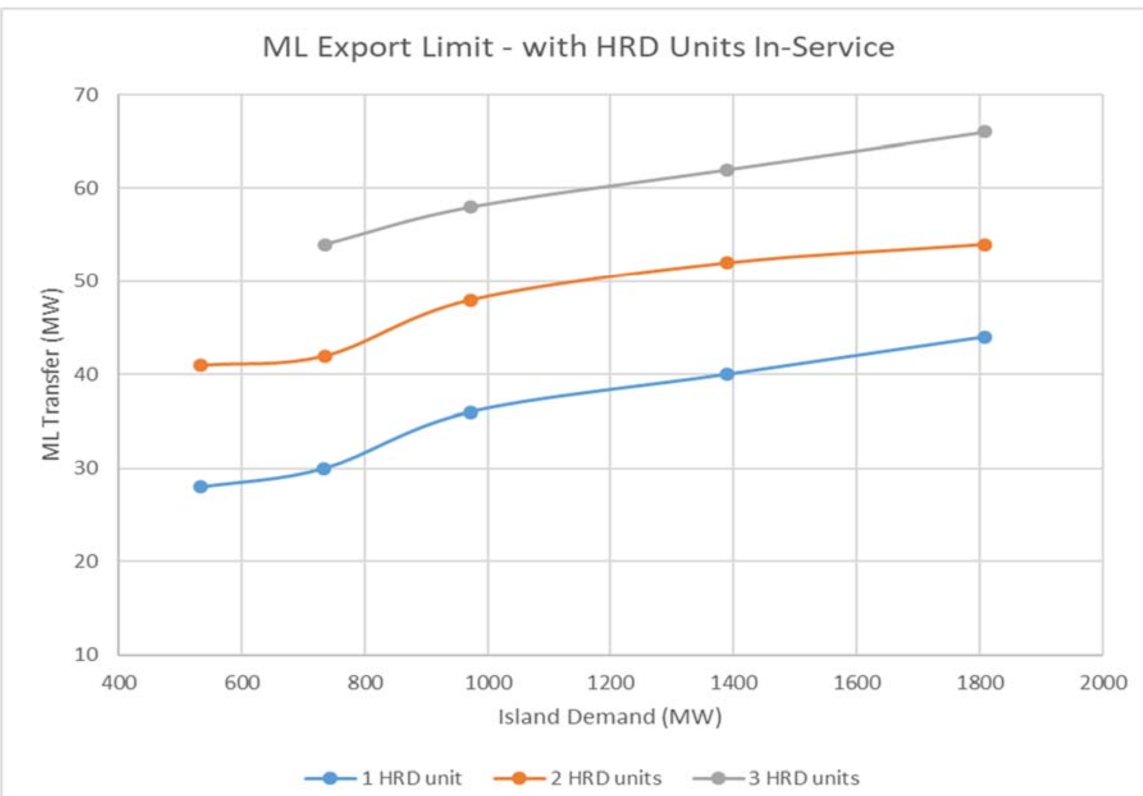

Figure 1–4. ML Export Limits with HRD Units In-service (without LIL runbacks)

1.2.2 With the use of LIL Runbacks and Run-ups

If LIL run-ups are initiated when there is loss of ML import, and LIL runbacks are initiated when there is loss of ML export, then ML power transfer is not limited, and the ML can operate over its full range from 320 MW import to 500 MW export. This assumes that there is sufficient room available on the LIL (up or down) to cover for loss of the ML bipole.

A simple approach to determine the amount of LIL runback or run-up that is required for a particular ML import or export level is to simply runback or run-up the LIL by the amount of ML export or import that was lost. Note that the LIL runback or run-up should be high enough at MFA to consider LIL losses such that the total LIL runback or run-up as measured at Soldiers Pond is equal to the amount of ML export or import that was lost. This method is applicable to all levels of ML import or export over all ranges of IIS demand.

1.3 Additional Conclusions

The following additional conclusions were made during the study.

1. **Need for Avalon Generation during High Island Demand**

To ensure stability and to avoid electromechanical oscillations for loss of the LIL bipole, there is a requirement to ensure that generation is online on the Avalon Peninsula over peak.

a) To avoid voltage collapse

The IIS can become unstable if the LIL bipole trips during high IIS demand. It was determined that a minimum amount of Avalon generation (as defined in Table 1-1) is required to be in-service during high IIS demand to prevent system instability if the LIL bipole is lost. The Come-By-Chance capacitor banks should also be in-service (as many as steady state voltage allows) when the power flow eastward from Bay d'Espoir ("BDE") towards Soldiers Pond ("SOP") is high to help support the voltage if the LIL bipole is lost.

Table 1-1. Minimum Avalon Thermal Generation Required to be in-service to prevent voltage collapse following LIL bipole trip

IIS Demand (MW)	Avalon Generation (MW)			
	0 SOP Syncs	1 SOP Sync	2 SOP Syncs	3 SOP Syncs
1750-1850	120	70	40	None*
1700-1750	70	15	None*	None*
1600-1700	30	None*	None*	None*

*unless required for MW dispatch to meet IIS demand and ML exports

b) To avoid electromechanical oscillations

Electromechanical oscillations were also observed following a trip of the LIL bipole. In this case, the oscillations were worst (least damped) with three SOP synchronous condensers in-service, and became more damped with fewer SOP synchronous condensers in-service. With one or no SOP synchronous condensers in-service, the oscillations are damped and no mitigation is required.

The following pre-contingency power flow limits should be followed to improve the damping of the oscillation and to avoid system instability:

- Two SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 540 MW
- Three SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 510 MW

Once properly tuned Power System Stabilizers ("PSSs") are in-service, these power flow restrictions for the two and three SOP synchronous condenser scenarios can likely be eliminated and then only the limits in Table 1-1 would apply.

c) To avoid instability due to 3PF on TL267

Additionally, in line with previous operational studies[3], when power flow from BDE to SOP reaches levels around 650 MW (with or without the LIL in service), the IIS can also experience instability if there is a three phase fault ("3PF") on line TL267. Therefore, power flow on this corridor should be limited to 650 MW.

2. Impact of SOP Synchronous Condensers on LIL Transfer Limits

The SOP synchronous condensers provide inertia to the Island, and they help the system by slowing down the rate of change of frequency immediately after infeed from the LIL is lost. It was found that although they slow down the initial rate of change of frequency, they do not impact the minimum frequency that occurs, and therefore the transfer limits defined in this study were the same whether one or two SOP synchronous condensers were in-service.

3. Concept of "Net DC"

The concept of "Net DC" to the IIS applies when the ML is exporting and can be runback to 0 MW if the LIL bipole is lost. For example, at a 1400 MW demand level, LIL power transfer is limited to 750 MW if ML is exporting 300 MW. At the same demand level, LIL power transfer is limited to 600 MW if ML is exporting 158 MW. In both cases, subtracting ML export from the LIL transfer limit results in a value of around 450 MW, which could be termed the "Net DC" limit. Figure 1–5 shows the approximate "Net DC" limits when the ML is exporting. Note that over peak, the Net DC is limited by loss of a LIL pole instead of loss of the LIL bipole. Also note that the "Net DC" limits are very similar for various ML export levels.

[3] TGS report R1529.01.02 "Solutions to Serve Island Demand during a LIL Bipole Outage", and TGS report TN1205.62.05 "Stage 4A LIL Bipole: Preliminary Assessment of High Power Operation".

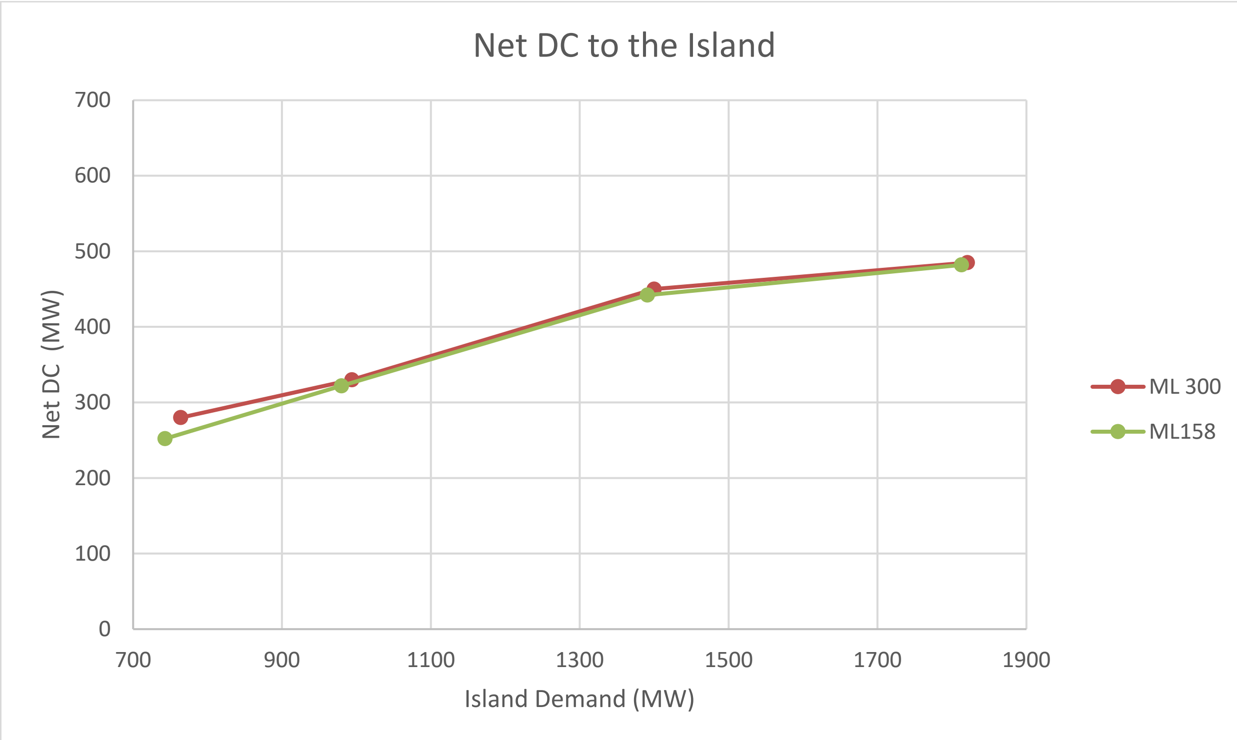

Figure 1–5. Maximum "Net DC" to the Island during ML export

1.4 Harmonic Analysis

In order to meet IEC harmonic limits, the analysis concluded that the LIL may be operated up to 675 MW in monopole operation and 900 MW in bipole operation with the filter configurations listed in Table 1-2.

Table 1-2. LIL limits and filter configurations to meet IEC harmonic limits[4]

Monopole Operation up to 675 MW		Bipole Operation up to 900 MW	
Muskrat Falls	**Soldiers Pond**	**Muskrat Falls**	**Soldier's Pond**
two A type	one A type, one B type	two A type filters**	one A type, one B type
two A type, one B type	one A type, two B type	two A type, one B type	one A type, two B type
two A type, two B type	two A type, two B type	two A type, two B type	two A type, two B type
three A type, one B type	two A type, three B type	three A type, one B type	two A type, three B type
	three A type, two B type		three A type, two B type

****** except when only one or two MFA units are in service under light load conditions, or when only one MFA unit is in service under peak load conditions, in which case, operation is possible only up to 810 MW with two A type filters

[4] The type A filter is a triple tuned filter, tuned to harmonics 3, 12, and 23. The type B filter is a high pass filter, tuned to the 11th harmonic.

2. Study Models and Criteria

The Interconnected Island System (IIS) is the area of focus for this study.

2.1 Interconnected Island System

The 230 kV network of the IIS is shown in Figure 2–1.

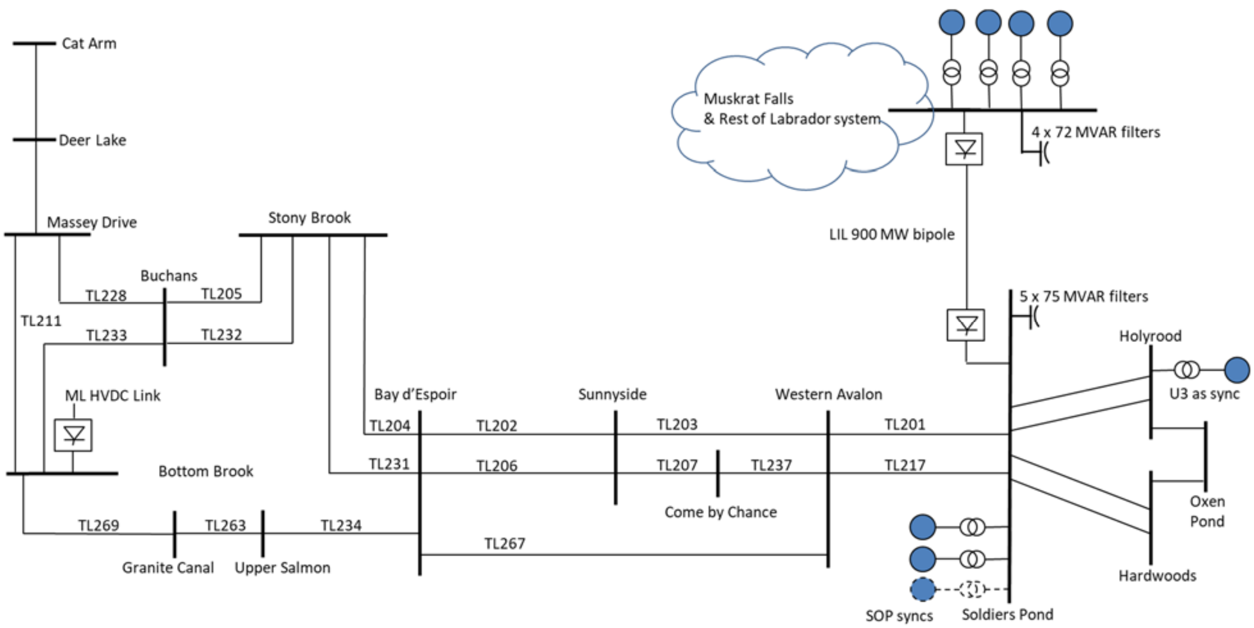

Figure 2–1. Interconnected Island System 230 kV grid

2.2 Study Assumptions

The following assumptions are made for this study:

- HRD units (1,2,3) are available as required, until the full LIL 900 MW bipole and all associated equipment and control functionality are in-service.[5] The final Stage 4 operational study will assume that the HRD units have been retired.
- LIL frequency controller is not in-service. The LIL frequency controller will be considered in-service in the final Stage 4 operational study.
- LIL 2 pu 10-minute overload is not available.
- The existing ULFS scheme will remain as is. The new UFLS scheme will be assumed in-service in the final Stage 4 operational study.
- ML can operate between 320 MW import and 500 MW export, if not limited by operational restrictions

[5] Thermal generation is minimized in all base cases, but may be increased, as required, if transmission system violations are found.

- It is assumed that the ML (if exporting) will runback to 0 MW in the event of the loss of the LIL bipole or a pole. It is assumed that no additional support will be provided from the ML frequency controller if it has been runback.
- As long as import capacity is available, the ML frequency controller will provide up to 150 MW of frequency support if a LIL pole is lost or for other underfrequency events that cause the ML frequency controller to operate, as long as the ML has not been runback for the event.
- The ML frequency controller was enabled when ML flow ranged between -170MW (import) to 150 MW (export). Runbacks will occur whenever the LIL bipole is lost and the ML is exporting more than 150 MW. It is assumed that if a runback occurs, the ML frequency controller will not provide further support.

2.3 Study Criteria

The applicable Transmission Planning Criteria for this study is summarized below:

- Steady state voltage : 0.95 pu – 1.05 pu during n-0 conditions
- Steady state voltage : 0.90 pu – 1.1 pu during n-1 conditions
- Post fault recovery voltages on the ac system shall be as follows:
    - Transient undervoltages following fault clearing should not drop below 70%
    - The duration of the voltage below 80% following fault clearing should not exceed 20 cycles
- Post fault system frequencies shall not drop below 59 Hz and shall not rise above 62 Hz
- For a loss of the ML bipole and for loss of the LIL bipole, underfrequency load shedding shall be permitted, but controlled, and the system frequency is allowed to shed the 58 Hz block of load shed, as long as the system recovers in a stable manner.

2.4 Contingencies

Table 2-1 lists the contingencies that were considered in this study.

Table 2-1. Contingencies

Line/Generator	Description
Loss of LIL pole	Permanent loss of LIL pole. Assumes no 2pu overload functionality
Loss of LIL bipole	Permanent loss of LIL bipole
Loss of ML bipole	Permanent loss of ML bipole
Loss of ML pole	Permanent loss of ML pole

2.5 PSSE Base Cases

Table 2-2 lists the base cases that were used to analyze the IIS system in this study.

Table 2-2. Base cases

Load Condition	Island Demand (MW)[6]	LIL Power Transfer (at MFA) (MW)	Island Generation (MW)
Peak[7]	1825	810 (import)	1214
Intermediate Peak	1391	700 (import)	889
Intermediate	980	620 (import)	548
Light	743	520 (import)	402
Extreme Light	537	300 (import)	402

[6] Island Demand includes load and losses. Variations in Island Demand for the same loading condition are attributed to incremental losses associated with variations in dispatch.
[7] Peak loading conditions are based on 2028 forecasted load.

3. LIL Transfer Limits

There are two contingencies that define the LIL transfer limits:

1. Loss of a LIL pole
2. Loss of the LIL bipole

Loss of the LIL Bipole

Loss of the LIL bipole is the contingency that defines the requirements of the UFLS scheme for the IIS. Ultimately, the UFLS scheme will be modified/re-designed during the final Stage 4 operational study to allow increased LIL transfer limits while still ensuring that the system remains stable after shedding the 58 Hz block of load, as per Transmission Planning Criteria.

This report is investigating the period in time where the system is transitioning from low to high power operation. During this time, the existing UFLS scheme will remain in place and LIL transfer limits will be enforced as required to ensure that the system remains stable following the loss of the LIL bipole. The frequency criteria used in this study allows the 58 Hz block of load to be shed if the LIL bipole is lost, as long as the system recovers well and in a stable manner following the loss of LIL bipole and the subsequent UFLS. Note also that if the LIL bipole is lost, the ML (if exporting greater than 150MW) will be runback to 0 MW[8].

Loss of the LIL bipole was simulated for IIS system conditions ranging from extreme light to peak demand, and for levels of ML power transfer ranging from 320 MW import to 500 MW export. There are two stability issues that were observed when the LIL bipole is lost:

1. Decline in IIS frequency and subsequent UFLS
2. Voltage collapse around the mid-point of the BDE-SOP 230 kV corridor (around Sunnyside) during high IIS demand conditions

LIL transfer limits required for reasons of underfrequency are described in Section 3.1. The voltage collapse issue is discussed further in Section 3.2.3.

Loss of the LIL Pole

The Transmission Planning Criteria for loss of a LIL pole are specified such that this event should not cause the IIS frequency to drop below 59 Hz, and it should not result in UFLS.

The LIL is ultimately being designed with a 10-minute 2 pu overload rating. If one of the LIL poles is lost, the remaining pole is rated to transmit 2 pu for 10 minutes, after which the continuous monopole rating drops down to 1.5 pu. The purpose of the 10-minute 2.0 pu overload rating is to allow operators time to quickly dispatch other resources to make up for the loss of infeed from the LIL pole that was lost.

During the transition from low to high power operation, this 2 pu overload capability will not yet be available. Rather, the LIL's capacity for pole compensation will be limited to 1 pu DC current. It is noted

[8] If the ML is exporting less than 150MW or importing less than 170MW, the ML response would be limited to frequency controller action.

that the ML is equipped with runbacks or frequency controller action to provide support in the event of the loss of a LIL pole.

Since the last update of the report, GE's PSSE model of the LIL was received. The loss of a LIL pole was revisited for this study using the GE model of the LIL, as described below.

Simulations for loss of a LIL pole were re-run using GE's model of the LIL for the same IIS system conditions as the LIL bipole. The LIL transfer limits determined for loss of the LIL bipole were checked to ensure that loss of a LIL pole at these LIL power transfer limits would meet the 59 Hz criteria.

3.1 Study Results

With the use of ML runbacks or the operation of the ML frequency controller, the IIS frequency remains above 59 Hz for loss of a LIL pole under all operating scenarios, with the exception of peak load conditions. Under peak load conditions, except for the case with ML exporting 500 MW export, loss of a LIL pole was more limiting than loss of the LIL bipole, and the LIL transfer limits were reduced accordingly for these cases in order to ensure IIS frequency remains above 59 Hz if a LIL pole trips.

The LIL power transfer limits during the transitional period are listed in Table 3-1 and shown in Figure 3–1 (ML frequency controller in-service) and Figure 3–2 (ML frequency controller out-of-service).

Please note the following:

- In all peak demand cases, voltage considerations were found to be more limiting than underfrequency concerns. The results in the table below only reflect underfrequency limits, while Section 3.2.3 discusses the voltage collapse issue and prevention in more detail.

Table 3-1. Transitional Period Results – LIL Transfer Limits with and without ML Frequency Controller

				ML Frequency Controller IN					ML Frequency Controller OUT				
	Demand	Generation	ML	Loss LIL Bipole Transfer Limit (MW)	Minimum Frequency (Hz)	Loss LIL Pole Transfer Limit (MW)	ML Runback* (MW)	Minimum Frequency (Hz)	Loss LIL Bipole Transfer Limit (MW)	Minimum Frequency (Hz)	Loss LIL Pole Transfer Limit (MW)	ML Runback* (MW)	Minimum Frequency (Hz)
Peak	1866	1530**	500	900	58.08	900	400	59.6	900	58.08	900	400	59.6
Ipeak	1428	1094	500	900	57.97	900	400	59.2	900	57.97	900	400	59.2
Int	1038	703	500	900	57.81	900	400	59.2	900	57.81	900	400	59.2
Light	812	476	500	820	57.93	820	350	59.5	820	57.93	820	350	59.5
ExLight	606	401	500	750	58	750	260	59.4	750	58	750	260	59.4
Peak	1821	1285**	300	900	57.71	785	300	59.1	900	57.71	785	300	59.1
Ipeak	1400	915	300	750	57.79	750	300	59.3	750	57.79	750	300	59.3
Int	994	589	300	630	57.87	630	190	59.13	630	57.87	630	190	59.13
Light	760	452	300	580	57.87	580	130	59.4	580	57.87	580	130	59.4
ExLight	553	409	300	470	58.05	470	0	59.17	470	58.05	470	45	59.08
Peak	1815	1303**	158	720	57.73	640	158	59.15	720	57.73	640	158	59.15
Ipeak	1391	889	158	600	57.72	600	158	59.83	600	57.72	600	158	59.22
Int	980	548	158	480	57.86	480	0	59.17	480	57.86	480	40	59.15
Light	742	433	158	410	57.88	410	0	59.31	410	57.88	410	0	59.13
ExLight	537	402	158	300	58.02	300	0	59.45	300	58.02	300	0	59.45
Peak	1820	1330**	0	670	57.92	570	-	59.03	510	57.81	470	-	59.08
Ipeak	1391	906	0	540	57.87	540	-	59.01	400	57.85	400	-	59.5
Int	972	538	0	450	57.92	450	-	59.23	310	57.91	310	-	59.66
Light	735	403	0	340	57.99	360	-	59.31	230	57.93	230	-	59.83
ExLight	535	404	0	130	59.05	130	-	59.99	130	58.1	130	-	59.99
Peak	1815	1049**	-150	650	57.95	570	-	59.04	510	57.77	465	-	59.06
Ipeak	1389	757	-150	540	57.91	540	-	59.03	400	57.87	400	-	59.6
Int	972	424	-150	410	57.99	410	-	59.3	300	57.88	300	-	59.45
Light	740	402	-150	190	58.82	190	-	59.8	190	57.99	190	-	59.8
ExLight	536	400	-46	90	59.15	90	-	59.99	90	58.4	90	-	59.99
Peak	1824	998**	-320	500	57.85	460	-	59	500	57.85	460	-	59
Ipeak	1402	724	-320	400	57.83	400	-	59.46	400	57.83	400	-	59.46
Int	987	421	-320	250	57.98	250	-	59.8	250	57.98	250	-	59.8
Light	750	400	-260	90	58.6	90	-	59.99	90	58.6	90	-	59.99

Loss of Pole is more limiting that loss of LIL bipole

Not included in plot since not a limiting case

*In all cases, it is assumed that if ML runback is used, there is no additional support provided by the ML frequency controller.

** HRD CT dispatched to avoid voltage collapse following loss of LIL bipole, and HRD units dispatched to provide sufficient generation for system conditions.

Minimum IIS Generation

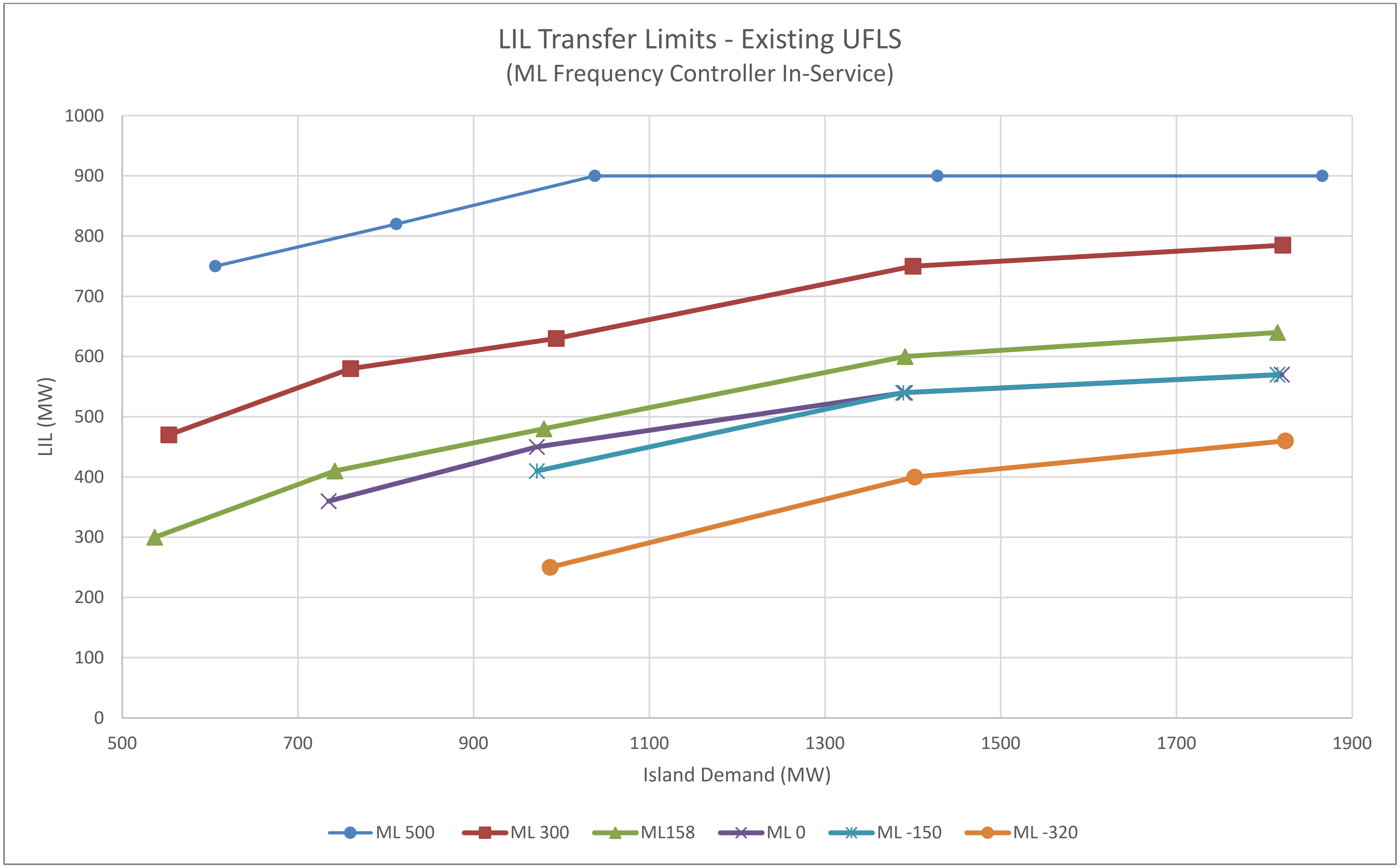

Figure 3–1. Transitional Period – LIL Transfer Limits – ML Frequency Controller In-Service

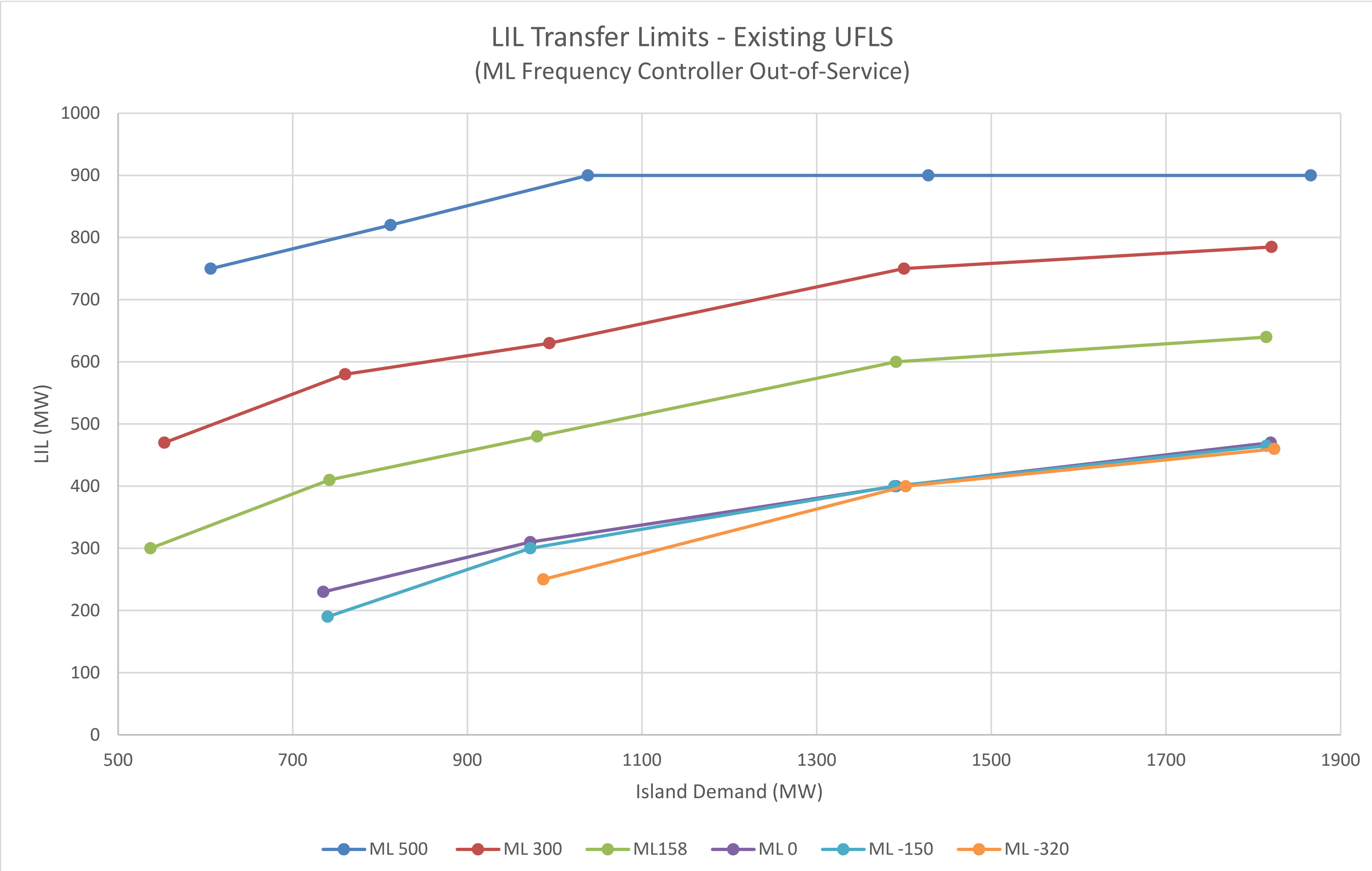

Figure 3–2. Transitional Period – LIL Transfer Limits – ML Frequency Controller Out-of-Service

3.2 Further Discussion on LIL Transfer Limits

This section discusses the following additional topics with regards to LIL transfer limits:

1. Concept of "Net DC" to the Island
2. Impact of 1 or 2 SOP synchronous condensers in-service
3. Need for Avalon Generation during high Island demand

3.2.1 Net DC to the Island

3.2.1.1 During ML Export

The concept of "Net DC" to the IIS applies when the ML is exporting and can be runback to 0 MW if the LIL is lost. For example, at a 1400 MW demand level, LIL power transfer is limited to750 MW if ML is exporting 300 MW. At the same demand level, LIL power transfer is limited to 600 MW if ML is exporting 158 MW. In these cases, subtracting ML export from the LIL transfer limit results in a value of around 450 MW, which could be termed the "Net DC" limit. Table 3-2 shows this example, indicating that for IIS demand around 1400 MW, the maximum "Net DC" to the IIS should be limited to 450 MW.

Table 3-2. Net DC to the Island

Demand (MW)	Generation (MW)	LIL Transfer Limit (MW)	ML Export (MW)	ML Runback or Frequency controller support	Maximum NET DC = LIL Limit -ML Runback or Frequency controller support (MW)
1821	1285	785	300	300	585
1400	915	750	300	300	450
994	589	630	300	300	330
764	404	580	300	300	280
1813	1214	640	158	158	482
1391	889	600	158	158	442
980	548	480	158	158	322
743	402	410	158	158	252

Figure 3–3 graphically depicts the maximum net DC to the Island from Table 3-2, with each line on the plot representing a different ML export level.

It is evident from Figure 3–3 that the net DC to the Island is approximately the same regardless of ML export level, as long as the ML export is runback to 0 MW when the LIL bipole is lost[9].

Note that over peak, the Net DC is limited by loss of a LIL pole instead of loss of the LIL bipole. Also note that the "Net DC" limits are very similar for various ML export levels.

[9] Please note that if the ML export is runback to 0 MW, it is assumed that no additional support will be provided from the ML frequency controller. The ML 0 MW or ML import cases assume ML frequency controller action since runbacks are not available in those cases.

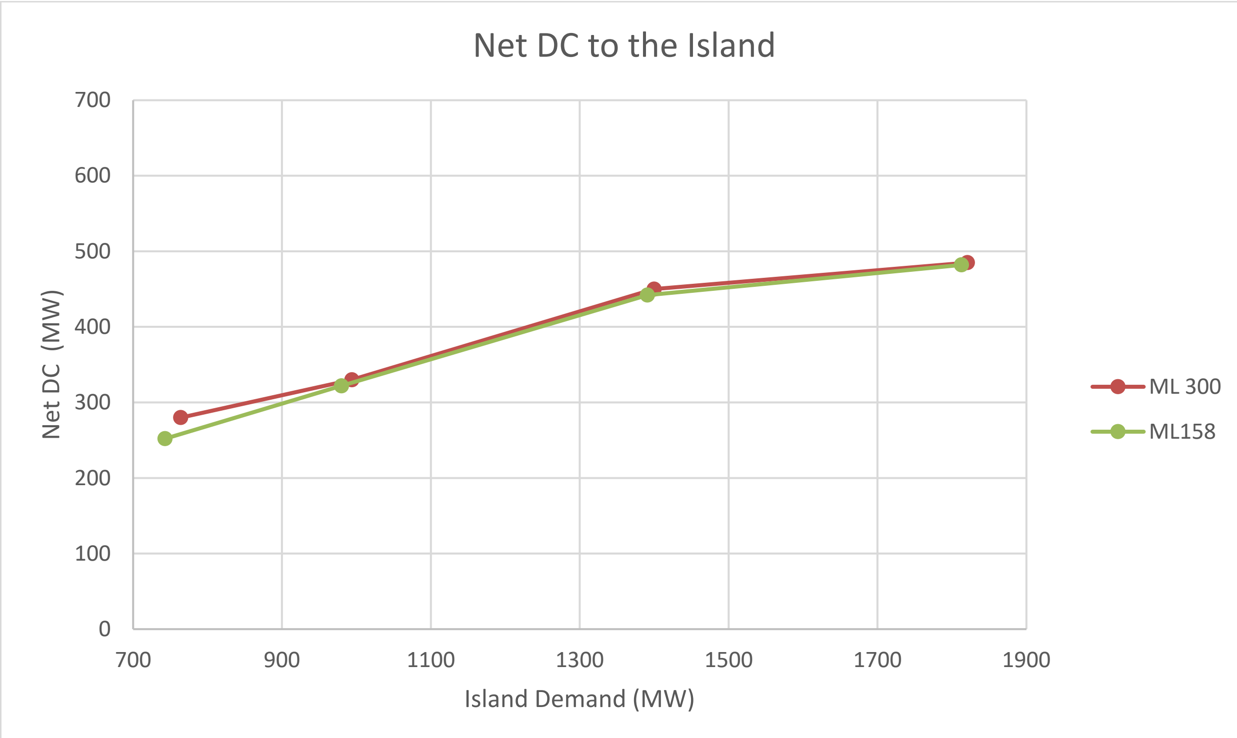

Figure 3–3. Maximum "Net DC" to the Island during ML export

3.2.1.2 During ML import

The "NET DC" concept does not apply in the same manner when the ML is operating at 0 MW or when importing because it cannot be runback to help the IIS frequency. However, as long as import capacity is available, the ML frequency controller will provide up to 150 MW of frequency support if a LIL pole or the bipole is lost.

The LIL transfer limits in Figure 3–1 corresponding to ML at 0 MW and ML importing 150 MW are nearly identical. This is because in both cases the ML provides a fast 150 MW response to loss of the LIL infeed, resulting in a similar frequency response in the IIS.

The LIL transfer limit corresponding to ML 320 MW import is approximately 150 MW lower than the ML 0 MW and ML 150 MW import cases, because in this case the ML is already operating at the import limit and does not provide any of the 150 MW support. In this case, the ML frequency controller capacity would be set to 0 MW to ensure that Maritime Area limits are not violated. Similarly, the LIL transfer limit corresponding to ML 250 MW import is approximately 80 MW lower than the ML 0 MW and ML 150 MW import cases, because there is only 70 MW of room for the frequency controller to assist. Therefore, in some sense the Net DC concept is also evident in the ML import cases, but from the perspective of support from the ML frequency controller, not from running back the ML export.

Therefore, if the ML is importing more than 170 MW (i.e. 320-170 MW=150 MW), the LIL transfer will be begin to be limited corresponding to how much room there is left for the ML frequency controller to respond, up until it reaches the maximum of 320 MW, at which point LIL transfer is most limited.

3.2.2 Impact of SOP Synchronous Condensers

The SOP synchronous condensers provide inertia to the Island, and help the system by slowing down the rate of change of frequency immediately after infeed from the LIL is lost.

Figure 3–4 shows an example of the IIS frequency response following a sustained loss of the LIL bipole, with one (blue) and two (green) synchronous condensers in-service. It is evident that the rate of change of initial frequency decline is slower with two synchronous condensers, but that the minimum frequency dip that occurs after ~3.4 seconds is very similar in both cases.[10] Therefore, this study found no significant difference in LIL power transfer limits whether there was one SOP synchronous condenser in-service or two SOP synchronous condensers in-service. This is explained by the fact that the minimum frequency of the system following the loss of supply is highly dependent on the resulting capacity deficit as opposed to total system inertia. On this basis, the loss of supply is most effectively counteracted by load shedding, runbacks, and frequency controller action. As mentioned above, the additional inertia serves to slow down the rate of frequency decay. However, the extra time for governor action is insufficient to make an appreciable difference in frequency recovery.

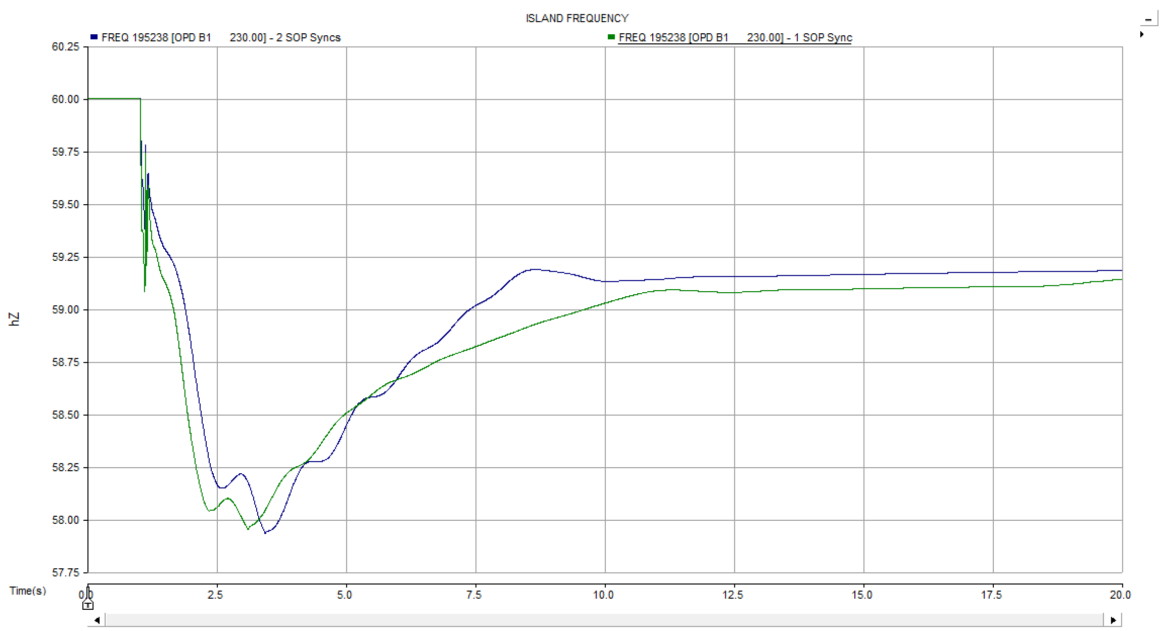

Figure 3–4. Loss of LIL bipole. Frequency response with 1 (blue) and 2 (green) SOP synchronous condensers.

[10] Both cases have very similar minimum frequencies with slight differences being attributed to variations in the electromechanical oscillations that occur as the frequency approaches 58 Hz. These variations are due to the differences in inertia in the two cases.

3.2.3 High Island Demand – Need for Avalon Generation

To ensure stability and to avoid electromechanical oscillations for loss of the LIL bipole, there is a requirement to ensure that generation is online on the Avalon Peninsula over peak. This was introduced in the Stage 4A operational study and the Avalon Capacity study[11] .

The Avalon Capacity study observed voltage collapse for three-phase faults on the 230 kV AC lines between Bay d'Espoir and Sunnyside/Western Avalon, and the Stage 4A High Power study observed similar voltage collapse scenarios for 3PF on lines at BDE and following loss of the LIL bipole under peak demand. Previous studies have correlated the voltage collapse issue with high power transfer (i.e. greater than 650 MW) between BDE and SOP. In order to reduce this power flow during peak Island demand, there is a need for Avalon generation to be in-service.

The results of this analysis indicate the following:

1. Voltage Collapse

The voltage collapse occurs when the system becomes unstable on the first swing of transient undervoltage (worst near Sunnyside) after the LIL bipole trips. This issue is worst with no SOP synchronous condensers in-service and improves as more SOP synchronous condensers are brought into service since they provide reactive power support in the area. It is noted that the voltage collapse is not a function of the pre-event LIL power flow or the 230 kV power flow to the Avalon Peninsula, but rather it is a function of the total power flow over the 230 kV corridor following the LIL bipole trip. This is due to the lack of dynamic reactive support to withstand such significant power flows in the BDE-SOP corridor. The voltage collapse can be mitigated by ensuring sufficient Avalon generation is on-line pre-contingency during high demand as summarized in Table 3-3, for scenarios with 0, 1, 2 and 3 SOP synchronous condensers in-service.

Table 3-3. Minimum Avalon Thermal Generation Required to be in-service to prevent voltage collapse following LIL bipole trip

IIS Demand (MW)	Avalon Generation (MW)			
	0 SOP Syncs	1 SOP Sync	2 SOP Syncs	3 SOP Syncs
1750-1850	120	70	40	None*
1700-1750	70	15	None*	None*
1600-1700	30	None*	None*	None*

*unless required for MW dispatch to meet IIS demand and ML exports

2. Electromechanical Oscillations

Electromechanical oscillations were also observed following a trip of the LIL bipole. In this case, the oscillations were worst (least damped) with three SOP synchronous condensers in-service, and became

[11] TGS report R1529.01.02 "Solutions to Serve Island Demand during a LIL Bipole Outage", and TGS report TN1205.62.05 "Stage 4A LIL Bipole: Preliminary Assessment of High Power Operation".

more damped with fewer SOP synchronous condensers in-service. With one or no SOP synchronous condensers in-service, the oscillations are damped and no mitigation is required.

The magnitude of the oscillations observed in the scenarios with two and three SOP synchronous condensers in-service can be reduced and the subsequent instability resulting from the undamped oscillations can be avoided by limiting the pre-contingency power flow eastward out of BDE during high demand. It should be noted that although the magnitude of the oscillations is significantly reduced (and instability avoided) by limiting this power flow, there are still lower magnitude oscillations observable in the AC system voltage. This issue will ultimately require mitigation using power system stabilizer tuning.

An example of the oscillations observed in AC voltage is given in Figure 3–5, which shows the SOP voltage response following a LIL bipole trip with one (red), two (green) and three (blue) SOP synchronous condensers in-service. It is observed that the first swing in AC undervoltage is worst with one SOP synchronous condenser in-service, but this response is most damped; whereas the case with three SOP synchronous condensers has the smallest first swing in AC undervoltage, but the oscillations are undamped, leading to system instability around 7 seconds after the LIL tripped.

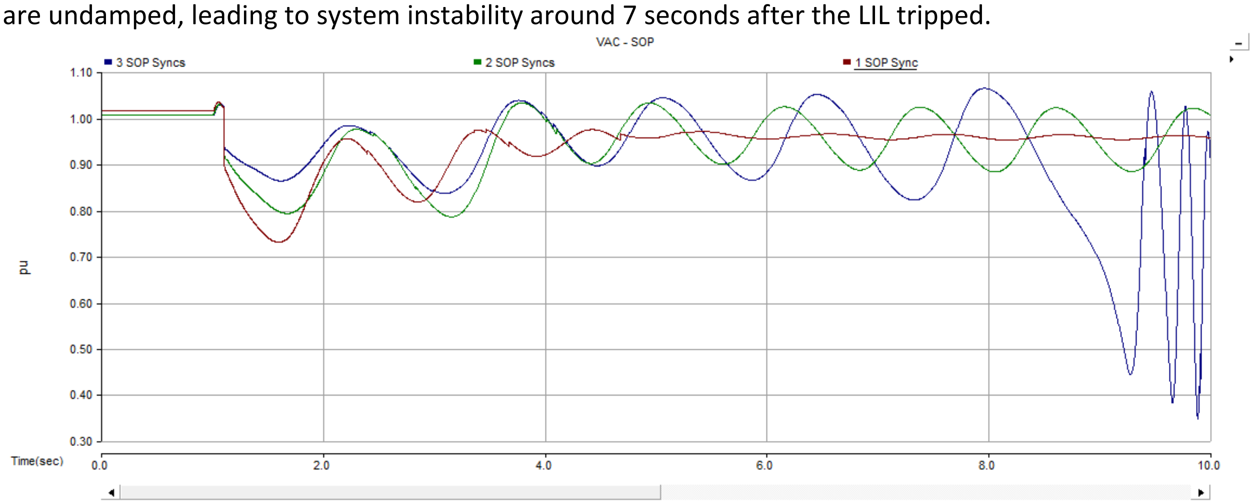

Figure 3–5. Example of SOP voltage response after loss of LIL bipole under high demand

The following pre-contingency power flow limits should be followed:

- Two SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 540 MW
- Three SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 510 MW

Once properly tuned PSS's are in-service, the minimum Avalon generation requirements for the 2 and 3 SOP synchronous condenser scenarios can likely be significantly reduced.

3. **Additional Items to Note**

- The Come-By-Chance capacitor banks should be in-service when the power flow eastward from BDE towards SOP is high to help support the voltage if the LIL bipole is lost. Keeping the pre-contingency voltage near Sunnyside as high as possible (within criteria) improves the system response to the worst case contingencies.

- In line with previous operational studies, when power flow from BDE to SOP reaches levels around 650 MW, the IIS can also experience instability if there is a 3PF on line TL267. Therefore, power flow on this corridor should be limited to 650 MW. The details of the operating guideline to limit power flow between BDE and SOP will be finalized during the final Stage 4 operational studies, taking into consideration all contingencies in the system including three-phase AC faults and loss of the LIL bipole.
- While it is targeted that system stability shall be maintained following the loss of the LIL bipole, this contingency is beyond the scope of Transmission Planning criteria. Results of the analysis indicate that the loss of the LIL bipole may result in transient undervoltages.

4. ML Transfer Limits

Loss of the ML bipole and ML pole are the contingencies that define the ML import and export limits.

If the ML bipole or pole is lost while exporting, the IIS will experience an overfrequency. Transmission Planning criteria states that this overfrequency should not go above 62 Hz.

If the ML bipole or pole is lost while importing, the IIS will experience an underfrequency. Transmission Planning criteria state that for loss of the bipole controlled UFLS is permitted, and the frequency is allowed to dip below 58 Hz, as long as the system recovers well after the 58 Hz block of load is shed. For loss of a pole, the frequency should remain above 59 Hz and UFLS is not permitted.

Note that if an ML pole is lost, it is assumed that the healthy ML pole will pick up the transfer that was lost on the other ML pole, up to its rating of 250 MW.

Ultimately, the LIL will have a frequency controller with a small deadband that will respond to assist IIS frequency if the ML bipole or pole trips. During the transition from low to high power operation, however, the LIL frequency controller will not yet be available.

This study determined ML export and import limits for two scenarios during the transition period:

1. Without the use of LIL runbacks or runups
2. With the use of LIL runbacks and runups

4.1 Without the use of LIL Runbacks/Run-ups

ML import and export limits were first determined without the use of LIL run-ups or runbacks to establish a baseline for the ML transfer limits. These limits were determined for scenarios when there are no Holyrood (HRD) units in-service as generators, and for scenarios where one or more HRD units are in-service. When there are no HRD units in-service as generators, the limiting criteria for loss of ML exports is keeping the system frequency below 62 Hz. When an HRD unit is in-service as a generator, the limiting criteria for ML exports becomes ensuring that the power on the HRD units does not decrease by more than 15 MW per unit as a result of the overfrequency following the loss of the ML bipole.

4.1.1 No HRD Units In-Service

These limits are listed in Table 4-1 for loss of the ML bipole and for loss of an ML pole. Red text depicts cases where loss of an ML pole is more limiting than loss of the ML bipole.

Table 4-1. ML import/export limits without LIL run-ups/runbacks – no HRD units

Import/ Export	Demand (MW)	Generation (MW)	Loss of ML Bipole		Loss of ML Pole	
			ML Transfer (MW)	Max/Min Frequency (Hz)	ML Transfer (MW)	Max/Min Frequency (Hz)
Export	1811	1213	160	62.0	160	~60.0
	1390	865	135	61.9	135	~60.0
	974	530	100	61.9	100	~60.0

Import/ Export	Demand (MW)	Generation (MW)	Loss of ML Bipole		Loss of ML Pole	
			ML Transfer (MW)	Max/Min Frequency (Hz)	ML Transfer (MW)	Max/Min Frequency (Hz)
	736	399	75	62.0	75	~60.0
	533	425	70	61.9	70	~60.0
Import	1835	1130	-320	58.07	-290	59.0
	1397	750	-320	57.98	-290	59.0
	982	537	-280	57.93	-280	59.16
	746	496	-220	57.93	-220	59.9

Since loss of an ML pole or bipole have the same 62 Hz frequency criteria, loss of an ML bipole defines the ML export limits.

The loss of supply (including the loss of a generator within the Island Interconnected System or the loss of a pole) must not result in UFLS. When importing, the loss of an ML pole is more restrictive than the loss of the ML bipole when defining the ML import limit in the peak demand case. In all other cases, limits are defined by the loss of the bipole. This is due to the fact that the ML is equipped with pole compensation where the healthy pole will run up to a maximum of 250 MW in the event of a pole trip. In the peak load case, there is a capacity shortfall, which results in a frequency drop to 59 Hz.

Figure 4–1 graphically depicts the most limiting ML import/export limits from Table 4-1. Note the data point for the extreme light demand case during ML import from Table 4-1 is not included because it is already at minimum generation, yet loss of the ML bipole does not result in a frequency dip to the limit of 58 Hz is the ML bipole is lost. This data point would falsely skew the results.

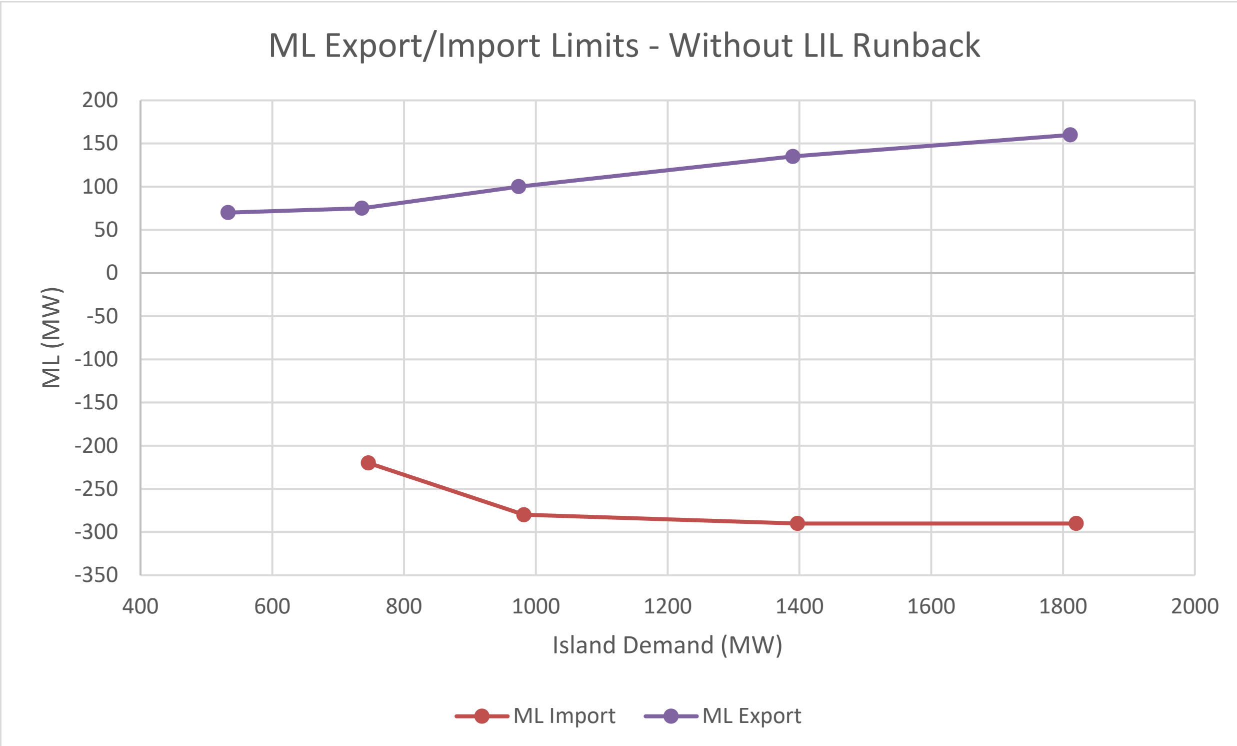

Figure 4–1. ML import/export[12] limits, without LIL run-ups/runbacks or frequency control

4.1.2 HRD Units In-Service

As previously mentioned, with HRD units in-service, ML exports must be limited such that loss of the ML bipole does not result in more than a 15 MW decrease in power output of an HRD unit in response to the system overfrequency. ML import levels shown in Figure 4–1 are not affected when HRD units are in-service.

Figure 4–2 depicts the ML export limits with 1, 2 and 3 HRD units in-service.

[12] ML export limits in Figure 4-1 assume that no HRD units are in-service. Please see Figure 4-2 for ML export limits with HRD units in-service.

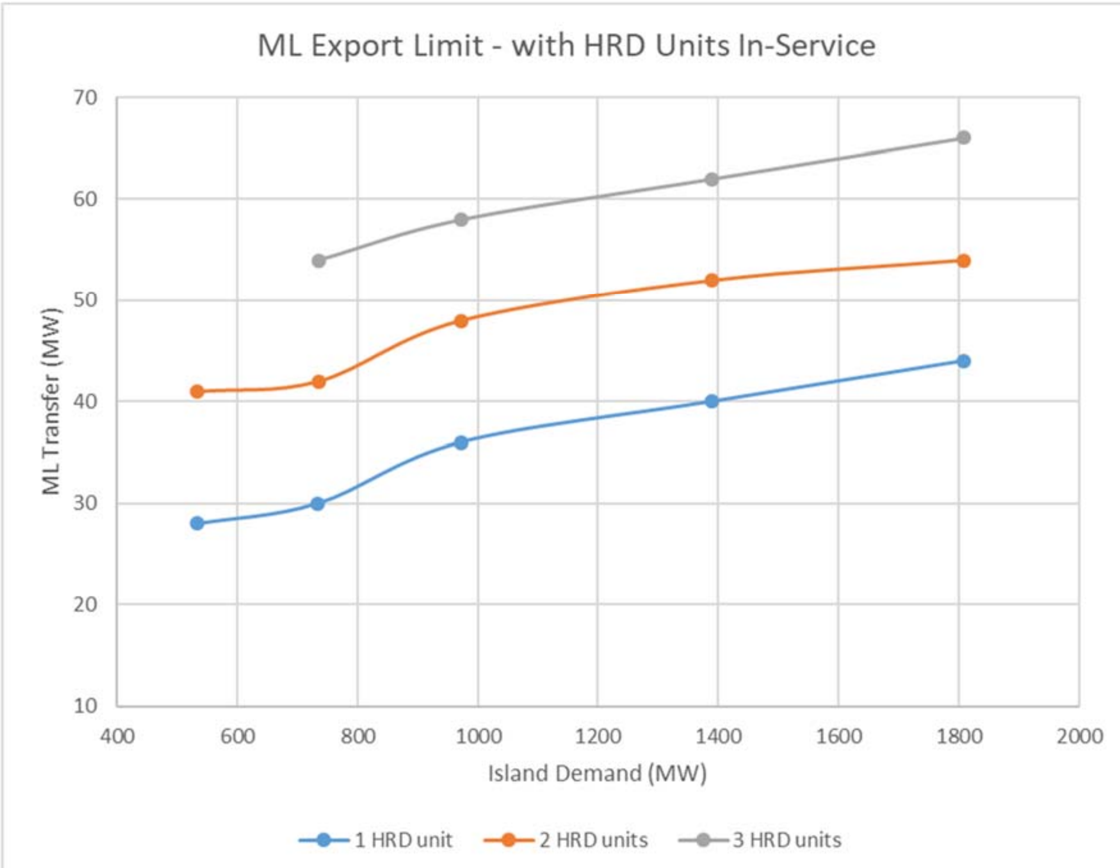

Figure 4–2. ML Export Limits with HRD units in-service

4.2 With LIL runbacks/run-ups

If LIL run-ups are used when there is loss of ML import, and LIL runbacks are used when there is loss of ML export, then the ML power transfer is not limited, and it can operate over its full range from 320 MW import to 500 MW export. This assumes that there is sufficient room available on the LIL (up or down) to cover for the loss of the ML bipole with the runbacks presented in this report.

4.2.1 ML Export Limits

Table 4-2 summarizes the minimum LIL runbacks needed to keep IIS frequency above 62 Hz following the loss of an ML pole or bipole at ML export at levels of 500 MW and 300 MW.

Table 4-2. Minimum LIL runbacks needed for loss of ML Export

Demand (MW)	Generation (MW)	ML Export (MW)	At MFA		At SOP		Maximum net loss of export on the IIS to meet 62 Hz (MW)
			LIL Transfer (MW)	Total Runback (MW)	LIL Transfer (MW)	Total Runback (MW)	
Loss of ML Bipole							
1428	1094	500	900 -> 500	400	832 -> 480	352	148
1038	703		900 -> 446	454	832 -> 432	400	100
812	476		900 -> 392	508	832 -> 380	452	48
606	402		750 -> 226	524	702 -> 222	480	20
1821	1285	300	900 ->744	156	832 -> 700	132	168
1400	915		840 -> 654	186	780 -> 618	162	138
994	589		710 -> 480	230	668 -> 464	204	96
764	404		640 -> 394	246	606 -> 380	226	74
553	400		470 -> 216	254	452 -> 212	240	60
Loss of ML Pole							
1428	1094	500	900 -> 712	188	832 -> 672	160	90
1038	703		900 -> 659	214	832 -> 626	206	44
812	476		900 -> 618	282	832 -> 588	244	6
606	402		750 -> 470	358	702 -> 452	250	0

However, rather than running back the LIL by the minimum amount needed to keep the IIS frequency below 62 Hz for each particular operating condition, a simpler approach that could be applied to all levels of ML export over all ranges of IIS demand would be to simply runback the LIL by the amount of ML export that was lost. Note that the LIL runback should be high enough at MFA to consider LIL losses, such that the total LIL runback as measured at Soldiers Pond is equal to the amount of ML export that was lost. Table 4-3 summarizes the maximum frequencies observed in the IIS using this approach for loss of the ML bipole at the maximum ML export of 500 MW.

Table 4-3. LIL Runback @ SOP = Loss of ML Export

Demand (MW)	Generation (MW)	ML Export (MW)	At MFA		At SOP		Maximum frequency (Hz)
			LIL Transfer (MW)	Total Runback (MW)	LIL Transfer (MW)	Total Runback (MW)	
1428	1094	500	900 -> 342	558	832 -> 332	500	60.2
1038	703		900 -> 342	558	832 -> 332	500	60.3
812	476		900 -> 342	558	832 -> 332	500	60.8*
606	402		750 -> 204	546	702 -> 202	500	61.3*

*These cases show some small oscillatory behaviour that will be addressed in the next stage of the operational study.

Please note that if there are HRD units in-service, LIL runback should be high enough to ensure that the maximum difference between the LIL runback as measured at Soldiers Pond and the loss of ML export is not greater than the limits shown in Figure 4–2. This will limit the decrease in power at an HRD unit to a maximum of 15 MW per unit if the ML bipole is lost.

4.2.2 ML Import Limits

Table 4-4 summarizes the minimum LIL run-ups needed to meet the underfrequency criteria for loss of the ML bipole and pole during maximum import of 320 MW.

Table 4-4. Minimum LIL run-ups needed for loss of ML import

Demand (MW)	Generation (MW)	ML Import (MW)	At MFA		At SOP		Maximum net loss of import on the IIS to meet underfrequency criteria (MW)
			LIL Transfer (MW)	Total Run-up (MW)	LIL Transfer (MW)	Total Run-up (MW)	
Loss of ML Bipole							
1820	974	320	0	0	0	0	>320
1401	674		0	0	0	0	320
987	421		250->296	46	245->290	45	275
818	407	260*	90->154	64	89->152	63	197
Loss of ML Pole							
1824	998	320	500 -> 519	19	480 -> 498	18	52
1402	724		390 -> 418	28	378 -> 404	26	44
987	421		250 -> 279	29	245 -> 273	28	42
750	400	260*	90 -> 90	0	89 -> 89	0	0

*maximum ML import during 750 MW demand with LIL at 90 MW (minimum IIS generation)

Rather than running up the LIL by the minimum amount needed to meet underfrequency criteria for each particular operating conditions, a simpler approach that could be applied to all levels of ML import over all ranges of IIS demand would be to simply run-up the LIL by the amount of ML import that was lost. Note that the LIL run-up should be high enough at MFA to consider LIL losses, such that the total LIL run-up as measured at Soldiers Pond is equal to the amount of ML import that was lost. Table 4-5 summarizes the minimum frequencies observed in the IIS if using this approach for loss of the ML bipole at the maximum import level of 320 MW.

Table 4-5. LIL Run-up @ SOP = Loss of ML Import

Demand (MW)	Generation (MW)	ML Import (MW)	At MFA		At SOP		Minimum Frequency (Hz)
			LIL Transfer (MW)	Total Run-up (MW)	LIL Transfer (MW)	Total Ru-up (MW)	
1824	998	320	460 -> 820	360	442 -> 762	320	59.9
1402	724		400 -> 760	350	387 -> 707	320	59.9
987	421		250 -> 594	344	244 -> 564	320	59.75

Demand (MW)	Generation (MW)	ML Import (MW)	At MFA		At SOP		Minimum Frequency (Hz)
			LIL Transfer (MW)	Total Run-up (MW)	LIL Transfer (MW)	Total Ru-up (MW)	
750	400	260*	90 -> 360	270	89 -> 349	260	59.8

*maximum ML import during 750 MW demand with LIL at 90 MW (minimum IIS generation)

5. Harmonic Analysis

Harmonic analysis was performed to determine the maximum LIL transfer limits before the IEC performance limits are exceeded, as the system transitions from low power (225 MW monopole) to high power (900 MW bipole) operation.

In this study, the harmonic currents generated by the converter as given in the GE AC Filter Performance report [1] were used.

5.1 IEC Performance Limits

The performance limits according to IEC 61000-3-6 are given in Table 5-1.

Table 5-1. IEC performance limits

Odd harmonic (non-multiple of 3)		Odd harmonics (multiple of 3)		Even harmonics	
Harmonic	Dh (%)	Harmonic	Dh (%)	Harmonic	Dh (%)
5	2	3	2	2	1.4
7	2	9	1	4	0.8
11	1.5	15	0.3	6	0.4
13	1.5	21	0.2	8	0.4
17≤h≤49	1.2*17/h	21<h≤45	0.2	10≤h≤50	0.19*(10/h)+0.22
THD ≤ 3%					

5.2 Muskrat Falls

5.2.1 AC system harmonic impedance

Because this study was looking at operational limits, impedance sectors were not used to represent the ac system as was the case for the contract design. Rather, the analysis was performed using power flow cases created by Hydro, where calculated impedance points at each harmonic order were considered under various operating conditions. The power flow cases used to represent the Labrador system at peak and light load scenarios are shown in Table 5-2.

Table 5-2. Loadflows considered for MFA

Number	Load Condition	Island Demand (MW)	LIL Power Transfer (MW)	Island Generation
P90	Peak	1815	689	Maximum
P50	Light	740	196	Minimum generation

The system conditions that were considered for each power flow case were:

- 1, 2, 3 or 4 MFA units in-service
- Contingencies:
  - MFA unit
  - 315 kV transmission line between Churchill Falls (CHF) and MFA out of service
  - One 735 kV transmission line between CHF and Montagnais out of service
  - Two 735 kV transmission lines between CHF and Montagnais out of service

5.2.2 Background harmonics

The measured background harmonics at CHF were increased by a factor of two[13] and applied at the MFA converter bus. Table 5-3 shows the background harmonics included in the study. The values for harmonics not included in Table 5-3 were negligible.

Table 5-3. Background harmonics applied at MFA

Harmonic	2x measured background harmonics at CHF
2	0.24
3	0.84
4	0.12
5	0.5
6	0.08
7	0.32
8	0.04
9	0.08
10	0.06
11	0.12
12	0.04
13	0.18
14	0.04
15	0.02
16	0.02
17	0.08
18	0.04
19	0.06
20	0.02
21	0.02
22	0.04

[13] Measurements were performed before the construction of Muskrat Falls Terminal Station 2. In addition, it is expected that the ac terminal station and HVdc converters will be in service before the Muskrat Falls generators. On this basis, background harmonics were doubled to provide a conservative representation of system conditions.

Harmonic	2x measured background harmonics at CHF
23	0.04
24	0.02
25	0.04
26	0.02
27	0.02
28	0.02
29	0.02
30	0.02
31	0.02
33	0.02
34	0.02
35	0.02
37	0.02
41	0.02
49	0.02

5.2.3 Results

In order to determine whether the IEC limits were met, the harmonic performance indices were calculated for four filter configurations:

- with 2A type filters in service
- with 2A type filters and 1B type filter in service
- with 2A type filters and 2B type filters in service
- with 3A type filters and 1B type filter in service

The type A filter is a triple tuned filter, tuned to harmonics 3, 12, and 23. The type B filter is a high pass filter, tuned to the 11th harmonic. The filter component data is shown in Figure 5–1 and Table 5-4.

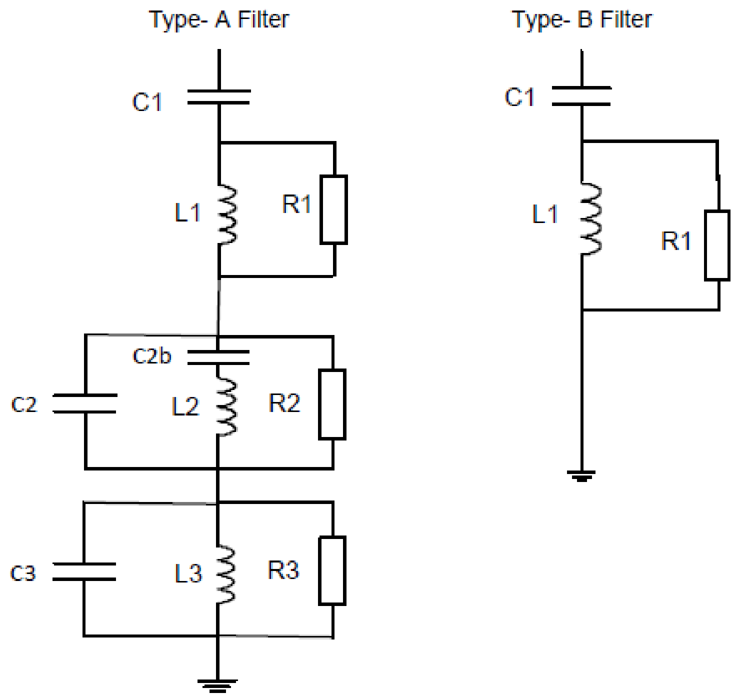

Figure 5–1. MFA filter circuit

Table 5-4. MFA filter parameters

Filter type	A	B
Nominal Mvar	72	72
system voltage (kVrms L-L)	315	315
C_1 (µF)	1.91	1.91
C_2 (µF)	13.58	-
C_3 (µF)	2.80	-
L_1 (mH)	21.03	30.5
L_2 (mH)	55.44	-
L_3 (mH)	6.98	-
R_1 (Ω)	369	388
R_2 (Ω)	443	-
R_3 (Ω)	1549	-
C_2b (µF)	126.9	-

The MFA study results are provided in Appendix 1 and 3, with values exceeding IEC limits shown in red. Note that these results are the maximum values for all cases studied, and the values for each harmonic order may not correspond to the same case.

The study results showed that the IEC limits were met in all cases for monopole operation. The LIL may therefore be operated up to 675 MW in monopole operation with:

- two A type filters in service
- two A type filters and one B type filter in service

- two A type filters and two B type filters in service
- three A type filters and one B type filter in service

In bipole operation, the LIL may be operated up to 810 MW:

- with two A type filters in service when one or two MFA units are in service under light load conditions
- one MFA unit in service under peak load conditions

For all other cases studied, the LIL may be operated up to 900 MW in bipole operation with:

- two A type filters and one B type filter in service
- two A type and two B type filters in service
- three A type and one B type filter in service

5.3 Soldiers Pond

5.3.1 AC system harmonic impedance

Similar to Muskrat Falls, at Soldiers Pond (SOP), the study considered the calculated impedance points at each harmonic order for the power flow cases listed in Table 5-5 and for the contingencies listed below. The power flow cases represented the Island system in the year 2028 ranging from peak to extreme light load conditions.

Table 5-5. Power flows considered for SOP

Load Condition	Island Demand (MW)	ML Export (MW)	LIL Power Transfer (MW)
Peak	1815	158	689
High Intermediate-	1390	158	606
Low Intermediate	980	158	525
Light	740	158	196
Extreme Light	530	158	196

The system conditions that were considered for each power flow case included:

- 1 or 2 SOP synchronous condensers in-service
- Contingencies:
  - o HRD unit
  - o SOP synchronous condenser
  - o 230kV transmission line between SOP and WAV out of service
  - o 230kV transmission line between SOP and HRD out of service

- o 230kV transmission line between SOP and HWD out of service

5.3.2 Background harmonics

For SOP, background harmonics were set in accordance with the maximum of the measured background harmonics as measured at Hardwoods Terminal Station, Western Avalon Terminal Station, and Holyrood Terminal Station.

Table 5-6 below shows the background harmonics included in the study. The values for harmonics not included in Table 5-6 were negligible.

Table 5-6. Background harmonics applied at SOP

Harmonic	Maximum measured background harmonics at HWD/WAV/HRD
2	0.02
3	1.06
4	0.08
5	1.42
6	0.03
7	0.52
8	0.01
9	0.20
11	0.10
13	0.36
14	0.01
15	0.01
16	0.01
17	0.05
18	0.01
19	0.03
20	0.01
21	0.01
23	0.05
24	0.01
25	0.07
27	0.01
29	0.02
31	0.01
35	0.01
37	0.01
41	0.01

5.3.3 Results

In order to determine whether the IEC limits were met, the harmonic performance indices were calculated for five filter configurations:

- with 1A type and 1B type filter in service
- with 1A type and 2B type filters in service
- with 2A type and 2B type filters in service
- with 2A type and 3B type filters in service
- with 3A type and 2B type filters in service

The Type A filter is a triple tuned filter, tuned to harmonics 3, 12, and 23. The Type B filter is a triple tuned filter, tuned to harmonics 11, 24, and 36. The filter component data is shown in Figure 5–2 and Table 5-7.

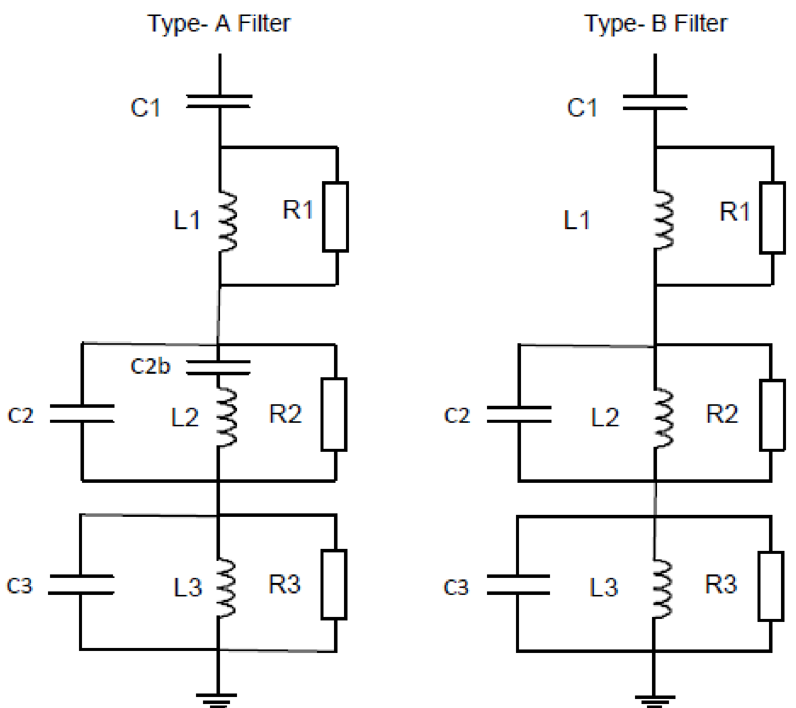

Figure 5–2. SOP filter circuits

Table 5-7. SOP filter parameters

Filter type	A	B
Nominal MVAr	75	75
system voltage (kVrms L-L)	230	230
C_1 (μF)	3.73	3.74
C_2 (μF)	17.34	4.50
C_3 (μF)	6.99	7.25
L_1 (mH)	10.72	5.15
L_2 (mH)	40.21	5.35
L_3 (mH)	2.88	1.12
R_1 (Ω)	141	170
R_2 (Ω)	514	175
R_3 (Ω)	2028	1491
C_2b (μF)	175	-

When the measured background harmonics are applied at Soldiers Pond, the IEC limits were met up to 675 MW in monopole operation and 900 MW in bipole operation.

The study results are provided in Appendix 2 and 4, with values exceeding IEC limits shown in red. Note that these results are the maximum values for all cases studied, and the values for each harmonic order may not correspond to the same case.

On the basis of the above, the LIL may be operated up to 675 MW in monopole operation or up to 900 MW in bipole operation with any of the following combinations of filters in-service:

- one A type filter and one B type filter in service
- one A type filter and two B type filters in service
- two A type filters and two B type filters in service
- two A type filters and three B type filters in service
- three A type filters and two B type filters in service

6. Conclusions

6.1 LIL Transfer Limits

The contingencies that define the LIL transfer limits are loss of the LIL bipole and loss of a LIL pole. LIL transfer limits for the transitional period are shown in Figure 6–1 (ML frequency controller in-service) and Figure 6–2 (ML frequency controller out-of-service).

Loss of the LIL Bipole

Ultimately, the UFLS scheme will be modified/re-designed during the final Stage 4 operational study to allow increased LIL transfer limits while ensuring that the system remains stable after shedding the 58 Hz block of load, as per Transmission Planning Criteria. However, during the period when the system is transitioning from low to high power operation, the existing UFLS scheme will remain in place, therefore LIL transfer limits are needed to ensure that the system remains stable following the loss of the LIL bipole. The frequency criteria used in this study allowed the 58 Hz block of load to be shed if the LIL bipole is lost, as long as the system recovered well and in a stable manner following the loss of LIL bipole. Note also that if the LIL bipole is lost, the ML (if exporting) will runback[14].

Loss of the LIL Pole

Transmission Planning Criteria for loss of a LIL pole are defined to ensure that such an event will not cause the IIS frequency to drop below 59 Hz and will not result in UFLS. The LIL will ultimately have a 10-minute 2 pu overload rating; however, during the period when the system is transitioning from low to high power operation, this overload capability will not be available. Rather, the LIL's capacity for pole compensation will be limited to 1 pu DC current. It is noted that the Maritime Link ("ML") is equipped with runbacks or frequency controller action to provide support in the event of the loss of a LIL pole.

With the use of ML runbacks or the operation of the ML frequency controller, the IIS frequency remained above 59 Hz for loss of a LIL pole under all operating scenarios, with the exception of peak load conditions. Under peak load conditions, except for the case with the ML exporting 500 MW, the loss of a LIL pole was more limiting than loss of the bipole. The LIL transfer limits were reduced accordingly for these peak load cases in order to ensure IIS frequency remains above 59 Hz if a LIL pole trips.

[14] If the ML is not exporting, the ML response would be limited to frequency controller action. If the ML is exporting and is runback, no further support is provided by the ML frequency controller.

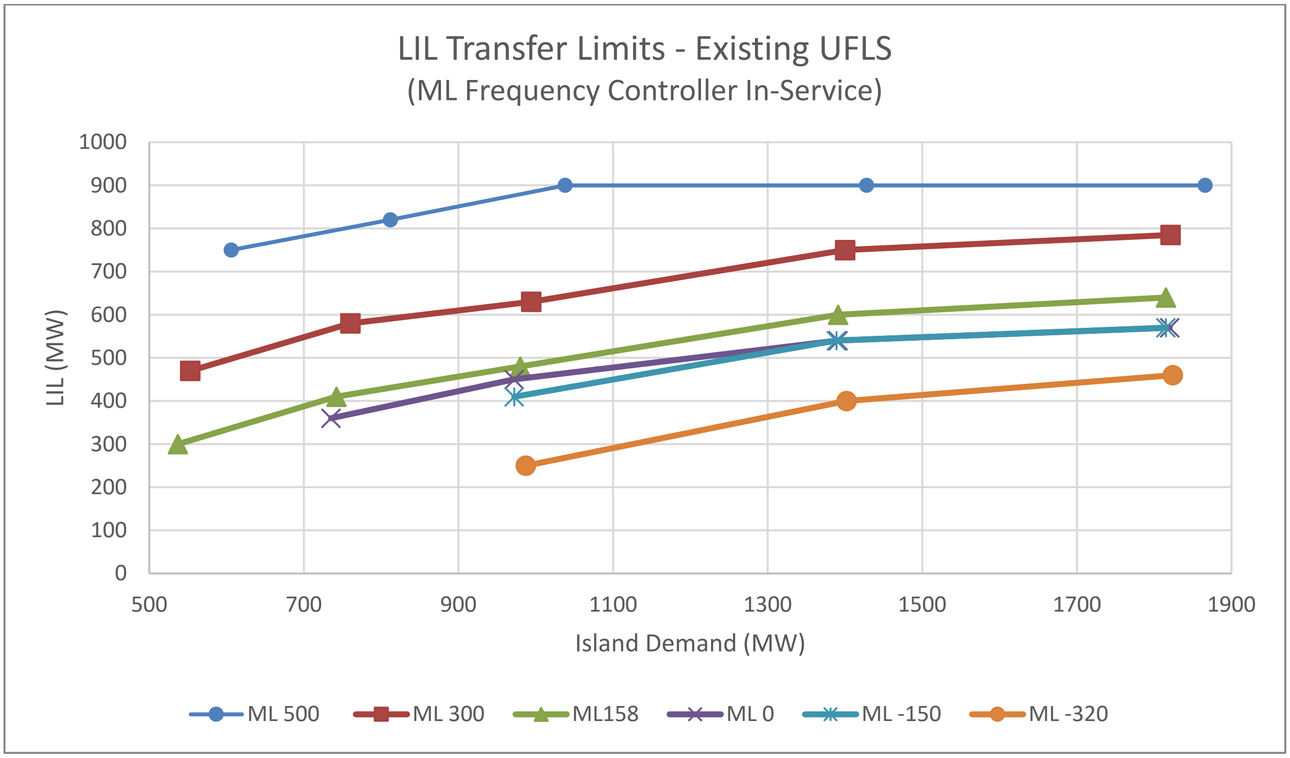

Figure 6–1. LIL Transfer Limits (ML Frequency Controller in-service)

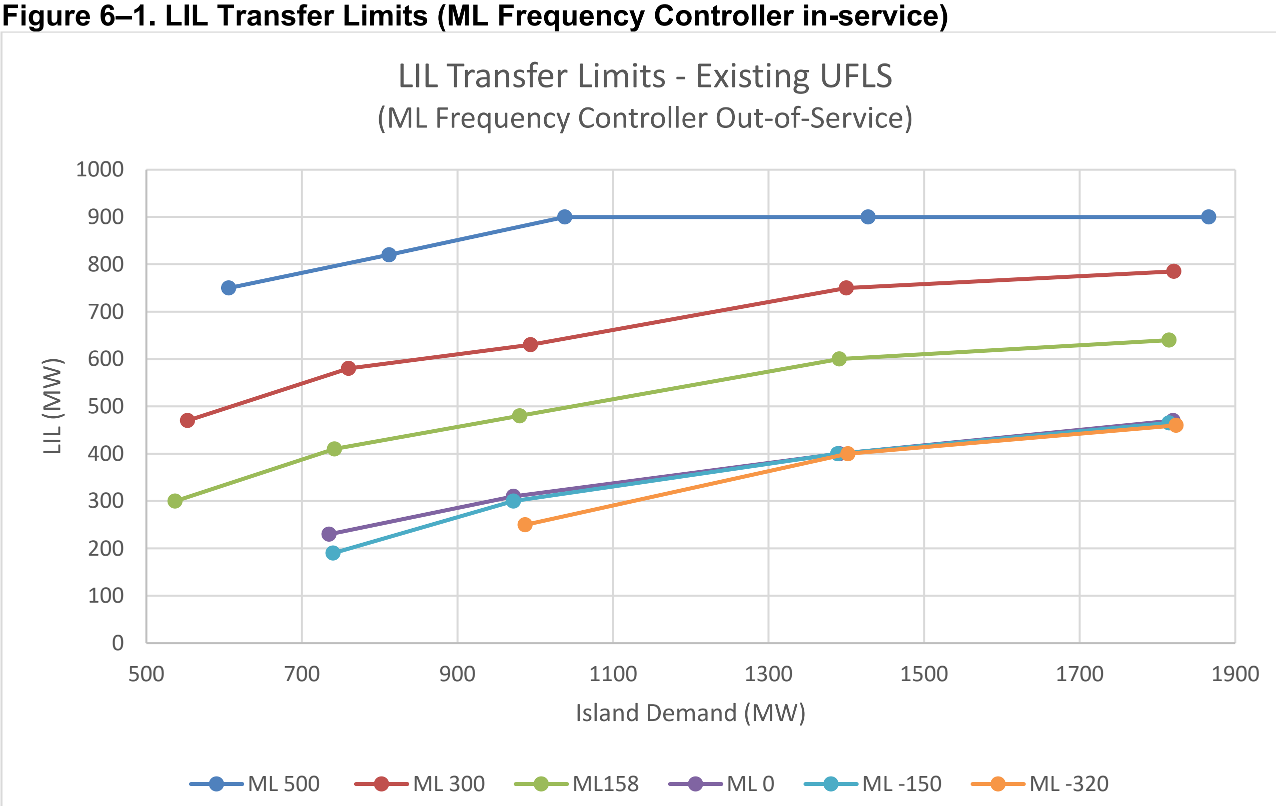

Figure 6–2. LIL Transfer Limits (ML Frequency Controller out-of-service)

6.2 ML Transfer Limits

As per Transmission Planning Criteria, loss of an ML pole (when importing) should not result in UFLS and frequency should remain above 59 Hz. UFLS is allowed for loss of the ML bipole; frequency is allowed to dip below 58 Hz as long as the system recovers well after the 58 Hz block of load is shed. If exporting, frequency should remain below 62 Hz for loss of an ML pole or bipole.

6.2.1 Without use of LIL Runbacks or Run-ups

ML transfer limits without the use of LIL runbacks or run-ups are show in Figure 6–3. This figure assumes that only HRD unit 3 is in-service as a synchronous condenser during ML export (no HRD units dispatched as generators). Figure 6–4 depicts the ML export limits[15] with 1, 2 and 3 HRD units in-service and dispatched as generators.

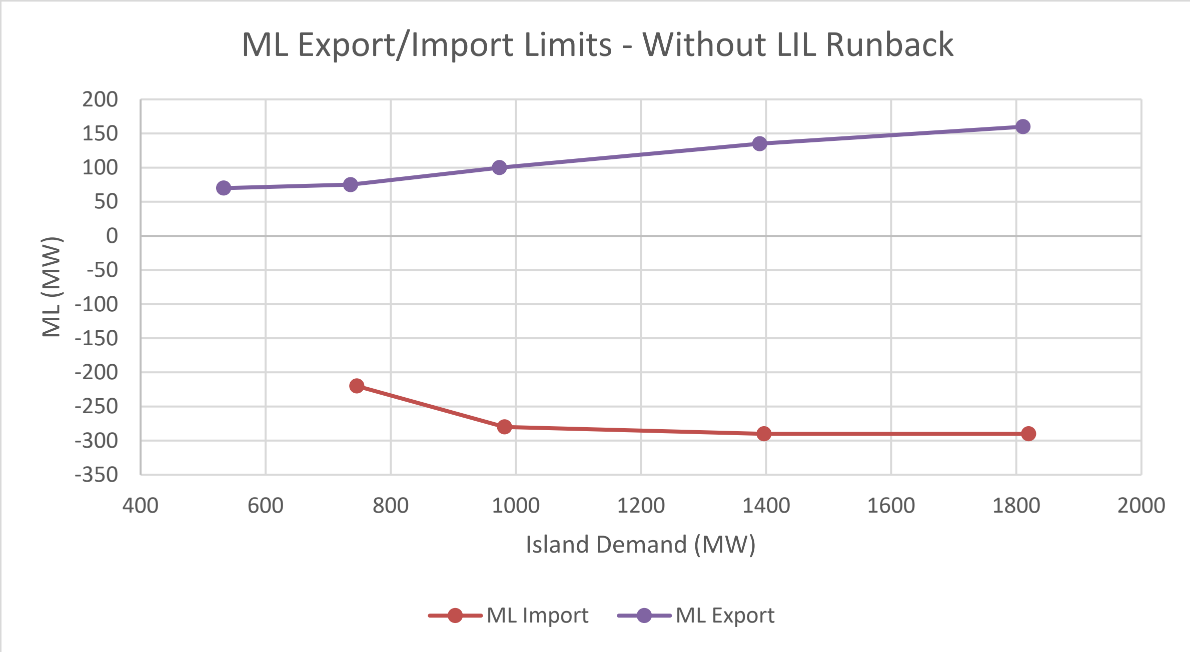

Figure 6–3. ML import/export limits, without LIL run-ups/runbacks or frequency control (no HRD units dispatched as generators)

[15] More restrictive ML export limits are needed when HRD units are in-service in order to limit the decrease in power output to 15 MW per HRD unit in response to the system overfrequency that occurs when the ML bipole is lost.

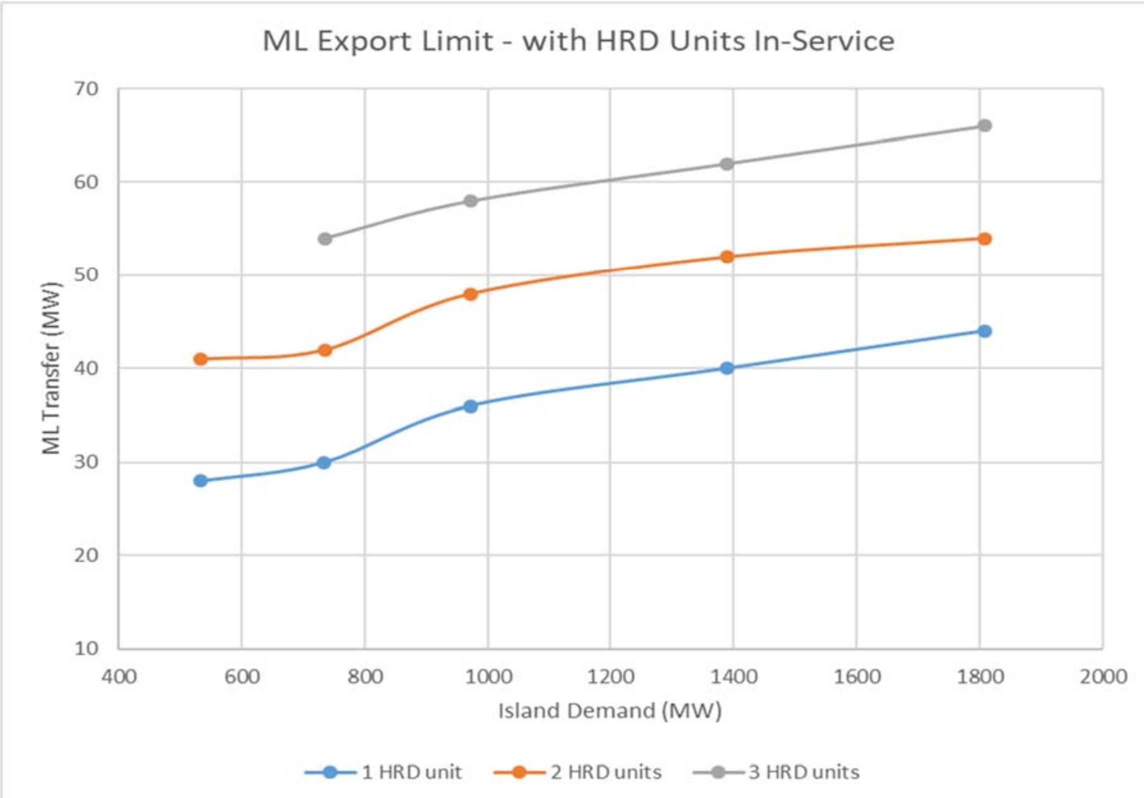

Figure 6–4. ML Export Limits with HRD Units In-service (without LIL runbacks)

6.2.2 With the use of LIL Runbacks and Run-ups

If LIL run-ups are initiated when there is loss of ML import, and LIL runbacks are initiated when there is loss of ML export, then ML power transfer is not limited, and the ML can operate over its full range from 320 MW import to 500 MW export. This assumes that there is sufficient room available on the LIL (up or down) to cover for loss of the ML bipole.

A simple approach to determine the amount of LIL runback or run-up that is required for a particular ML import or export level is to simply runback or run-up the LIL by the amount of ML export or import that was lost. Note that the LIL runback or run-up should be high enough at MFA to consider LIL losses such that the total LIL runback or run-up as measured at Soldiers Pond is equal to the amount of ML export or import that was lost. This method is applicable to all levels of ML import or export over all ranges of IIS demand.

6.3 Additional Conclusions

The following additional conclusions were made during the study.

1. **Need for Avalon Generation during High Island Demand**

To ensure stability and to avoid electromechanical oscillations for loss of the LIL bipole, there is a requirement to ensure that generation is online on the Avalon Peninsula over peak.

a) To avoid voltage collapse

The IIS can become unstable if the LIL bipole trips during high IIS demand. It was determined that a minimum amount of Avalon generation (as defined in Table 6-1) is required to be in-service when IIS demand is greater than 1600 MW to prevent system instability if the LIL bipole is lost. The Come-By-Chance capacitor banks should also be in-service (as many as steady state voltage allows) when the power flow eastward from Bay d'Espoir (BDE) towards SOP is high to help support the voltage if the LIL bipole is lost.

Table 6-1. Minimum Avalon Thermal Generation Required to be in-service

IIS Demand (MW)	Avalon Generation (MW)			
	0 SOP Syncs	1 SOP Sync	2 SOP Syncs	3 SOP Syncs
1750-1850	120	70	40	None*
1700-1750	70	15	None*	None*
1600-1700	30	None*	None*	None*

*unless required for MW dispatch to meet IIS demand and ML exports

b) To avoid electromechanical oscillations

Electromechanical oscillations were also observed following a trip of the LIL bipole. In this case, the oscillations were worst (least damped) with three SOP synchronous condensers in-service, and became more damped with fewer SOP synchronous condensers in-service. With one or no SOP synchronous condensers in-service, the oscillations are damped and no mitigation is required.

The following pre-contingency power flow limits should be followed to improve the damping of the oscillation and to avoid system instability:

- Two SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 540 MW
- Three SOP synchronous condensers – limit power flow eastward out of BDE (on TL202, TL206, TL267) to 510 MW

Once properly tuned PSS's are in-service, these power flow restrictions for the two and three SOP synchronous condenser scenarios can likely be eliminated and then only the limits in Table 1-1 would apply.

c) To avoid instability due to 3PF on TL267

Additionally, in line with previous operational studies[16], when power flow from BDE to SOP reaches levels around 650 MW (with or without the LIL in service), the IIS can also experience instability if there is a three phase fault ("3PF") on line TL267. Therefore, power flow on this corridor should be limited to 650 MW.

[16] TGS report R1529.01.02 "Solutions to Serve Island Demand during a LIL Bipole Outage", and TGS report TN1205.62.05 "Stage 4A LIL Bipole: Preliminary Assessment of High Power Operation".

2. Impact of SOP Synchronous Condensers on LIL Transfer Limits

The SOP synchronous condensers provide inertia to the Island, and they help the system by slowing down the rate of change of frequency immediately after infeed from the LIL is lost. It was found that although they slow down the initial rate of change of frequency, they do not impact the minimum frequency that occurs, and therefore the transfer limits defined in this study were the same whether one or two SOP synchronous condensers were in-service.

3. Concept of "Net DC"

The concept of "Net DC" to the IIS applies when the ML is exporting and can be runback to 0 MW if the LIL bipole is lost. For example, at a 1400 MW demand level, LIL power transfer is limited to 750 MW if ML is exporting 300 MW. At the same demand level, LIL power transfer is limited to 600 MW if ML is exporting 158 MW. In both cases, subtracting ML export from the LIL transfer limit results in a value of around 450 MW, which could be termed the "Net DC" limit. Figure 6–5 shows the approximate "Net DC" limits when the ML is exporting. Note that over peak, the Net DC is limited by loss of a LIL pole instead of loss of the LIL bipole. Also note that the "Net DC" limits are very similar for various ML export levels.

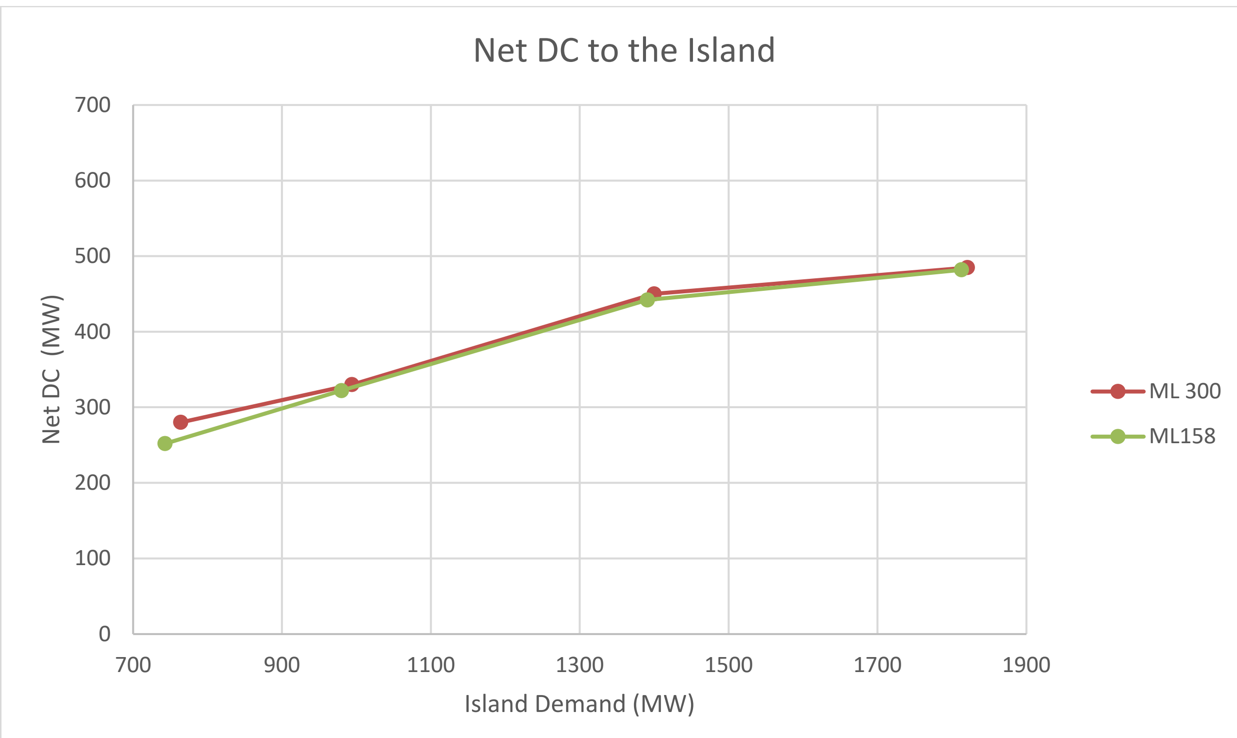

Figure 6–5. Maximum "Net DC" to the Island during ML export

6.4 Harmonic Analysis

In order to meet IEC harmonic limits, the analysis concluded that the LIL may be operated up to 675 MW in monopole operation and 900 MW in bipole operation with the filter configurations listed in Table 6-2.

Table 6-2. LIL limits and filter configurations to meet IEC harmonic limits[17]

Monopole Operation up to 675 MW		Bipole Operation up to 900 MW	
Muskrat Falls	**Soldiers Pond**	**Muskrat Falls**	**Soldier's Pond**
two A type	one A type, one B type	two A type filters**	one A type, one B type
two A type, one B type	one A type, two B type	two A type, one B type	one A type, two B type
two A type, two B type	two A type, two B type	two A type, two B type	two A type, two B type
three A type, one B type	two A type, three B type	three A type, one B type	two A type, three B type
	three A type, two B type		three A type, two B type

** except when only one or two MFA units are in service under light load conditions, or when only one MFA unit is in service under peak load conditions, in which case, operation is possible only up to 810 MW with two A type filters

[17] The type A filter is a triple tuned filter, tuned to harmonics 3, 12, and 23. The type B filter is a high pass filter, tuned to the 11th harmonic.

Engineering Support Services for:

RFI Studies

Newfoundland and Labrador Hydro

Attention: Mr. Rob Collett

Redesign of UFLS Scheme for High Power Operation

Technical Note: TN1205.84.09
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Revisions

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Appendices

1 – UFLS Scheme / UFLS for Loss of LIL Bipole

2 – 66 kV Bus Voltages – Pre/Post-UFLS event

1. Summary

The previous operational study[1] that evaluated high power operation of the Labrador Island Link ("LIL") included a redesign of the underfrequency load shedding ("UFLS") scheme to allow higher LIL power transfer under more Interconnected Island System ("IIS") conditions. In the redesigned UFLS scheme, more load was added to the existing frequency blocks, such that the entire UFLS scheme was nearly doubled in size. The redesign was required to allow higher LIL power transfer, while maintaining IIS stability in case the LIL bipole were to trip.

This study further evaluates the redesigned UFLS scheme by investigating the following:

- Impact of the location of the load shed in the UFLS, specifically the impact of on or off-Avalon load shed
- Impact of the split of the load blocks throughout the UFLS scheme, specifically whether more load could be shifted to lower frequency blocks without negatively impacting IIS recovery
- Final analysis of the loss of LIL bipole scenarios to determine the minimum IIS frequencies, amount of load that is shed and the maximum LIL power transfer limits to achieve a stable recovery of the IIS following the loss of the LIL bipole under various IIS conditions and Maritime Link ("ML") transfer levels
- Investigation of the impact of the UFLS on the 66 kV system voltages, by tabulating the pre- and post-event voltage at each 66 kV bus when the UFLS has operated due to loss of the LIL bipole
- Restoration of IIS load after it has been shed subsequent to an UFLS event

The primary objective of this study is to develop an optimized UFLS scheme that ensures Hydro's transmission system will remain stable following a LIL bipole trip. The conclusions should assist Newfoundland Power ("NP") in the development of a restoration plan, establishing the location of the load shed blocks and help guide further analysis to determine if any minor system modifications are required (e.g. protection settings).

The analysis included a review of system impacts associated with UFLS and system restoration. The analysis was performed using Hydro's system models, which include representations of Newfoundland Power's regional systems. While these models allow for an assessment system frequency impacts, results associated with specific local voltage impacts on Newfoundland Power's systems are preliminary. It is therefore recommended that further analysis be performed by Newfoundland Power using their detailed system models as part of the final design of the UFLS scheme. Such a study would include reviews of the local impacts of scheme implementation, particularly voltage regulation.

1.1 Study Conclusions

The study conclusions are summarized below:

[1] TGS report TN1205.72.04 "Stage 4E LIL Bipole: High Power Operation", dated April 7, 2020.

- The redesigned UFLS scheme includes a total of 841 MW of load compared to 474 MW in the existing UFLS scheme, based on peak demand levels.[2]
- The location of the load being shed, be it on or off-Avalon, does not have a significant impact on the IIS frequency recovery. The main importance is the total amount of load being shed on the IIS. Therefore, NP has full flexibility in selecting the feeders to be shed.
- It is better to evenly split the load being shed in each frequency block, rather than to shift more load to lower frequency blocks. Shifting load to lower frequency blocks resulted in faster frequency decay, which ultimately led to more load being shed and lower IIS frequency compared to when the loadshed was more evenly spread over the frequency blocks.
- The largest changes in 66 kV bus voltages due to the most severe UFLS events (loss of LIL bipole) were as high as 0.082 pu, with most of the highest impacts observed in PSSE zone 14 (Central) and zone 11 (St Johns), and a small pocket in zone 15 (West). A full table of impacts showing pre- and post-UFLS event 66 kV voltages over a full range of IIS conditions is provided in Appendix 2.
- In the event of a LIL bipole outage, it is recommended to ensure the ML frequency controller is in-service when restoring load that has been shed. The ML frequency controller significantly increases the maximum allowable size of load blocks that can be switched back into service at one time, while maintaining IIS frequency above 59 Hz, and avoiding further UFLS. Restoration activities would require close communications and coordination with Nova Scotia Power Inc. to fully utilize the ML frequency controller during the restoration process.
- Imports from NS cannot be assumed during restoration. The real power provided by the ML frequency controller (150 MW) is temporary (or transient) and it should be assumed unavailable after 10 minutes. Therefore, the operator must ensure generation is available within 10 minutes after switching in a block.

[2] This includes load shed at CBP&P (Kruger) - Refiner line 5P and 5S tripped at 58.8 Hz.

2. Redesign of UFLS Scheme

2.1 New UFLS Scheme

With the existing UFLS scheme, LIL power transfer must be limited so the IIS remains stable in case the LIL bipole trips. The UFLS scheme was redesigned in the Stage 4E operational study by adding more load to the frequency blocks to increase LIL transfer limits. This study revisited the redesigned UFLS scheme to see if it could be optimized and to check the sensitivity to the location of the load (on versus off Avalon) and to see if it would be possible to shift some of the load to lower frequency blocks.

The final redesigned UFLS scheme is compared to the existing UFLS scheme in Table 2-1. The new UFLS scheme sheds approximately 90-95 MW of load every 0.1 Hz starting at 58.8 Hz down through to 58.0 Hz. Appendix 1 contains a table showing the PSSE load buses that have been included in the redesigned UFLS scheme.

Table 2-1. Existing and Redesigned UFLS Schemes

Frequency Block (Hz)	Existing UFLS – Load blocks (MW)	Redesigned UFLS – Load blocks (MW)
58.8	45	93
58.7	-	94
58.6	46	93
58.5	-	91
58.4	58	94
58.3	-	94
58.2	73	94
58.1	92	92
58.0	160	95
Total Load (MW)	**474**	**841**

Appendix 1 also contains a table listing the amount of load that is shed and the minimum resulting frequency that occurs when the LIL bipole trips when operating at the maximum LIL transfer limits for a wide range of IIS conditions. The tables in Appendix 1 were obtained in another study[3] that determined guidelines for the number of LIL restart attempts that are permissible in order to ensure the IIS frequency remains within the limits defined in the Transmission Planning Criteria for loss of a LIL pole or loss of the LIL bipole. The guidelines depend on the ML power flow level, direction and whether runbacks are required if the LIL bipole or pole trips. In certain scenarios ML runback must be delayed by the time it takes to allow for the LIL restart attempts.

[3] TGS report TN1205.77.04, “Operational Considerations of LIL restarts and ML Runbacks”, refer to Table 1-1 Section 1-1.

2.2 Impact of On versus Off-Avalon Load Shed

The newly redesigned UFLS includes approximately 338 MW of off-Avalon load and 503 MW of on-Avalon load.

The sensitivity to location of the load blocks was tested by shifting all the 338 MW of off-Avalon load included in the UFLS scheme to the higher frequency blocks and all the 503 MW of on-Avalon load to the lower frequency blocks (as opposed to a mix of on and off-Avalon load locations through the UFLS blocks). In most cases, minimal impact was observed in the IIS frequency response. An example is given in Figure 2–1 below. It is observed in Figure 2–1 that the frequency reaches a similar minimum value but recovers slightly faster in the on-Avalon case (blue waveform) compared to the off-Avalon case (green waveform). However, this difference in recovery is not due to the difference in location of the load, but rather to the fact that slightly more load was shed in the on-Avalon case (a total of 515 MW load was shed) compared to the off-Avalon case (a total of 476 MW load was shed). This is because it was not possible to exactly match the size of load blocks at each frequency in the UFLS models for the on-Avalon versus off-Avalon UFLS scheme variations. So even though in both cases the same frequency blocks were shed, the total amount of load shed was not exactly the same, hence the slight difference observed in IIS frequency response.

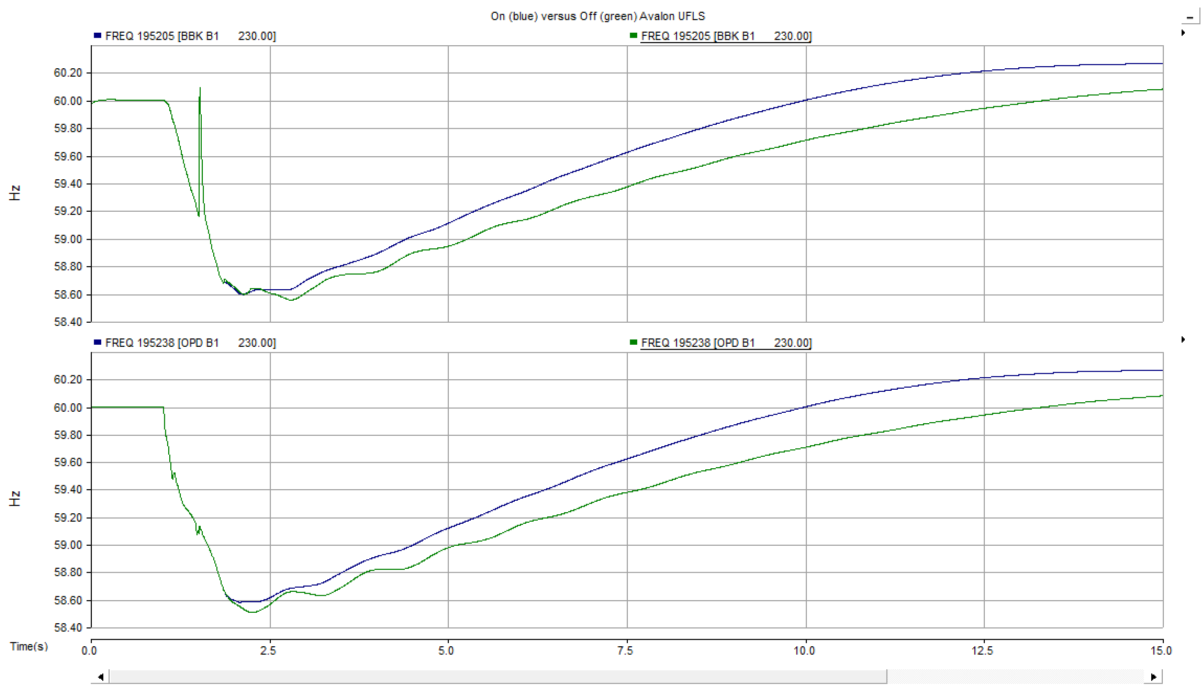

Figure 2–1. Example of IIS frequency when LIL bipole is lost - On (blue) versus Off (green) Avalon UFLS

The only time a larger difference was observed was if the frequency response was on the verge of hitting the next frequency block, and in that case there was a difference in on versus off-Avalon load shedding, however, it did not impact the final result of maintaining stability in the IIS. Therefore, it is the quantity of load shed that is of primary importance, not the location of the load shed.

2.3 Impact of Shifting Load to Lower Frequency Blocks

The impact of shifting load to lower frequency blocks was tested, as shown in Table 2-2. The proportions of load in this case were set to be more similar to the existing UFLS scheme, which has smaller blocks of loadshed at the higher frequencies and larger blocks of loadshed at the lower frequencies.

Table 2-2. Redesigned UFLS Scheme – Sensitivity to amount of load per block

Frequency Block (Hz)	Evenly spaced load blocks (MW)	More load at lower frequency blocks (MW)
58.8	93	99
58.7	94	-
58.6	93	70
58.5	91	-
58.4	94	111
58.3	94	-
58.2	94	141
58.1	92	174
58.0	95	245
Total Load (MW)	**841**	**841**

The study showed that shifting more load to lower frequency blocks resulted in more significant frequency decay when the LIL bipole was lost. For scenarios when loss of the LIL bipole did not require the entire UFLS to operate, shifting the load to lower frequency blocks resulted in more load being shed and lower minimum frequency, when compared to a UFLS scheme that had the load more evenly spread out over the frequency blocks. An example is shown in Figure 2–2.

Therefore, it is concluded that it is better to space the load shed amounts more evenly throughout the frequency blocks. Approximately 90-95 MW is shed every 0.01 Hz starting from 58.8 Hz in the redesigned UFLS scheme to minimize the system impact for a wide range of load shedding events.

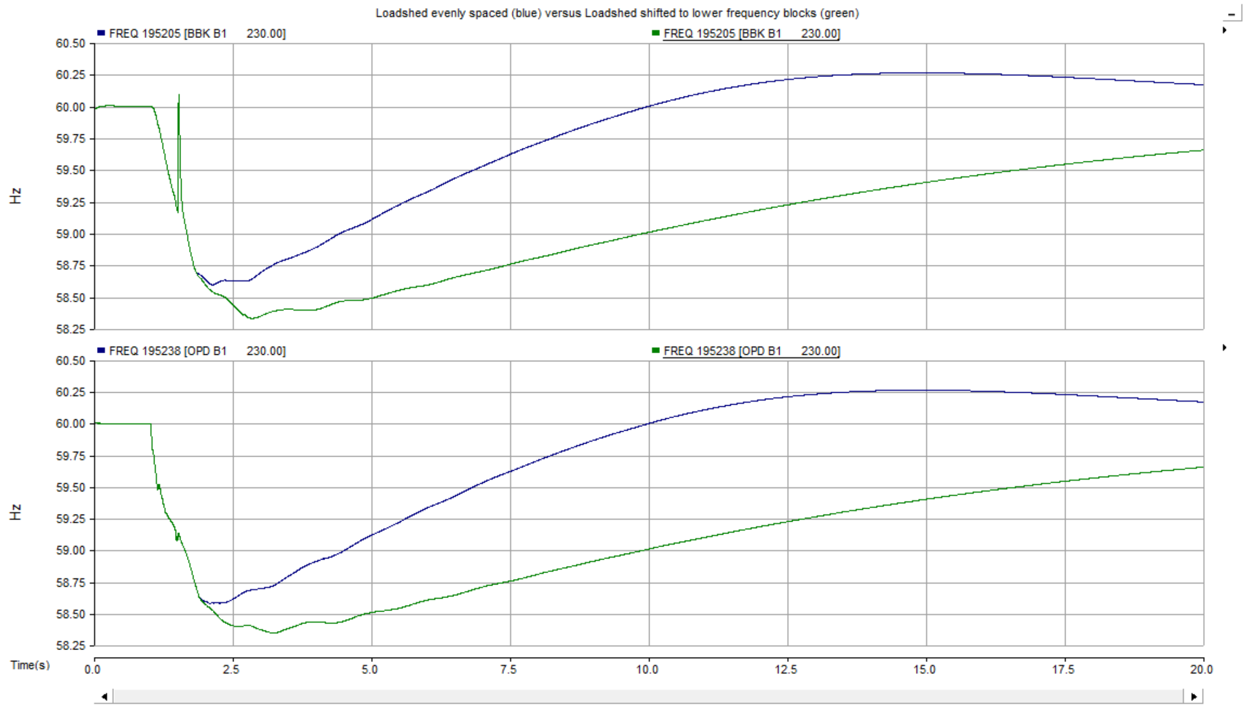

Figure 2–2. Example of IIS frequency when LIL bipole is lost – loadshed shifted to lower frequency blocks (green) versus loadshed more evenly spaced throughout frequency blocks (blue)

2.4 Loss of ML Bipole

If the ML bipole trips when importing, LIL frequency controller action and/or LIL run-up are designed to operate to automatically offset the loss of infeed from the ML, and no load shed would occur.

However, to test the newly redesigned UFLS scheme to see how much load would be shed if the rare scenario occurred in which the LIL frequency controller and LIL run-ups were not in-service, loss of the ML bipole when importing 320 MW was tested with the LIL frequency controller out-of-service and without applying a LIL run-up. The results are summarized in Table 2-3, which shows the minimum frequency that occurs in the IIS and the total amount of load that would be shed for various IIS conditions ranging from peak demand to light demand.

Table 2-3. UFLS for loss of ML Bipole, if there is no LIL frequency controller/runup

Demand Scenario	IIS Demand (MW)	IIS Generation (MW)	LIL Transfer (MW)	ML Import (MW)	Minimum Frequency (Hz)	Amount of Load Shed that occurred (MW)
Peak	1825	998	900	320	58.48	357
Intermediate Peak	1400	422	680	320	58.38	346
Intermediate	987	421	250	320	58.23	270
Light	750	400	90	260*	58.18	218

*Case already at minimum generation, therefore 260 MW is the maximum ML import under light load conditions.

3. 66 kV Voltage – Pre/Post UFLS

The impact of UFLS on the 66 kV voltage was observed by noting the pre-event and post-event 66 kV voltages after the LIL bipole was lost and UFLS had taken place. Please note that the voltages were taken from the post-event dynamic simulation cases, meaning that tap-changers and automatic switched capacitors/reactors in the system have not yet operated.

The largest changes in 66 kV bus voltages due to the most severe UFLS events (loss of LIL bipole) were as high as 0.082 pu. A table showing pre- and post-UFLS event 66 kV voltages over a full range of IIS conditions is provided in Appendix 2. In the table, impacts greater than 0.02 pu are highlighted in red, and impacts greater than 0.05 pu are highlighted in yellow.

3.1 1.07 pu Feeder Trip Settings

There are various 66 kV feeders located in the areas of Stephenville and Burin that have 1.07 pu voltage trip settings (with a 6 second delay). The table in Appendix 2 shows that under certain IIS conditions in the post-UFLS event system (prior to operation of tap changers and switched capacitors/reactors), these 66 kV areas experience voltages greater than the 1.07 pu trip setting.

3.1.1 Stephenville

The 66 kV area near Stephenville experienced post-UFLS event voltages > 1.07 pu in the peak demand case when ML was importing 320 MW. The PSSE UFLS scheme had included a 52 MW peak load at bus 195635 (SVL), however, it was determined after the fact that there is only 20.8 MW (GAL) of load available to be shed in the Stephenville area. When this 52 MW load was removed from the UFLS scheme (and replaced with load from other areas to keep total amount of load in the UFLS scheme the same) the voltages in this area remained below 1.07 pu post-UFLS.

Therefore, a solution would be to exclude load in the Stephenville area from the UFLS scheme.

3.1.2 Burin

In the Burin area, voltages greater than 1.07 pu were also observed. Redistributing load in the UFLS scheme to different areas did not have a significant improvement on the high voltages. The worst-case voltages greater than 1.07 pu were observed in extreme light demand case when ML was exporting 500 MW. In this pre-event power flow case, there is a large transfer of power in the 230 kV bulk system from the LIL infeed to export 500 MW on the ML. When the LIL bipole trips, the ML export runs back to 0 MW and UFLS occurs, and the voltages in the 230 kV bulk system rise to more than 1.06 pu in the Come-By-Chance and Sunnyside area. The high voltage in the bulk system transfers through to the 66 kV area in Burin resulting in 66 kV voltages higher than 1.07 pu. Once the transformer tap-changers operate, the high voltages on the 66 kV system are mitigated, however, this action is expected to take longer than the 6-second trip setting.

In theory, this same issue could arise in the system for events unrelated to UFLS. For example, Transmission Planning Criteria allows bulk system voltages to be as high as 1.1 pu for n-1 contingencies in the system. If the bulk system can experience voltages up to 1.1 pu (due to whatever contingency may arise), then the underlying 66 kV will also see high voltages until tap changers have had a chance to respond and bring the 66 kV voltage back down.

Further investigation is required by NP to determine the timing of tap-changer action to see if the timing of the 1.07 pu trip settings can be better coordinated to work with the possibility of high voltages in the bulk system.

4. Restoration of Load after UFLS

After UFLS has occurred and Island generation is available, the loads that were shed need to be restored while adhering to system operating limits. Simulations were performed to determine the maximum sizes of load blocks that can be placed back into service at a time without causing the IIS frequency to drop below 59 Hz and risk further UFLS to occur. It is assumed in each of these cases that the LIL bipole has tripped and is out-of-service when the load is being restored.

Restoring loads in five areas of the Island (Avalon, Burin, West, St. Johns, Central) was tested for IIS demand from extreme light to peak conditions. It was determined that the location of the load being restored does not significantly affect the maximum allowable size. The maximum allowable size correlates to the IIS generation dispatch; higher generation means more inertia on the system, which results in better frequency response to a sudden increase in load, allowing larger blocks of load to be restored at once.

Table 4-1 summarizes the maximum blocks of load that can be placed back into service based on post-contingency IIS demand conditions and generation dispatch. Having the ML frequency controller in-service increases the size of load blocks that can be placed back into service at one time. If the ML frequency controller is not in-service, the block sizes are significantly reduced. Therefore, if the ML frequency controller is not in-service it is recommended to restore the load in accordance with historic practices, which is to switch individual feeders back in one at a time through close coordination with Newfoundland Power, rather than following the maximum load block sizes presented in this report. It is worth noting that the ML frequency controller should rarely be disabled.

Note: Imports from NS cannot be assumed during restoration. The real power provided by the ML frequency controller (150 MW) is temporary (or transient) and it should be assumed unavailable after 10 minutes. Therefore, the operator must ensure generation is available within 10 minutes after switching in a block.

Table 4-1. Maximum blocks of load during restoration

ML Exports/ Imports (Pre-Cont.)	ML Exports/ Imports (Post-Cont.)[4]	Island Demand (Post-Cont.)	Island Gen. (Post-Cont.)[5]	Max Blocks ML Frequency Controller Enabled	Max Blocks ML Frequency Controller Disabled
500	0	1291	1339	268	Limit to Individual Feeders - In Accordance with Historic Practice
		906	1008	142	
		570	650	137	
		459	458	133	
		362	382	132	
158	0	971	1039	140	
		770	769	129	

[4] When ML is exporting or importing less than 150MW the ML frequency controller can operate at full capacity (150 MW) post contingency.

[5] This would be the Island Generation following the loss of the LIL. The power required to restore each block would be provided transiently using the ML frequency controller (150 MW) and/or AGC. Ten minutes following the event, it is expected that additional generation would have to be dispatched to offset the temporary 150 MW imports provided by the ML F/C and to ensure spinning reserve requirements are satisfied on the IIS.

ML Exports/ Imports (Pre-Cont.)	ML Exports/ Imports (Post-Cont.)[4]	Island Demand (Post-Cont.)	Island Gen. (Post-Cont.)[5]	Max Blocks ML Frequency Controller Enabled	Max Blocks ML Frequency Controller Disabled
		568	567	108	
		456	455	126	
		437	436	120	
-150	-150	964	813	125	
		729	469	73	
		698	437	76	
		675	424	73	
-320	-320	985	664	N/A*	
		774	453	N/A*	
		771	450	N/A*	
		693	482	N/A*	

*No ML F/C Capacity when imports are greater than 170MW

Using the results from Table 4-1, with the ML frequency controller in-service, maximum load block sizes were plotted against IIS generation. An overall trendline[6] was drawn to ensure the maximum load block size would remain below the values determined in this study for various ML levels. This ensures some margin in keeping the frequency above 59 Hz to avoid triggering UFLS while restoring load.

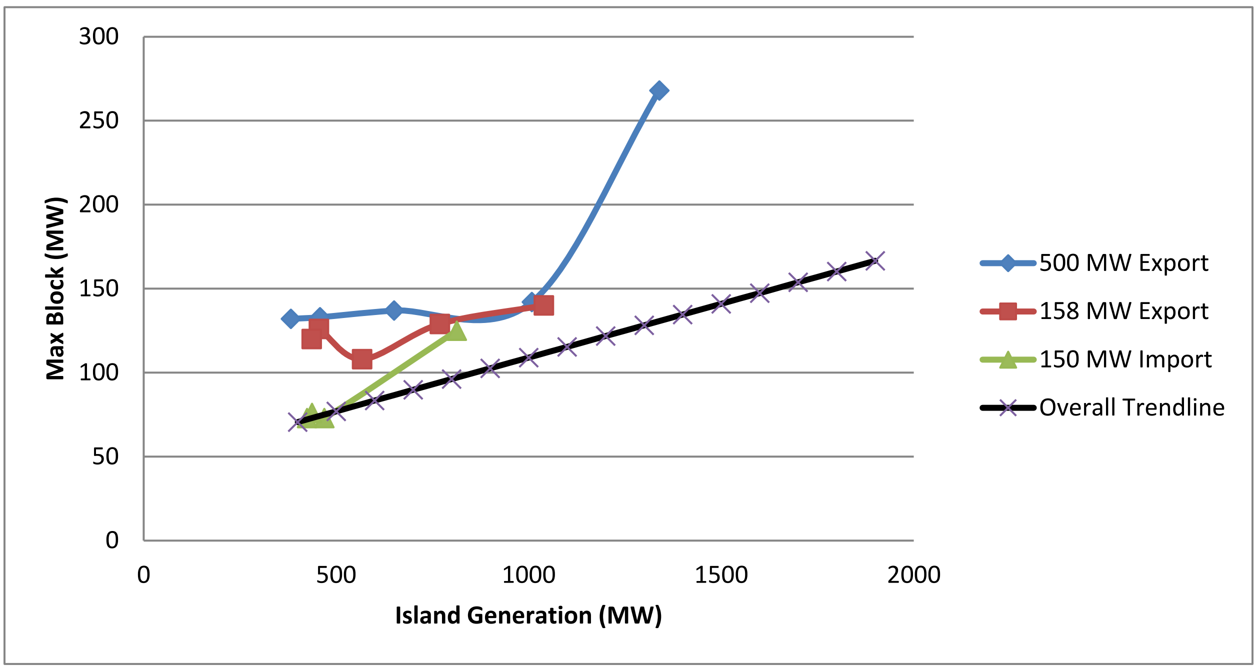

Figure 4–1. Maximum load blocks (from Table 4-1) versus IIS generation

[6] The overall trendline for all plots was developed based on each individual plot trendline. The overall trendline remains below each individual trendline for the entire range of Island Generation.

Based on this trendline, an equation (below) was derived to calculate the maximum load block size based on IIS generation, which can be used when the ML frequency controller is in-service.

MAX BLOCK (MW) = 0.064 * Island Generation (MW) – 45

APPENDIX 1

- Redesigned UFLS Scheme
- UFLS for Loss of LIL bipole

TGS™
TransGrid Solutions

Bus	Station	Area	PEAK LOAD (MW)	EXCLUDED (MW)	%	REDESIGNED UFLS 59	58.8	58.7	58.6	58.5	58.4	58.3	58.2	58.1	58	
196565	KEN NP 66.000	STJOHNS	53.97		1	53.97										15 s delay
195135	GLV NP 138.00	CENTRAL	11.6		1	11.6										15 s delay
196546	BLK NPT3 66.000	AVALON	36.7	5.4	0.85286104		31.3									
196221	GRH_NP 12.500	BURIN	13.6		1						13.6					
195624	MDR B2B3 66.000	WEST	88.9	25.8	0.70978628			63.1								
196570	KBR NP 66.000	STJOHNS	16.1		1			16.1								
195144	CLV NP 138.00	CENTRAL	56.3	10	0.82238011				46.3							
196568	SJM NP 66.000	STJOHNS	50.3	4.5	0.91053678				23.5							
195126	GFS NP 138.00	CENTRAL	40.9	6.2	0.84841076						34.7					
196572	RRD NP 66.000	STJOHNS	37.9		1							37.9				
195132	GAN NP 138.00	CENTRAL	24.4	9.4	0.6147541			15								
196573	VIR NP 66.000	STJOHNS	70.5	8.9	0.87375887								41.16			
195655	HWD B7B8 66.000	STJOHNS	52.5		1							38.1				
195130	COB NP 138.00	CENTRAL	28.5	11.9	0.58245614						16.6					
195167	BRB NP 138.00	AVALON	23.5		1				23.5							
196562	BCV NP 66.000	STJOHNS	26.9	6.4	0.76208178								20.5			
196564	GOU NP 66.000	STJOHNS	29.4		1										29.4	
196560	KEL NP 66.000	STJOHNS	23.9	8.9	0.62761506							15				
196567	SLA NP 66.000	STJOHNS	49.1		1										49.1	
196563	GDL NP 66.000	STJOHNS	53.6		1					53.6						
196574	PUL NP 66.000	STJOHNS	39.9	9.6	0.7593985					30.3						
195133	GAM NP 138.00	CENTRAL	29.3		1						29.3					
195157	MSY NP 138.00	BURIN	16.8		1										16.8	
195165	BLK NP 138.00	AVALON	11.3		1									11.3		
196561	CHA NP 66.000	STJOHNS	54.5		1		54.5									
195432	BDE B14 25.000	BDE-HERM	6.7		1					6.7						
195409	PPD T1 12.500	GNP	1.3		1		1.3									
195407	RHR B1 12.500	GNP	3.9		1		3.9									
195408	CHD T1 12.500	GNP	1.8		1		1.8									
195435	CRV T1 12.500	BDE-HERM	2.7		1							2.7				
195436	EHW T1 25.000	BDE-HERM	2.7		1								2.7			
195437	BCX T1 25.000	BDE-HERM	7.2		1								7.2			
195635	SVL B2 66.000	WEST	52.2		1									52.2		
196566	MOL NP 66.000	STJOHNS	49.8		1									28.9		
195127	BFS NP 138.00	CENTRAL	22.6		1								22.6			

	59	58.8	58.7	58.6	58.5	58.4	58.3	58.2	58.1	58
TOTALS (MW)	66	93	94	93	91	94	94	94	92	95
Frequency (Hz)	59	58.8	58.7	58.6	58.5	58.4	58.3	58.2	58.1	58

Note: loads in the EXCLUDED column are part of NP's critical customer list and are currently excluded from NP's UFLS scheme. There are additional feeders included in NP's UFLS scheme that are not part of the Stage 4E modified UFLS scheme totaling 36.4 MW, which would also be excluded from a modified UFLS scheme.

	Demand (MW)	Generation (MW)	ML (MW)	LIL Transfer Limit (MW)	DC Faults on Both Poles with Unsuccessful Restarts (Loss of LIL Bipole)							
					One Restart (500ms)		Two Restarts (900ms)		Three Restarts (1400ms)		Four Restarts (1750ms)	
					UFLS (MW)	Minimum/ Maximum Frequency (Hz)	UFLS (MW)	Minimum/ Maximum Frequency (Hz)	UFLS (MW)	Minimum/ Maximum Frequency (Hz)	UFLS (MW)	Minimum/ Maximum Frequency (Hz)
Peak	1866	1530	500	900	278	58.52	556	58.31/61.16	671	58.04/62.23		
Ipeak	1428	1094	500	900	343	58.38	550	58.00/61.66	620	57.75/63.00		
Int	1038	703	500	900	249	58.26	404	57.79/60.94	404	57.27/61.00		
Light	812	476	500	900	224	58.05	279	57.74/60.50	279	56.85		
ExLight	575	401	500	750	105	58.34	174	57.94/60.70	174	57.21/60.77		
Peak	1821	1285	300	900	554	58.29	676	58.13/60.9	832	57.93/62.45		
Ipeak	1400	915	300	900	511	58.10	620	57.81/60.84	620	57.65/60.86		
Int	994	589	300	810	405	57.93	405	57.91	405	57.50		
Light	760	452	300	690	280	57.96	280	57.91	280	57.58		
ExLight	553	409	300	470	99	58.41	97	58.39	137	58.18		
Peak	1815	1303	158	900	673	58.03	821	57.98/60.98	839	57.94/60.99		
Ipeak	1391	889	158	850	618	57.94	618	57.93	620	57.75		
Int	980	548	158	650	405	57.91	405	57.93	405	57.95		
Light	742	433	158	500	280	57.99	280	58.00	280	57.98		
ExLight	537	402	158	300	106	58.40	99	58.40	106	58.39		
Peak	1820	1330	0	900	658	58.03	835	58.03	835	57.95	835	57.96
Ipeak	1391	906	0	840	616	57.93	616	57.91	617	57.83	617	57.83
Int	972	538	0	575	397	58.00	405	58.00	405	58.00	405	57.99
Light	734	403	0	340	171	58.39	171	58.39	171	58.39	171	58.39
ExLight	535	404	0	130	-	59.05	-	59.05	-	59.05	-	59.05
Peak	1815	1049	-150	900	783	58.00	835	57.98	835	57.95	835	57.95
Ipeak	1389	757	-150	820	618	57.91	618	57.89	618	57.77	618	57.77
Int	972	424	-150	410	244	58.37	244	58.38	244	58.39	244	58.38
Light	740	402	-150	190	60	58.79	60	58.79	60	58.79	60	58.79
ExLight	536	400	-46	90	-	59.13	-	59.13	-	59.13	-	59.13
Peak	1824	998	-320	700	675	58.02	840	57.93/60.86	840	57.92/61.05	840	57.93/61.06
Ipeak	1402	422	-320	680	620	57.87	620	57.87	620	57.87	620	57.87
Int	987	421	-320	250	223	58.38	223	58.38	223	58.38	223	58.38
Light	750	400	-260	90	60	58.77	60	58.77	60	58.77	60	58.77

at minimum IIS generation

APPENDIX 2

66 kV Pre/Post UFLS due to Loss of LIL Bipole

TransGrid Solutions

ML = 500 MW Export

66 kV Bus	Bus Names	Peak Demand, ML= 500 MW			Int_Peak Demand, ML= 500 MW			Intermediate Demand, ML= 500 MW			Extreme Light Demand, ML= 500 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0389	1.0487	0.0098	1.0389	1.0463	0.0074	1.0368	1.0501	0.0133	1.0426	1.0515	0.0089
195601	WDL TAP	1.0331	1.0499	0.0168	1.0361	1.0485	0.0124	1.0367	1.0532	0.0166	1.0452	1.0556	0.0104
195602	WDL B1	1.0330	1.0498	0.0168	1.0361	1.0485	0.0124	1.0367	1.0533	0.0166	1.0453	1.0557	0.0104
195603	GLB L29	1.0299	1.0467	0.0168	1.0341	1.0466	0.0124	1.0358	1.0524	0.0166	1.0455	1.0559	0.0104
195604	RHR TAP	1.0255	1.0516	0.0261	1.0311	1.0502	0.0191	1.0340	1.0549	0.0208	1.0450	1.0572	0.0123
195605	RHR B1	1.0248	1.0516	0.0268	1.0306	1.0502	0.0196	1.0337	1.0549	0.0212	1.0448	1.0573	0.0124
195606	BHL T1	0.9973	1.0324	0.0351	1.0120	1.0405	0.0285	0.9999	1.0509	0.0510	1.0070	1.0511	0.0441
195607	SCV L27	0.9964	1.0333	0.0369	1.0117	1.0415	0.0298	1.0000	1.0519	0.0519	1.0075	1.0521	0.0446
195608	CHD B1	0.9944	1.0339	0.0395	1.0103	1.0420	0.0317	0.9992	1.0524	0.0532	1.0075	1.0526	0.0451
195609	PPD L27	1.0349	1.0782	0.0434	1.0493	1.0839	0.0347	1.0461	1.1036	0.0575	1.0451	1.0931	0.0480
195610	DHR B1B2	1.0363	1.0776	0.0412	1.0501	1.0833	0.0332	1.0464	1.1029	0.0565	1.0449	1.0924	0.0476
195611	PBN B2	1.0367	1.0776	0.0409	1.0503	1.0832	0.0329	1.0464	1.1028	0.0563	1.0448	1.0923	0.0475
195612	HBY B1	1.0204	1.0614	0.0410	1.0395	1.0725	0.0330	1.0404	1.0969	0.0565	1.0435	1.0912	0.0477
195620	DLP B1B4	1.0402	1.0492	0.0090	1.0403	1.0472	0.0069	1.0398	1.0510	0.0112	1.0444	1.0517	0.0072
195621	PAS B1	1.0235	1.0371	0.0136	1.0244	1.0351	0.0107	1.0260	1.0410	0.0150	1.0329	1.0424	0.0095
195622	MMT NP	1.0198	1.0367	0.0169	1.0197	1.0329	0.0132	1.0202	1.0379	0.0176	1.0273	1.0380	0.0107
195624	MDR B2B3	1.0173	1.0632	0.0459	1.0207	1.0555	0.0348	1.0205	1.0627	0.0422	1.0279	1.0617	0.0338
195625	MDR B4	1.0197	1.0378	0.0181	1.0190	1.0331	0.0141	1.0188	1.0373	0.0186	1.0256	1.0367	0.0110
195626	CBPP B	1.0119	1.0262	0.0143	1.0113	1.0225	0.0112	1.0113	1.0259	0.0146	1.0159	1.0224	0.0065
195627	CBPP D	1.0119	1.0264	0.0145	1.0113	1.0226	0.0113	1.0113	1.0260	0.0147	1.0159	1.0227	0.0068
195628	CBPP E	1.0120	1.0264	0.0144	1.0114	1.0227	0.0113	1.0114	1.0260	0.0147	1.0161	1.0227	0.0066
195629	CBP&P A	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001
195630	DLP 50HZ	1.0386	1.0387	0.0001	1.0386	1.0387	0.0001	1.0386	1.0387	0.0001	1.0386	1.0387	0.0001
195631	BRKFIELD	1.0072	1.0073	0.0001	1.0072	1.0073	0.0001	1.0072	1.0073	0.0001	1.0072	1.0073	0.0001
195632	CBP&P C	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001
195633	WATSONS	1.0060	1.0061	0.0001	1.0060	1.0061	0.0001	1.0060	1.0061	0.0001	1.0060	1.0061	0.0001
195635	SVL B2	1.0097	1.0249	0.0153	1.0167	1.0487	0.0319	1.0228	1.0500	0.0272	1.0306	1.0508	0.0202
195636	BBK T2	1.0601	1.0758	0.0157	1.0409	1.0549	0.0139	1.0327	1.0489	0.0162	1.0204	1.0350	0.0146
195637	DLS B1	1.0479	1.0621	0.0143	1.0389	1.0517	0.0127	1.0481	1.0629	0.0148	1.0570	1.0706	0.0137
195639	BUC B2	1.0275	1.0780	0.0504	1.0348	1.0699	0.0351	1.0297	1.0902	0.0605	1.0369	1.0903	0.0534
195640	DPD L64	1.0292	1.0798	0.0506	1.0366	1.0717	0.0352	1.0314	1.0920	0.0606	1.0386	1.0921	0.0536
195641	SLK L80	1.0443	1.0950	0.0507	1.0474	1.0841	0.0368	1.0452	1.1060	0.0608	1.0482	1.1036	0.0554
195643	ACG GFL	0.9928	0.9999	0.0072	1.0020	1.0065	0.0045	0.9942	1.0029	0.0087	0.9982	1.0060	0.0079
195644	ACG BFL	1.0077	1.0129	0.0052	1.0141	1.0173	0.0032	1.0087	1.0150	0.0063	1.0115	1.0172	0.0058
195650	WAV B2	1.0423	1.0720	0.0297	1.0393	1.0442	0.0049	1.0438	1.0883	0.0445	1.0548	1.1137	0.0589
195652	HRD B6B7	1.0340	1.0578	0.0238	1.0227	1.0341	0.0113	1.0325	1.0600	0.0275	1.0387	1.0647	0.0260
195654	OPD B2B5	1.0241	1.0504	0.0263	1.0204	1.0359	0.0154	1.0251	1.0544	0.0293	1.0327	1.0596	0.0269
195655	HWD B7B8	1.0198	1.0462	0.0264	1.0139	1.0296	0.0156	1.0232	1.0529	0.0297	1.0248	1.0503	0.0255
195675	CHF T601	1.0088	1.0172	0.0084	1.0088	1.0172	0.0084	1.0088	1.0171	0.0083	1.0162	1.0226	0.0064
195676	CHF T602	1.0088	1.0172	0.0084	1.0088	1.0172	0.0084	1.0088	1.0171	0.0083	1.0162	1.0226	0.0064
195677	CHF AIRPORT	1.0073	1.0158	0.0085	1.0073	1.0158	0.0085	1.0073	1.0157	0.0084	1.0148	1.0212	0.0064
195678	BRDG CAMP	1.0050	1.0135	0.0086	1.0050	1.0135	0.0086	1.0050	1.0135	0.0085	1.0125	1.0190	0.0065
195679	LOGANTWR	1.0055	1.0140	0.0085	1.0055	1.0140	0.0085	1.0055	1.0140	0.0085	1.0130	1.0195	0.0065
195680	WHITEFISH	1.0040	1.0126	0.0086	1.0040	1.0126	0.0086	1.0040	1.0125	0.0085	1.0116	1.0181	0.0065
195681	JACOPIE	1.0041	1.0126	0.0086	1.0041	1.0126	0.0086	1.0041	1.0126	0.0085	1.0116	1.0181	0.0065
195682	TWIN TAP	1.0044	1.0131	0.0086	1.0044	1.0131	0.0086	1.0044	1.0130	0.0085	1.0120	1.0185	0.0065
195683	ATIKONAK	0.9881	0.9970	0.0089	0.9881	0.9970	0.0089	0.9881	0.9969	0.0088	0.9959	1.0027	0.0067
195684	LOB LODGE	0.9876	0.9965	0.0089	0.9876	0.9965	0.0089	0.9876	0.9964	0.0088	0.9954	1.0021	0.0068
195685	LOBSTICK	0.9825	0.9914	0.0089	0.9825	0.9914	0.0089	0.9825	0.9914	0.0088	0.9904	0.9972	0.0068
195686	LOB TAP	0.9870	0.9959	0.0089	0.9870	0.9959	0.0089	0.9870	0.9959	0.0088	0.9948	1.0016	0.0068
195687	GABBRO	0.9858	0.9946	0.0089	0.9858	0.9947	0.0089	0.9858	0.9946	0.0088	0.9936	1.0003	0.0068
195688	JWF TAP	1.0048	1.0134	0.0086	1.0048	1.0134	0.0086	1.0048	1.0133	0.0085	1.0124	1.0189	0.0065
195824	STG MID2	1.0067	1.0219	0.0152	1.0117	1.0434	0.0317	1.0161	1.0430	0.0269	1.0270	1.0472	0.0201
195843	GOU MID1	1.0089	1.0391	0.0302	1.0068	1.0257	0.0189	1.0176	1.0506	0.0330	1.0237	1.0515	0.0278
195844	MOB MID3	1.0031	1.0257	0.0226	1.0044	1.0191	0.0147	1.0140	1.0375	0.0235	1.0211	1.0411	0.0200
195845	CHA MID1	1.0130	1.0465	0.0336	1.0086	1.0292	0.0206	1.0204	1.0539	0.0335	1.0250	1.0527	0.0278
195870	CHF T601	1.0088	1.0172	0.0084	1.0088	1.0172	0.0084	1.0088	1.0171	0.0083	1.0162	1.0226	0.0064
196312	OPD T3Y	1.0068	1.0263	0.0194	1.0115	1.0201	0.0086	1.0214	1.0456	0.0242	1.0159	1.0402	0.0243
196316	OPD T1Y	1.0068	1.0263	0.0194	1.0115	1.0201	0.0086	1.0214	1.0456	0.0242	1.0159	1.0402	0.0243
196318	HWD T4Y	1.0120	1.0286	0.0166	1.0151	1.0207	0.0057	1.0217	1.0438	0.0221	1.0189	1.0424	0.0236
196324	HWD T1Y	1.0120	1.0286	0.0166	1.0151	1.0207	0.0057	1.0217	1.0438	0.0221	1.0189	1.0424	0.0236
196326	MDR T3Y	0.9775	1.0129	0.0354	0.9904	1.0181	0.0277	0.9872	1.0242	0.0371	0.9919	1.0226	0.0308
196330	MDR T1Y	0.9775	1.0129	0.0354	0.9904	1.0181	0.0277	0.9872	1.0242	0.0371	0.9919	1.0226	0.0308
196334	DLS T1Y	0.9840	0.9981	0.0142	0.9828	0.9955	0.0127	0.9884	1.0032	0.0148	0.9847	0.9981	0.0134
196336	DLK T1Y	0.9974	1.0262	0.0288	1.0036	1.0271	0.0235	0.9972	1.0443	0.0472	0.9996	1.0413	0.0417
196338	BHL T1Y	1.0069	1.0407	0.0337	1.0213	1.0488	0.0276	1.0211	1.0724	0.0513	1.0155	1.0595	0.0441
196340	PBN T1Y	1.0113	1.0490	0.0377	1.0340	1.0649	0.0309	1.0405	1.0955	0.0550	1.0240	1.0700	0.0461
196348	MKS T1Y	1.0073	1.0427	0.0354	1.0160	1.0236	0.0075	1.0182	1.0620	0.0438	1.0326	1.0887	0.0561
196500	DLK NP	1.0387	1.0481	0.0094	1.0389	1.0461	0.0072	1.0378	1.0501	0.0123	1.0433	1.0514	0.0081
196501	STX NP	1.0098	1.0251	0.0153	1.0166	1.0485	0.0319	1.0224	1.0495	0.0271	1.0306	1.0509	0.0202
196502	STG NP	1.0102	1.0254	0.0152	1.0164	1.0483	0.0319	1.0218	1.0489	0.0271	1.0309	1.0510	0.0202
196503	HAR NP	1.0097	1.0250	0.0153	1.0168	1.0487	0.0320	1.0229	1.0501	0.0272	1.0306	1.0509	0.0202
196504	GAL NP	1.0097	1.0250	0.0153	1.0168	1.0488	0.0320	1.0229	1.0501	0.0272	1.0306	1.0509	0.0202
196505	WHE TAP	1.0097	1.0250	0.0153	1.0168	1.0487	0.0320	1.0229	1.0501	0.0272	1.0306	1.0509	0.0202
196506	WHE NP	1.0605	1.0762	0.0157	1.0413	1.0553	0.0140	1.0331	1.0493	0.0162	1.0208	1.0355	0.0147
196507	GBY NP	0.9950	1.0080	0.0130	1.0003	1.0118	0.0116	1.0216	1.0352	0.0135	1.0396	1.0522	0.0125
196508	PAB NP	0.9923	1.0053	0.0130	0.9983	1.0099	0.0116	1.0204	1.0339	0.0135	1.0391	1.0516	0.0125
196509	LGL NP	0.9836	0.9955	0.0119	0.9908	1.0014	0.0106	1.0127	1.0251	0.0124	1.0292	1.0408	0.0115
196517	GFS NPT1	1.0370	1.0977	0.0607	1.0386	1.0784	0.0398	1.0324	1.1042	0.0718	1.0355	1.1035	0.0679
196518	RUS NP	1.0379	1.0985	0.0606	1.0395	1.0792	0.0397	1.0334	1.1050	0.0716	1.0364	1.1042	0.0678
196519	SBK NP	1.0441	1.1039	0.0598	1.0456	1.0849	0.0393	1.0401	1.1107	0.0706	1.0428	1.1097	0.0669
196520	RBK NP	1.0209	1.0790	0.0581	1.0281	1.0632	0.0351	1.0316	1.0982	0.0667	1.0376	1.0990	0.0613
196521	NDJ NP	0.9982	1.0582	0.0600	1.0092	1.0434	0.0341	1.0173	1.0847	0.0673	1.0258	1.0863	0.0606
196522	LEW NP	0.9747	1.0343	0.0596	0.9921	1.0261	0.0340	1.0063	1.0735	0.0672	1.0202	1.0806	0.0604

66 kV Bus	Bus Names	Peak Demand, ML= 500 MW			Int_Peak Demand, ML= 500 MW			Intermediate Demand, ML= 500 MW			Extreme Light Demand, ML= 500 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196523	GAN NPT2	1.0225	1.0856	0.0631	1.0236	1.0571	0.0335	1.0234	1.0921	0.0687	1.0220	1.0821	0.0601
196524	COB NPT2	0.9942	1.0688	0.0746	1.0123	1.0539	0.0416	1.0083	1.0895	0.0813	0.9837	1.0541	0.0705
196525	CLK NP	0.9518	1.0294	0.0776	0.9968	1.0403	0.0435	0.9998	1.0837	0.0839	0.9979	1.0705	0.0726
196526	BOY NP	0.9119	0.9909	0.0789	0.9759	1.0205	0.0445	0.9861	1.0715	0.0854	1.0017	1.0754	0.0737
196527	FHD L54	0.9045	0.9832	0.0787	0.9711	1.0155	0.0444	0.9831	1.0685	0.0854	1.0006	1.0743	0.0737
196528	GAM NPT2	0.9554	1.0369	0.0815	0.9851	1.0279	0.0428	0.9912	1.0743	0.0832	1.0204	1.0989	0.0786
196529	HBS NP	0.9576	1.0393	0.0817	0.9874	1.0304	0.0429	0.9935	1.0769	0.0834	1.0228	1.1016	0.0788
196530	TRN NP	0.9591	1.0410	0.0819	0.9890	1.0321	0.0431	0.9951	1.0787	0.0836	1.0244	1.1034	0.0790
196531	GPD NP	0.9602	1.0422	0.0820	0.9901	1.0332	0.0431	0.9961	1.0798	0.0837	1.0255	1.1046	0.0791
196532	WES NP	0.9603	1.0424	0.0820	0.9902	1.0334	0.0432	0.9963	1.0800	0.0837	1.0257	1.1048	0.0791
196533	CLV NPT1	0.9961	1.0504	0.0543	1.0085	1.0274	0.0189	1.0085	1.0681	0.0596	1.0245	1.0915	0.0670
196534	MIL NP	0.9979	1.0523	0.0544	1.0099	1.0289	0.0189	1.0099	1.0696	0.0597	1.0255	1.0925	0.0671
196535	LET NP	1.0007	1.0552	0.0545	1.0120	1.0310	0.0190	1.0120	1.0719	0.0598	1.0267	1.0938	0.0671
196536	SMV NP	1.0026	1.0572	0.0546	1.0132	1.0323	0.0190	1.0132	1.0731	0.0599	1.0271	1.0942	0.0671
196537	LOK NP	1.0029	1.0576	0.0547	1.0134	1.0325	0.0190	1.0134	1.0733	0.0599	1.0271	1.0942	0.0671
196538	PUN NP	1.0025	1.0571	0.0547	1.0131	1.0321	0.0190	1.0131	1.0730	0.0599	1.0268	1.0939	0.0671
196539	CAT NPT1	0.9996	1.0541	0.0545	1.0111	1.0301	0.0190	1.0111	1.0709	0.0598	1.0261	1.0932	0.0671
196540	SPT NP	1.0392	1.0677	0.0285	1.0261	1.0356	0.0095	1.0285	1.0577	0.0292	1.0367	1.0771	0.0404
196541	LAU NP	1.0364	1.0520	0.0156	1.0298	1.0291	-0.0007	1.0364	1.0475	0.0110	1.0388	1.0608	0.0221
196542	STL WIND	1.0371	1.0500	0.0129	1.0305	1.0278	-0.0028	1.0372	1.0456	0.0084	1.0395	1.0582	0.0187
196543	WEBCV_NP	1.0365	1.0586	0.0221	1.0325	1.0377	0.0053	1.0397	1.0548	0.0150	1.0367	1.0669	0.0303
196544	GRH NP	1.0381	1.0634	0.0253	1.0348	1.0430	0.0082	1.0419	1.0589	0.0170	1.0356	1.0699	0.0343
196545	GAR NP	1.0377	1.0647	0.0270	1.0296	1.0385	0.0089	1.0345	1.0580	0.0235	1.0362	1.0737	0.0375
196546	BLK NPT3	1.0295	1.0678	0.0383	1.0281	1.0394	0.0113	1.0327	1.0804	0.0478	1.0298	1.0874	0.0576
196547	NHR NP	1.0217	1.0565	0.0348	1.0193	1.0285	0.0093	1.0243	1.0700	0.0457	1.0217	1.0771	0.0554
196548	ISL NP	1.0111	1.0418	0.0307	1.0074	1.0142	0.0068	1.0130	1.0561	0.0431	1.0109	1.0634	0.0525
196549	HCT NP	1.0033	1.0310	0.0277	0.9987	1.0037	0.0050	1.0048	1.0459	0.0410	1.0032	1.0534	0.0502
196550	NCH NP	1.0049	1.0326	0.0277	1.0011	1.0061	0.0050	1.0062	1.0473	0.0410	1.0047	1.0549	0.0502
196551	OPL NP	1.0052	1.0329	0.0277	1.0013	1.0064	0.0050	1.0065	1.0476	0.0411	1.0050	1.0553	0.0502
196552	CAR NP	0.9861	1.0073	0.0213	0.9792	0.9798	0.0006	0.9880	1.0243	0.0363	0.9874	1.0326	0.0452
196553	VIC NP	0.9862	1.0075	0.0213	0.9794	0.9800	0.0006	0.9881	1.0245	0.0363	0.9875	1.0327	0.0452
196554	HGR NP	0.9843	1.0053	0.0211	0.9772	0.9777	0.0005	0.9861	1.0222	0.0361	0.9855	1.0304	0.0449
196555	ILC NP	0.9811	1.0012	0.0202	0.9735	0.9735	0.0000	0.9829	1.0183	0.0354	0.9824	1.0265	0.0441
196556	BRB T2T3	0.9766	0.9961	0.0195	0.9685	0.9681	-0.0004	0.9783	1.0130	0.0347	0.9779	1.0212	0.0433
196557	ULT TAP	1.0323	1.0565	0.0242	1.0215	1.0333	0.0118	1.0315	1.0594	0.0279	1.0379	1.0640	0.0261
196558	ULT NP	1.0323	1.0565	0.0242	1.0215	1.0333	0.0118	1.0315	1.0594	0.0279	1.0379	1.0640	0.0261
196559	SCV NP	1.0305	1.0552	0.0247	1.0203	1.0325	0.0122	1.0306	1.0589	0.0283	1.0371	1.0634	0.0263
196560	KEL NP	1.0184	1.0471	0.0287	1.0119	1.0279	0.0160	1.0240	1.0560	0.0319	1.0306	1.0583	0.0277
196561	CHA NP	1.0130	1.0466	0.0336	1.0086	1.0292	0.0206	1.0204	1.0539	0.0335	1.0250	1.0528	0.0278
196562	BCV NP	1.0058	1.0321	0.0263	1.0036	1.0192	0.0156	1.0166	1.0514	0.0348	1.0213	1.0496	0.0282
196563	GDL NP	1.0092	1.0428	0.0336	1.0069	1.0280	0.0212	1.0181	1.0521	0.0339	1.0232	1.0514	0.0282
196564	GOU NP	1.0096	1.0399	0.0303	1.0078	1.0267	0.0189	1.0183	1.0513	0.0330	1.0243	1.0522	0.0279
196565	KEN NP	1.0164	1.0433	0.0269	1.0137	1.0298	0.0162	1.0215	1.0517	0.0302	1.0284	1.0553	0.0268
196566	MOL NP	1.0127	1.0399	0.0272	1.0107	1.0296	0.0189	1.0198	1.0519	0.0321	1.0269	1.0546	0.0278
196567	SLA NP	1.0171	1.0446	0.0275	1.0148	1.0317	0.0169	1.0219	1.0528	0.0310	1.0297	1.0572	0.0276
196568	SJM NP	1.0115	1.0414	0.0299	1.0101	1.0288	0.0187	1.0192	1.0516	0.0324	1.0269	1.0550	0.0281
196569	MUN NP	1.0144	1.0429	0.0285	1.0130	1.0307	0.0178	1.0206	1.0520	0.0313	1.0294	1.0572	0.0278
196570	KBR NP	1.0127	1.0425	0.0298	1.0119	1.0309	0.0190	1.0198	1.0516	0.0318	1.0293	1.0575	0.0282
196571	PEP NP	1.0112	1.0411	0.0299	1.0108	1.0304	0.0195	1.0191	1.0512	0.0321	1.0290	1.0573	0.0284
196572	RRD NP	1.0181	1.0473	0.0292	1.0160	1.0339	0.0179	1.0223	1.0533	0.0310	1.0310	1.0588	0.0278
196573	VIR NP	1.0106	1.0408	0.0302	1.0105	1.0316	0.0211	1.0189	1.0518	0.0330	1.0291	1.0580	0.0289
196574	PUL NP	0.9980	1.0379	0.0399	1.0013	1.0295	0.0282	1.0129	1.0504	0.0375	1.0259	1.0573	0.0313
196575	BIG NP	1.0066	1.0345	0.0279	1.0066	1.0241	0.0175	1.0173	1.0477	0.0304	1.0239	1.0497	0.0258
196576	MOB NP	1.0078	1.0297	0.0219	1.0100	1.0237	0.0137	1.0200	1.0434	0.0234	1.0270	1.0469	0.0199
196577	TCV NP	1.0082	1.0301	0.0219	1.0104	1.0241	0.0137	1.0204	1.0438	0.0234	1.0274	1.0473	0.0198
196578	ROP NP	1.0077	1.0290	0.0214	1.0099	1.0231	0.0132	1.0198	1.0424	0.0226	1.0269	1.0461	0.0192
196579	MRP NP	1.0078	1.0292	0.0214	1.0100	1.0233	0.0133	1.0198	1.0425	0.0227	1.0268	1.0460	0.0192
196580	HCP TAP NP	1.0072	1.0249	0.0177	1.0098	1.0201	0.0103	1.0197	1.0374	0.0177	1.0274	1.0421	0.0148
196581	HCP NP	1.0075	1.0253	0.0179	1.0099	1.0204	0.0105	1.0196	1.0373	0.0177	1.0273	1.0420	0.0148
196582	CAB NP	1.0069	1.0227	0.0158	1.0099	1.0185	0.0087	1.0202	1.0354	0.0152	1.0281	1.0407	0.0125
196583	FER NP	1.0093	1.0126	0.0032	1.0133	1.0089	-0.0043	1.0245	1.0243	-0.0002	1.0333	1.0319	-0.0014
196584	FER WIND	1.0096	1.0122	0.0026	1.0135	1.0086	-0.0050	1.0248	1.0238	-0.0010	1.0336	1.0314	-0.0022
196585	SUM NP	0.9119	0.9909	0.0789	0.9759	1.0205	0.0445	0.9861	1.0715	0.0854	1.0017	1.0754	0.0737
196586	TWG NP	0.9018	0.9817	0.0799	0.9725	1.0176	0.0452	0.9842	1.0705	0.0863	1.0041	1.0783	0.0742
196587	HRD OUTS	1.0329	1.0570	0.0241	1.0219	1.0335	0.0116	1.0319	1.0596	0.0278	1.0382	1.0643	0.0261

ML = 300 MW Export

66 kV Bus	Bus Names	Peak Demand, ML= 300 MW			Int_Peak Demand, ML= 300 MW			Intermediate Demand, ML= 300 MW			Light Demand, ML= 300 MW			Extreme Light Demand, ML= 300 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0406	1.0465	0.0059	1.0366	1.0435	0.0069	1.0390	1.0448	0.0057	1.0419	1.0483	0.0065	1.0441	1.0472	0.0030
195601	WDL TAP	1.0349	1.0478	0.0129	1.0337	1.0457	0.0120	1.0390	1.0478	0.0088	1.0432	1.0518	0.0086	1.0468	1.0497	0.0029
195602	WDL B1	1.0347	1.0476	0.0129	1.0337	1.0457	0.0120	1.0390	1.0478	0.0088	1.0432	1.0519	0.0086	1.0468	1.0498	0.0029
195603	GLB L29	1.0317	1.0446	0.0129	1.0317	1.0437	0.0120	1.0381	1.0469	0.0088	1.0429	1.0516	0.0086	1.0471	1.0500	0.0029
195604	RHR TAP	1.0273	1.0494	0.0221	1.0287	1.0473	0.0187	1.0363	1.0493	0.0130	1.0418	1.0534	0.0116	1.0465	1.0494	0.0029
195605	RHR B1	1.0266	1.0494	0.0228	1.0282	1.0474	0.0192	1.0360	1.0493	0.0133	1.0416	1.0534	0.0118	1.0464	1.0493	0.0029
195606	BHL T1	1.0062	1.0299	0.0237	0.9954	1.0235	0.0281	0.9948	1.0168	0.0220	0.9906	1.0138	0.0232	0.9996	1.0110	0.0114
195607	SCV L27	1.0054	1.0309	0.0255	0.9950	1.0244	0.0294	0.9949	1.0177	0.0229	0.9909	1.0147	0.0238	1.0002	1.0116	0.0114
195608	CHD B1	1.0034	1.0314	0.0281	0.9936	1.0250	0.0313	0.9941	1.0182	0.0241	0.9905	1.0152	0.0247	1.0001	1.0115	0.0114
195609	PPD L27	1.0443	1.0752	0.0309	1.0449	1.0793	0.0343	1.0399	1.0643	0.0244	1.0356	1.0609	0.0253	1.0371	1.0477	0.0106
195610	DHR B1B2	1.0457	1.0746	0.0289	1.0458	1.0786	0.0328	1.0402	1.0637	0.0234	1.0357	1.0603	0.0246	1.0369	1.0475	0.0106
195611	PBN B2	1.0461	1.0746	0.0285	1.0460	1.0786	0.0326	1.0403	1.0636	0.0233	1.0357	1.0602	0.0245	1.0368	1.0474	0.0106
195612	HBY B1	1.0300	1.0586	0.0286	1.0351	1.0678	0.0327	1.0342	1.0575	0.0233	1.0320	1.0566	0.0245	1.0355	1.0461	0.0106
195620	DLP B1B4	1.0416	1.0471	0.0055	1.0401	1.0461	0.0060	1.0421	1.0472	0.0051	1.0445	1.0502	0.0057	1.0462	1.0493	0.0032
195621	PAS B1	1.0249	1.0331	0.0082	1.0270	1.0353	0.0082	1.0301	1.0373	0.0071	1.0342	1.0421	0.0078	1.0364	1.0413	0.0049
195622	MMT NP	1.0208	1.0310	0.0101	1.0236	1.0335	0.0098	1.0257	1.0342	0.0085	1.0303	1.0395	0.0092	1.0320	1.0378	0.0058
195624	MDR B2B3	1.0321	1.0626	0.0305	1.0283	1.0548	0.0266	1.0217	1.0416	0.0199	1.0347	1.0549	0.0203	1.0267	1.0373	0.0106
195625	MDR B4	1.0206	1.0315	0.0108	1.0233	1.0337	0.0104	1.0247	1.0336	0.0089	1.0293	1.0390	0.0096	1.0307	1.0368	0.0061
195626	CBPP B	1.0126	1.0214	0.0088	1.0144	1.0230	0.0086	1.0154	1.0229	0.0075	1.0185	1.0265	0.0080	1.0194	1.0250	0.0056
195627	CBPP D	1.0127	1.0215	0.0089	1.0144	1.0231	0.0087	1.0154	1.0230	0.0076	1.0185	1.0267	0.0082	1.0195	1.0252	0.0057
195628	CBPP E	1.0128	1.0216	0.0088	1.0145	1.0231	0.0086	1.0155	1.0231	0.0076	1.0187	1.0267	0.0081	1.0196	1.0252	0.0056
195629	CBP&P A	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0057	0.0000	1.0057	1.0064	0.0007	1.0057	1.0058	0.0001
195630	DLP 50HZ	1.0386	1.0387	0.0001	1.0386	1.0386	0.0001	1.0386	1.0385	-0.0001	1.0386	1.0389	0.0003	1.0386	1.0386	0.0000
195631	BRKFIELD	1.0072	1.0073	0.0001	1.0072	1.0073	0.0001	1.0072	1.0072	0.0000	1.0072	1.0079	0.0007	1.0072	1.0073	0.0001
195632	CBP&P C	1.0057	1.0058	0.0001	1.0057	1.0058	0.0001	1.0057	1.0057	0.0000	1.0057	1.0064	0.0007	1.0057	1.0058	0.0001
195633	WATSONS	1.0060	1.0061	0.0001	1.0060	1.0061	0.0001	1.0060	1.0060	0.0000	1.0060	1.0066	0.0006	1.0060	1.0060	0.0001
195635	SVL B2	1.0097	1.0462	0.0365	1.0167	1.0443	0.0275	1.0228	1.0389	0.0161	1.0276	1.0436	0.0160	1.0306	1.0321	0.0016
195636	BBK T2	1.0601	1.0704	0.0103	1.0409	1.0505	0.0096	1.0327	1.0377	0.0050	1.0193	1.0263	0.0070	1.0204	1.0215	0.0011
195637	DLS B1	1.0479	1.0572	0.0094	1.0389	1.0477	0.0088	1.0481	1.0525	0.0044	1.0491	1.0559	0.0068	1.0570	1.0577	0.0007
195639	BUC B2	1.0377	1.0604	0.0227	1.0349	1.0583	0.0235	1.0328	1.0545	0.0217	1.0305	1.0562	0.0257	1.0246	1.0343	0.0097
195640	DPD L64	1.0394	1.0623	0.0228	1.0366	1.0602	0.0236	1.0346	1.0562	0.0217	1.0322	1.0579	0.0258	1.0263	1.0360	0.0096
195641	SLK L80	1.0486	1.0732	0.0247	1.0474	1.0725	0.0251	1.0465	1.0695	0.0230	1.0455	1.0739	0.0284	1.0430	1.0525	0.0095
195643	ACG GFL	1.0017	1.0049	0.0032	1.0037	1.0073	0.0036	1.0029	1.0064	0.0035	1.0021	1.0075	0.0053	1.0032	1.0047	0.0015
195644	ACG BFL	1.0139	1.0163	0.0023	1.0153	1.0179	0.0026	1.0147	1.0172	0.0025	1.0142	1.0180	0.0038	1.0149	1.0160	0.0010
195650	WAV B2	1.0469	1.0546	0.0077	1.0405	1.0640	0.0235	1.0394	1.0590	0.0196	1.0472	1.0748	0.0276	1.0397	1.0439	0.0042
195652	HRD B6B7	1.0335	1.0546	0.0211	1.0246	1.0535	0.0289	1.0219	1.0318	0.0099	1.0308	1.0431	0.0123	1.0262	1.0203	-0.0059
195654	OPD B2B5	1.0257	1.0525	0.0269	1.0224	1.0544	0.0320	1.0226	1.0341	0.0115	1.0258	1.0389	0.0130	1.0230	1.0173	-0.0057
195655	HWD B7B8	1.0214	1.0468	0.0254	1.0158	1.0484	0.0326	1.0145	1.0263	0.0118	1.0227	1.0356	0.0129	1.0184	1.0132	-0.0052
195675	CHF T601	1.0088	1.0170	0.0083	1.0088	1.0171	0.0083	1.0088	1.0160	0.0072	1.0159	1.0246	0.0087	1.0165	1.0220	0.0055
195676	CHF T602	1.0088	1.0170	0.0083	1.0088	1.0171	0.0083	1.0088	1.0160	0.0072	1.0159	1.0246	0.0087	1.0165	1.0220	0.0055
195677	CHF AIRPORT	1.0073	1.0157	0.0083	1.0073	1.0157	0.0083	1.0073	1.0146	0.0073	1.0145	1.0233	0.0087	1.0151	1.0207	0.0056
195678	BRDG CAMP	1.0050	1.0134	0.0084	1.0050	1.0134	0.0085	1.0050	1.0124	0.0074	1.0122	1.0210	0.0088	1.0128	1.0184	0.0056
195679	LOGANTWR	1.0055	1.0139	0.0084	1.0055	1.0139	0.0084	1.0055	1.0129	0.0074	1.0127	1.0215	0.0088	1.0133	1.0189	0.0056
195680	WHITEFISH	1.0041	1.0125	0.0084	1.0040	1.0125	0.0085	1.0041	1.0115	0.0074	1.0113	1.0201	0.0088	1.0119	1.0175	0.0056
195681	JACOPIE	1.0041	1.0125	0.0084	1.0041	1.0125	0.0085	1.0041	1.0115	0.0074	1.0113	1.0201	0.0088	1.0119	1.0175	0.0056
195682	TWIN TAP	1.0045	1.0129	0.0085	1.0044	1.0129	0.0085	1.0045	1.0119	0.0074	1.0117	1.0206	0.0089	1.0123	1.0179	0.0056
195683	ATIKONAK	0.9881	0.9969	0.0087	0.9881	0.9969	0.0088	0.9881	0.9958	0.0077	0.9956	1.0047	0.0091	0.9962	1.0020	0.0058
195684	LOB LODGE	0.9876	0.9963	0.0087	0.9876	0.9964	0.0088	0.9876	0.9953	0.0077	0.9951	1.0041	0.0091	0.9957	1.0015	0.0058
195685	LOBSTICK	0.9825	0.9913	0.0087	0.9825	0.9913	0.0088	0.9826	0.9902	0.0077	0.9901	0.9992	0.0091	0.9907	0.9965	0.0058
195686	LOB TAP	0.9870	0.9958	0.0087	0.9870	0.9958	0.0088	0.9871	0.9947	0.0077	0.9945	1.0036	0.0091	0.9951	1.0009	0.0058
195687	GABBRO	0.9858	0.9945	0.0087	0.9858	0.9945	0.0088	0.9858	0.9935	0.0077	0.9933	1.0023	0.0091	0.9939	0.9997	0.0058
195688	JWF TAP	1.0048	1.0132	0.0084	1.0048	1.0133	0.0085	1.0048	1.0122	0.0074	1.0120	1.0209	0.0088	1.0126	1.0183	0.0056
195824	STG MID2	1.0067	1.0430	0.0363	1.0117	1.0391	0.0273	1.0161	1.0320	0.0159	1.0249	1.0408	0.0159	1.0270	1.0286	0.0016
195843	GOU MID1	1.0103	1.0403	0.0301	1.0085	1.0464	0.0379	1.0106	1.0258	0.0152	1.0171	1.0302	0.0132	1.0164	1.0118	-0.0046
195844	MOB MID3	1.0036	1.0262	0.0226	1.0050	1.0333	0.0282	1.0094	1.0184	0.0091	1.0144	1.0067	-0.0077	1.0158	1.0079	-0.0078
195845	CHA MID1	1.0142	1.0464	0.0322	1.0105	1.0489	0.0384	1.0114	1.0270	0.0157	1.0203	1.0367	0.0165	1.0175	1.0141	-0.0034
195870	CHF T601	1.0088	1.0170	0.0083	1.0088	1.0171	0.0083	1.0088	1.0160	0.0072	1.0159	1.0246	0.0087	1.0165	1.0220	0.0055
196312	OPD T3Y	0.9954	1.0128	0.0173	1.0134	1.0369	0.0236	1.0155	1.0227	0.0072	1.0171	1.0271	0.0100	1.0177	1.0108	-0.0070
196316	OPD T1Y	0.9954	1.0128	0.0173	1.0134	1.0369	0.0236	1.0155	1.0227	0.0072	1.0171	1.0271	0.0100	1.0177	1.0108	-0.0070
196318	HWD T4Y	1.0014	1.0145	0.0132	1.0169	1.0369	0.0199	1.0185	1.0237	0.0052	1.0190	1.0275	0.0085	1.0200	1.0123	-0.0076
196324	HWD T1Y	1.0014	1.0145	0.0132	1.0169	1.0369	0.0199	1.0185	1.0237	0.0052	1.0190	1.0275	0.0085	1.0200	1.0123	-0.0076
196326	MDR T3Y	0.9913	1.0123	0.0210	0.9976	1.0174	0.0198	1.0012	1.0169	0.0157	1.0000	1.0165	0.0166	1.0036	1.0121	0.0085
196330	MDR T1Y	0.9913	1.0123	0.0210	0.9976	1.0174	0.0198	1.0012	1.0169	0.0157	1.0000	1.0165	0.0166	1.0036	1.0121	0.0085
196334	DLS T1Y	0.9840	0.9933	0.0093	0.9828	0.9916	0.0088	0.9884	0.9928	0.0044	0.9783	0.9847	0.0064	0.9847	0.9854	0.0007
196336	DLK T1Y	1.0064	1.0241	0.0178	0.9993	1.0229	0.0236	1.0045	1.0255	0.0209	0.9992	1.0213	0.0221	1.0046	1.0172	0.0127
196338	BHL T1Y	1.0159	1.0382	0.0223	1.0169	1.0444	0.0275	1.0283	1.0504	0.0222	1.0115	1.0346	0.0231	1.0205	1.0323	0.0118
196340	PBN T1Y	1.0202	1.0460	0.0257	1.0298	1.0604	0.0307	1.0474	1.0702	0.0228	1.0162	1.0398	0.0236	1.0290	1.0398	0.0108
196348	MKS T1Y	1.0147	1.0264	0.0117	1.0084	1.0301	0.0218	1.0099	1.0284	0.0185	1.0206	1.0435	0.0229	1.0158	1.0182	0.0024
196500	DLK NP	1.0402	1.0459	0.0057	1.0376	1.0441	0.0065	1.0401	1.0455	0.0054	1.0428	1.0489	0.0061	1.0449	1.0480	0.0031
196501	STX NP	1.0098	1.0463	0.0365	1.0166	1.0441	0.0275	1.0224	1.0384	0.0160	1.0278	1.0438	0.0160	1.0306	1.0322	0.0016
196502	STG NP	1.0102	1.0466	0.0364	1.0164	1.0439	0.0275	1.0218	1.0379	0.0160	1.0282	1.0442	0.0160	1.0309	1.0324	0.0016
196503	HAR NP	1.0097	1.0462	0.0365	1.0168	1.0443	0.0275	1.0229	1.0390	0.0161	1.0277	1.0436	0.0160	1.0306	1.0322	0.0016
196504	GAL NP	1.0097	1.0463	0.0365	1.0168	1.0444	0.0275	1.0229	1.0390	0.0161	1.0277	1.0437	0.0160	1.0306	1.0322	0.0016
196505	WHE TAP	1.0097	1.0462	0.0365	1.0168	1.0443	0.0275	1.0229	1.0390	0.0161	1.0277	1.0436	0.0160	1.0306	1.0322	0.0016
196506	WHE NP	1.0605	1.0708	0.0103	1.0413	1.0510	0.0096	1.0331	1.0381	0.0050	1.0197	1.0267	0.0070	1.0208	1.0219	0.0011
196507	GBY NP	0.9950	1.0035	0.0085	1.0003	1.0083	0.0080	1.0216	1.0256	0.0040	1.0263	1.0326	0.0063	1.0396	1.0403	0.0006
196508	PAB NP	0.9923	1.0008	0.0085	0.9983	1.0063	0.0080	1.0204	1.0244	0.0040	1.0254	1.0317	0.0063	1.0391	1.0397	0.0006
196509	LGL NP	0.9836	0.9914	0.0078	0.9908	0.9982	0.0074	1.0127	1.0164	0.0037	1.0159	1.0219	0.0060	1.0292	1.0298	0.0006
196517	GFS NPT1	1.0399	1.0768	0.0369	1.0381	1.0779	0.0397	1.0322	1.0649	0.0327	1.0326	1.0701	0.0376	1.0334	1.0462	0.0128
196518	RUS NP	1.0407	1.0775	0.0368	1.0390	1.0786	0.0397	1.0331	1.0658	0.0326	1.0335	1.0710	0.0375	1.0344	1.0471	0.0127
196519	SBK NP	1.0467	1.0831	0.0364	1.0451	1.0843	0.0392	1.0399	1.0719	0.0320	1.0402	1.0769	0.0367	1.0410	1.0533	0.0123
196520	RBK NP	1.0221	1.0574	0.0353	1.0281	1.0675	0.0394	1.0316	1.0615	0.0299	1.0329	1.0672	0.0343	1.0364	1.0436	0.0072
196521	NDJ NP	0.9991	1.0353	0.0362	1.0095	1.0506	0.0411	1.0175	1.0480	0.0305	1.0193	1.0540	0.0347	1.0245	1.0297	0.0052
196522	LEW NP	0.9755	1.0116	0.0360	0.9924	1.0333	0.0409	1.0065	1.0369	0.0304	1.0101	1.0447	0.0346	1.0189	1.0241	0.0052
196523	GAN NPT2	1.0231	1.0610	0.0379	1.0243	1.0679	0.0436	1.0239	1.0555	0.0316	1.0211	1.0567	0.0356	1.0209	1.0238	0.0030
196524	COB NPT2	0.9992	1.0439	0.0448	1.0073	1.0587	0.0514	1.0111	1.0509	0.0398	0.9675	1.0090	0.0415	0.9765	0.9847	0.0082
196525	CLK NP	0.9570	1.0036	0.0466	0.9903	1.0437	0.0534	1.0087	1.0493	0.0406	0.9767	1.0190	0.0423	0.9906	0.9984	0.0078
196526	BOY NP	0.9173	0.9648	0.0475	0.9684	1.0229	0.0545	0.9986	1.0396	0.0410	0.9755	1.0183	0.0428	0.9941	1.0019	0.0077
196527	FHD L54	0.9100	0.9573	0.0473	0.9635	1.0179	0.0543	0.9957	1.0366	0.0409	0.9735	1.0162	0.0427	0.9930	1.0008	0.0077
196528	GAM NPT2	0.9656	1.0144	0.0488	0.9806	1.0345	0.0539	0.9906	1.0336	0.0430	1.0057	1.0525	0.0467	1.0139	1.0223	0.0084
196529	HBS NP	0.9679	1.0168	0.0489	0.9828	1.0370	0.0541	0.9929	1.0360	0.0431	1.0081	1.0549	0.0468	1.0162	1.0246	0.0084
196530	TRN NP	0.9694	1.0185	0.0490	0.9844	1.0387	0.0542	0.9945	1.0376	0.0432	1.0097	1.0566	0.0469	1.0179	1.0262	0.0084
196531	GPD NP	0.9704	1.0196	0.0491	0.9855	1.0398	0.0543	0.9955	1.0387	0.0432	1.0108	1.0577	0.0469	1.0190	1.0273	0.0083
196532	WES NP	0.9706	1.0198	0.0491	0.9856	1.0400	0.0543	0.9957	1.0389	0.0432	1.0110	1.0579	0.0470	1.0191	1.0275	0.0083
196533	CLV NPT1	1.0049	1.0288	0.0239	1.0024	1.0359	0.0334	1.0033	1.0308	0.0275	1.0154	1.0476	0.0321	1.0132	1.0190	0.0059

ML = 300 MW Export

66 kV Bus	Bus Names	Peak Demand, ML= 300 MW			Int_Peak Demand, ML= 300 MW			Intermediate Demand, ML= 300 MW			Light Demand, ML= 300 MW			Extreme Light Demand, ML= 300 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196534	MIL NP	1.0064	1.0304	0.0240	1.0041	1.0376	0.0335	1.0049	1.0325	0.0275	1.0167	1.0488	0.0321	1.0145	1.0203	0.0058
196535	LET NP	1.0087	1.0328	0.0241	1.0065	1.0401	0.0336	1.0073	1.0349	0.0276	1.0184	1.0505	0.0322	1.0163	1.0221	0.0058
196536	SMV NP	1.0101	1.0342	0.0241	1.0080	1.0417	0.0337	1.0088	1.0364	0.0276	1.0192	1.0514	0.0322	1.0173	1.0231	0.0058
196537	LOK NP	1.0103	1.0345	0.0241	1.0083	1.0419	0.0337	1.0090	1.0366	0.0276	1.0193	1.0515	0.0322	1.0174	1.0232	0.0058
196538	PUN NP	1.0100	1.0341	0.0241	1.0079	1.0416	0.0337	1.0086	1.0362	0.0276	1.0190	1.0512	0.0322	1.0171	1.0229	0.0058
196539	CAT NPT1	1.0078	1.0318	0.0240	1.0055	1.0391	0.0336	1.0063	1.0339	0.0276	1.0176	1.0498	0.0322	1.0155	1.0213	0.0058
196540	SPT NP	1.0448	1.0589	0.0141	1.0206	1.0383	0.0177	1.0226	1.0334	0.0108	1.0322	1.0351	0.0029	1.0260	1.0247	-0.0013
196541	LAU NP	1.0413	1.0465	0.0052	1.0250	1.0306	0.0057	1.0314	1.0371	0.0058	1.0315	1.0438	0.0124	1.0280	1.0256	-0.0025
196542	STL WIND	1.0420	1.0450	0.0030	1.0257	1.0291	0.0034	1.0321	1.0365	0.0044	1.0322	1.0451	0.0129	1.0288	1.0256	-0.0031
196543	WEBCV_NP	1.0407	1.0532	0.0125	1.0283	1.0397	0.0114	1.0354	1.0451	0.0097	1.0284	1.0430	0.0145	1.0259	1.0262	0.0003
196544	GRH NP	1.0420	1.0580	0.0161	1.0310	1.0453	0.0143	1.0379	1.0495	0.0116	1.0272	1.0431	0.0159	1.0249	1.0266	0.0017
196545	GAR NP	1.0425	1.0575	0.0151	1.0249	1.0410	0.0161	1.0295	1.0406	0.0111	1.0297	1.0386	0.0089	1.0254	1.0255	0.0001
196546	BLK NPT3	1.0332	1.0506	0.0175	1.0283	1.0603	0.0320	1.0349	1.0588	0.0239	1.0320	1.0627	0.0307	1.0271	1.0324	0.0053
196547	NHR NP	1.0251	1.0398	0.0147	1.0190	1.0492	0.0302	1.0249	1.0472	0.0223	1.0239	1.0529	0.0290	1.0183	1.0224	0.0041
196548	ISL NP	1.0143	1.0257	0.0115	1.0064	1.0345	0.0281	1.0115	1.0318	0.0203	1.0129	1.0397	0.0268	1.0064	1.0090	0.0026
196549	HCT NP	1.0063	1.0155	0.0092	0.9973	1.0237	0.0264	1.0019	1.0206	0.0187	1.0050	1.0301	0.0250	0.9979	0.9993	0.0014
196550	NCH NP	1.0075	1.0167	0.0092	0.9999	1.0264	0.0265	1.0037	1.0224	0.0187	1.0064	1.0314	0.0250	1.0004	1.0018	0.0014
196551	OPL NP	1.0078	1.0170	0.0093	1.0002	1.0267	0.0265	1.0040	1.0227	0.0187	1.0067	1.0317	0.0250	1.0007	1.0021	0.0014
196552	CAR NP	0.9885	0.9928	0.0043	0.9768	0.9994	0.0226	0.9822	0.9972	0.0150	0.9887	1.0099	0.0212	0.9794	0.9781	-0.0013
196553	VIC NP	0.9887	0.9929	0.0043	0.9771	0.9996	0.0226	0.9824	0.9974	0.0150	0.9889	1.0100	0.0212	0.9796	0.9783	-0.0013
196554	HGR NP	0.9868	0.9910	0.0042	0.9747	0.9971	0.0225	0.9800	0.9949	0.0149	0.9869	1.0079	0.0210	0.9773	0.9758	-0.0015
196555	ILC NP	0.9836	0.9871	0.0035	0.9708	0.9928	0.0219	0.9763	0.9906	0.0143	0.9838	1.0042	0.0204	0.9738	0.9719	-0.0019
196556	BRB T2T3	0.9792	0.9824	0.0032	0.9656	0.9871	0.0215	0.9710	0.9849	0.0139	0.9793	0.9991	0.0199	0.9687	0.9665	-0.0022
196557	ULT TAP	1.0318	1.0534	0.0216	1.0234	1.0529	0.0296	1.0211	1.0314	0.0103	1.0300	1.0426	0.0126	1.0256	1.0198	-0.0058
196558	ULT NP	1.0318	1.0535	0.0216	1.0234	1.0529	0.0296	1.0211	1.0314	0.0103	1.0300	1.0426	0.0126	1.0256	1.0198	-0.0058
196559	SCV NP	1.0302	1.0523	0.0221	1.0221	1.0523	0.0302	1.0202	1.0309	0.0107	1.0292	1.0421	0.0129	1.0250	1.0193	-0.0057
196560	KEL NP	1.0188	1.0454	0.0267	1.0138	1.0497	0.0359	1.0142	1.0285	0.0142	1.0234	1.0391	0.0157	1.0206	1.0159	-0.0046
196561	CHA NP	1.0142	1.0465	0.0322	1.0105	1.0489	0.0384	1.0114	1.0271	0.0157	1.0203	1.0367	0.0165	1.0175	1.0142	-0.0033
196562	BCV NP	1.0074	1.0327	0.0253	1.0055	1.0461	0.0406	1.0078	1.0248	0.0170	1.0169	1.0343	0.0174	1.0149	1.0097	-0.0052
196563	GDL NP	1.0107	1.0438	0.0331	1.0087	1.0480	0.0393	1.0106	1.0268	0.0162	1.0181	1.0334	0.0153	1.0162	1.0128	-0.0035
196564	GOU NP	1.0111	1.0413	0.0301	1.0097	1.0476	0.0380	1.0119	1.0272	0.0153	1.0184	1.0315	0.0132	1.0169	1.0124	-0.0045
196565	KEN NP	1.0180	1.0452	0.0272	1.0156	1.0490	0.0334	1.0169	1.0293	0.0124	1.0220	1.0356	0.0135	1.0198	1.0144	-0.0054
196566	MOL NP	1.0143	1.0451	0.0308	1.0126	1.0490	0.0364	1.0146	1.0289	0.0143	1.0204	1.0355	0.0151	1.0186	1.0133	-0.0053
196567	SLA NP	1.0187	1.0472	0.0285	1.0167	1.0514	0.0347	1.0183	1.0314	0.0132	1.0226	1.0367	0.0141	1.0206	1.0152	-0.0054
196568	SJM NP	1.0131	1.0435	0.0305	1.0120	1.0489	0.0369	1.0145	1.0291	0.0146	1.0198	1.0341	0.0143	1.0185	1.0138	-0.0047
196569	MUN NP	1.0160	1.0458	0.0298	1.0149	1.0502	0.0353	1.0173	1.0308	0.0136	1.0215	1.0361	0.0146	1.0201	1.0150	-0.0051
196570	KBR NP	1.0143	1.0459	0.0316	1.0138	1.0499	0.0360	1.0168	1.0308	0.0141	1.0209	1.0360	0.0151	1.0198	1.0150	-0.0048
196571	PEP NP	1.0128	1.0452	0.0324	1.0128	1.0492	0.0365	1.0162	1.0305	0.0143	1.0203	1.0357	0.0154	1.0195	1.0147	-0.0048
196572	RRD NP	1.0197	1.0500	0.0302	1.0179	1.0527	0.0347	1.0196	1.0328	0.0132	1.0233	1.0378	0.0145	1.0214	1.0164	-0.0050
196573	VIR NP	1.0122	1.0468	0.0346	1.0125	1.0503	0.0378	1.0162	1.0313	0.0152	1.0201	1.0364	0.0163	1.0195	1.0147	-0.0047
196574	PUL NP	0.9996	1.0438	0.0442	1.0033	1.0482	0.0449	1.0102	1.0300	0.0198	1.0149	1.0352	0.0203	1.0162	1.0140	-0.0022
196575	BIG NP	1.0080	1.0356	0.0277	1.0082	1.0431	0.0349	1.0114	1.0250	0.0135	1.0175	1.0222	0.0047	1.0172	1.0116	-0.0055
196576	MOB NP	1.0087	1.0304	0.0217	1.0111	1.0384	0.0273	1.0154	1.0247	0.0093	1.0203	1.0119	-0.0085	1.0218	1.0143	-0.0075
196577	TCV NP	1.0091	1.0308	0.0217	1.0116	1.0388	0.0272	1.0159	1.0251	0.0093	1.0208	1.0123	-0.0085	1.0222	1.0147	-0.0075
196578	ROP NP	1.0086	1.0297	0.0211	1.0110	1.0375	0.0265	1.0153	1.0241	0.0089	1.0202	1.0105	-0.0097	1.0217	1.0140	-0.0077
196579	MRP NP	1.0087	1.0299	0.0212	1.0111	1.0377	0.0266	1.0153	1.0242	0.0089	1.0202	1.0106	-0.0096	1.0217	1.0140	-0.0076
196580	HCP TAP NP	1.0080	1.0254	0.0175	1.0107	1.0325	0.0218	1.0152	1.0213	0.0061	1.0202	1.0048	-0.0154	1.0222	1.0132	-0.0090
196581	HCP NP	1.0082	1.0258	0.0176	1.0108	1.0327	0.0219	1.0150	1.0213	0.0063	1.0201	1.0047	-0.0153	1.0220	1.0130	-0.0090
196582	CAB NP	1.0077	1.0232	0.0155	1.0108	1.0300	0.0192	1.0156	1.0202	0.0046	1.0207	1.0032	-0.0175	1.0229	1.0133	-0.0096
196583	FER NP	1.0101	1.0124	0.0023	1.0142	1.0180	0.0038	1.0199	1.0180	-0.0019	1.0253	1.0209	-0.0045	1.0281	1.0180	-0.0101
196584	FER WIND	1.0104	1.0120	0.0016	1.0145	1.0175	0.0030	1.0202	1.0180	-0.0023	1.0256	1.0219	-0.0037	1.0283	1.0182	-0.0101
196585	SUM NP	0.9173	0.9648	0.0475	0.9684	1.0229	0.0545	0.9986	1.0396	0.0410	0.9755	1.0183	0.0428	0.9941	1.0019	0.0077
196586	TWG NP	0.9072	0.9553	0.0481	0.9645	1.0196	0.0551	0.9969	1.0381	0.0412	0.9785	1.0215	0.0430	0.9966	1.0043	0.0077
196587	HRD OUTS	1.0325	1.0539	0.0214	1.0238	1.0531	0.0293	1.0214	1.0315	0.0101	1.0302	1.0428	0.0125	1.0258	1.0200	-0.0058

ML = 158 MW Export

66 kV Bus	Bus Names	Peak Demand, ML= 158 MW			Int_Peak Demand, ML= 158 MW			Intermediate Demand, ML= 158 MW			Light Demand, ML= 158 MW			Extreme Light Demand, ML= 158 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0323	1.0396	0.0073	1.0379	1.0420	0.0041	1.0405	1.0434	0.0030	1.0437	1.0471	0.0034	1.0444	1.0451	0.0007
195601	WDL TAP	1.0264	1.0408	0.0144	1.0351	1.0441	0.0090	1.0404	1.0463	0.0060	1.0451	1.0506	0.0055	1.0471	1.0476	0.0006
195602	WDL B1	1.0263	1.0407	0.0144	1.0350	1.0440	0.0090	1.0404	1.0464	0.0060	1.0451	1.0506	0.0055	1.0471	1.0477	0.0006
195603	GLB L29	1.0232	1.0376	0.0144	1.0331	1.0420	0.0090	1.0395	1.0455	0.0059	1.0448	1.0503	0.0055	1.0473	1.0479	0.0005
195604	RHR TAP	1.0187	1.0424	0.0237	1.0300	1.0456	0.0156	1.0378	1.0479	0.0101	1.0437	1.0521	0.0084	1.0468	1.0474	0.0005
195605	RHR B1	1.0180	1.0424	0.0244	1.0295	1.0456	0.0161	1.0375	1.0479	0.0105	1.0435	1.0522	0.0087	1.0467	1.0472	0.0005
195606	BHL T1	0.9911	1.0199	0.0288	1.0010	1.0167	0.0157	1.0006	1.0113	0.0107	0.9984	1.0107	0.0122	1.0016	1.0037	0.0021
195607	SCV L27	0.9902	1.0209	0.0306	1.0006	1.0176	0.0170	1.0007	1.0122	0.0115	0.9987	1.0116	0.0128	1.0021	1.0042	0.0021
195608	CHD B1	0.9881	1.0214	0.0333	0.9992	1.0181	0.0189	1.0000	1.0127	0.0127	0.9984	1.0121	0.0137	1.0021	1.0042	0.0021
195609	PPD L27	1.0434	1.0805	0.0371	1.0507	1.0697	0.0190	1.0458	1.0575	0.0118	1.0438	1.0574	0.0136	1.0391	1.0399	0.0008
195610	DHR B1B2	1.0449	1.0799	0.0350	1.0515	1.0691	0.0176	1.0461	1.0569	0.0108	1.0438	1.0568	0.0130	1.0389	1.0397	0.0008
195611	PBN B2	1.0452	1.0799	0.0347	1.0517	1.0691	0.0174	1.0461	1.0568	0.0107	1.0438	1.0567	0.0129	1.0388	1.0396	0.0008
195612	HBY B1	1.0291	1.0639	0.0348	1.0409	1.0583	0.0174	1.0401	1.0508	0.0107	1.0402	1.0531	0.0129	1.0376	1.0383	0.0007
195620	DLP B1B4	1.0372	1.0432	0.0060	1.0413	1.0449	0.0037	1.0434	1.0462	0.0028	1.0461	1.0492	0.0031	1.0466	1.0478	0.0012
195621	PAS B1	1.0237	1.0317	0.0080	1.0286	1.0337	0.0051	1.0320	1.0360	0.0040	1.0362	1.0408	0.0045	1.0373	1.0395	0.0022
195622	MMT NP	1.0216	1.0311	0.0095	1.0254	1.0315	0.0061	1.0279	1.0327	0.0049	1.0325	1.0380	0.0055	1.0331	1.0359	0.0027
195624	MDR B2B3	1.0207	1.0499	0.0292	1.0323	1.0497	0.0174	1.0267	1.0384	0.0116	1.0396	1.0514	0.0118	1.0292	1.0331	0.0039
195625	MDR B4	1.0220	1.0321	0.0101	1.0251	1.0316	0.0065	1.0270	1.0321	0.0051	1.0316	1.0374	0.0058	1.0319	1.0349	0.0029
195626	CBPP B	1.0136	1.0218	0.0083	1.0157	1.0214	0.0057	1.0170	1.0218	0.0048	1.0202	1.0254	0.0053	1.0203	1.0236	0.0033
195627	CBPP D	1.0136	1.0219	0.0083	1.0157	1.0215	0.0058	1.0170	1.0219	0.0048	1.0202	1.0256	0.0054	1.0204	1.0237	0.0033
195628	CBPP E	1.0137	1.0220	0.0083	1.0159	1.0215	0.0057	1.0171	1.0219	0.0048	1.0203	1.0256	0.0053	1.0205	1.0238	0.0032
195629	CBP&P A	1.0057	1.0058	0.0001	1.0057	1.0056	0.0000	1.0057	1.0057	0.0000	1.0057	1.0059	0.0003	1.0057	1.0057	0.0001
195630	DLP 50HZ	1.0386	1.0387	0.0001	1.0386	1.0385	-0.0001	1.0386	1.0385	0.0000	1.0386	1.0386	0.0001	1.0386	1.0386	0.0000
195631	BRKFIELD	1.0072	1.0073	0.0001	1.0072	1.0072	0.0000	1.0072	1.0072	0.0000	1.0072	1.0074	0.0002	1.0072	1.0073	0.0001
195632	CBP&P C	1.0057	1.0058	0.0001	1.0057	1.0057	0.0000	1.0057	1.0057	0.0000	1.0057	1.0059	0.0003	1.0057	1.0057	0.0001
195633	WATSONS	1.0060	1.0061	0.0001	1.0060	1.0059	0.0000	1.0060	1.0060	0.0000	1.0060	1.0062	0.0002	1.0060	1.0060	0.0000
195635	SVL B2	1.0097	1.0443	0.0346	1.0167	1.0375	0.0207	1.0228	1.0344	0.0116	1.0276	1.0393	0.0117	1.0306	1.0289	-0.0016
195636	BBK T2	1.0601	1.0685	0.0084	1.0409	1.0435	0.0026	1.0327	1.0332	0.0005	1.0193	1.0221	0.0028	1.0204	1.0184	-0.0020
195637	DLS B1	1.0479	1.0555	0.0076	1.0389	1.0413	0.0024	1.0481	1.0484	0.0003	1.0491	1.0518	0.0027	1.0570	1.0549	-0.0021
195639	BUC B2	1.0308	1.0542	0.0234	1.0404	1.0515	0.0111	1.0303	1.0384	0.0081	1.0270	1.0376	0.0105	1.0355	1.0347	-0.0008
195640	DPD L64	1.0325	1.0560	0.0235	1.0421	1.0532	0.0111	1.0320	1.0401	0.0081	1.0288	1.0393	0.0105	1.0372	1.0364	-0.0008
195641	SLK L80	1.0456	1.0703	0.0247	1.0497	1.0626	0.0129	1.0454	1.0543	0.0088	1.0441	1.0565	0.0124	1.0476	1.0471	-0.0005
195643	ACG GFL	1.0023	1.0063	0.0041	1.0047	1.0068	0.0020	1.0045	1.0060	0.0015	1.0034	1.0059	0.0024	1.0061	1.0060	-0.0001
195644	ACG BFL	1.0143	1.0172	0.0029	1.0160	1.0174	0.0014	1.0158	1.0169	0.0010	1.0151	1.0169	0.0017	1.0170	1.0169	-0.0001
195650	WAV B2	1.0403	1.0773	0.0369	1.0470	1.0621	0.0151	1.0388	1.0466	0.0078	1.0439	1.0552	0.0113	1.0425	1.0383	-0.0041
195652	HRD B6B7	1.0192	1.0638	0.0445	1.0256	1.0463	0.0208	1.0270	1.0324	0.0054	1.0283	1.0357	0.0074	1.0252	1.0183	-0.0069
195654	OPD B2B5	1.0218	1.0719	0.0500	1.0237	1.0473	0.0235	1.0245	1.0314	0.0069	1.0262	1.0349	0.0087	1.0236	1.0169	-0.0068
195655	HWD B7B8	1.0126	1.0602	0.0475	1.0172	1.0412	0.0240	1.0153	1.0226	0.0073	1.0188	1.0275	0.0087	1.0164	1.0105	-0.0058
195675	CHF T601	1.0088	1.0171	0.0083	1.0088	1.0165	0.0077	1.0088	1.0144	0.0056	1.0165	1.0224	0.0059	1.0166	1.0199	0.0033
195676	CHF T602	1.0088	1.0171	0.0083	1.0088	1.0165	0.0077	1.0088	1.0144	0.0056	1.0165	1.0224	0.0059	1.0166	1.0199	0.0033
195677	CHF AIRPORT	1.0073	1.0157	0.0084	1.0073	1.0151	0.0078	1.0073	1.0130	0.0056	1.0151	1.0210	0.0059	1.0152	1.0185	0.0033
195678	BRDG CAMP	1.0050	1.0135	0.0085	1.0050	1.0129	0.0079	1.0050	1.0107	0.0057	1.0128	1.0188	0.0060	1.0128	1.0162	0.0034
195679	LOGANTWR	1.0055	1.0140	0.0085	1.0055	1.0134	0.0079	1.0055	1.0112	0.0057	1.0133	1.0193	0.0060	1.0134	1.0167	0.0034
195680	WHITEFISH	1.0041	1.0126	0.0085	1.0041	1.0119	0.0079	1.0040	1.0098	0.0057	1.0119	1.0179	0.0060	1.0119	1.0153	0.0034
195681	JACOPIE	1.0041	1.0126	0.0085	1.0041	1.0120	0.0079	1.0041	1.0098	0.0057	1.0119	1.0179	0.0060	1.0119	1.0153	0.0034
195682	TWIN TAP	1.0045	1.0130	0.0085	1.0045	1.0124	0.0079	1.0044	1.0102	0.0057	1.0123	1.0183	0.0060	1.0123	1.0157	0.0034
195683	ATIKONAK	0.9881	0.9969	0.0088	0.9881	0.9963	0.0082	0.9881	0.9941	0.0059	0.9962	1.0024	0.0062	0.9963	0.9997	0.0035
195684	LOB LODGE	0.9876	0.9964	0.0088	0.9876	0.9958	0.0082	0.9876	0.9935	0.0059	0.9956	1.0018	0.0062	0.9957	0.9992	0.0035
195685	LOBSTICK	0.9825	0.9914	0.0088	0.9826	0.9907	0.0082	0.9825	0.9885	0.0059	0.9906	0.9968	0.0062	0.9907	0.9942	0.0035
195686	LOB TAP	0.9870	0.9959	0.0088	0.9870	0.9952	0.0082	0.9870	0.9930	0.0059	0.9951	1.0013	0.0062	0.9952	0.9987	0.0035
195687	GABBRO	0.9858	0.9946	0.0088	0.9858	0.9940	0.0082	0.9858	0.9917	0.0059	0.9938	1.0000	0.0062	0.9939	0.9974	0.0035
195688	JWF TAP	1.0048	1.0133	0.0085	1.0048	1.0127	0.0079	1.0048	1.0105	0.0057	1.0126	1.0186	0.0060	1.0127	1.0160	0.0034
195824	STG MID2	1.0067	1.0411	0.0344	1.0117	1.0323	0.0206	1.0161	1.0276	0.0115	1.0249	1.0365	0.0116	1.0270	1.0254	-0.0016
195843	GOU MID1	1.0029	1.0585	0.0556	1.0097	1.0388	0.0291	1.0117	1.0223	0.0106	1.0151	1.0271	0.0120	1.0148	1.0094	-0.0054
195844	MOB MID3	1.0012	1.0419	0.0407	1.0059	1.0253	0.0194	1.0102	1.0147	0.0044	1.0128	1.0194	0.0066	1.0150	1.0062	-0.0088
195845	CHA MID1	1.0044	1.0601	0.0557	1.0118	1.0417	0.0298	1.0130	1.0241	0.0111	1.0166	1.0287	0.0121	1.0156	1.0116	-0.0040
195870	CHF T601	1.0088	1.0171	0.0083	1.0088	1.0165	0.0077	1.0088	1.0144	0.0056	1.0165	1.0224	0.0059	1.0166	1.0199	0.0033
196312	OPD T3Y	0.9943	1.0322	0.0379	1.0147	1.0305	0.0158	1.0108	1.0136	0.0028	1.0125	1.0168	0.0043	1.0197	1.0115	-0.0082
196316	OPD T1Y	0.9943	1.0322	0.0379	1.0147	1.0305	0.0158	1.0108	1.0136	0.0028	1.0125	1.0168	0.0043	1.0197	1.0115	-0.0082
196318	HWD T4Y	1.0012	1.0341	0.0329	1.0185	1.0308	0.0123	1.0156	1.0163	0.0007	1.0168	1.0194	0.0025	1.0229	1.0141	-0.0088
196324	HWD T1Y	1.0012	1.0341	0.0329	1.0185	1.0308	0.0123	1.0156	1.0163	0.0007	1.0168	1.0194	0.0025	1.0229	1.0141	-0.0088
196326	MDR T3Y	0.9936	1.0134	0.0198	1.0014	1.0124	0.0110	1.0061	1.0138	0.0077	1.0047	1.0131	0.0084	1.0061	1.0080	0.0020
196330	MDR T1Y	0.9936	1.0134	0.0198	1.0014	1.0124	0.0110	1.0061	1.0138	0.0077	1.0047	1.0131	0.0084	1.0061	1.0080	0.0020
196334	DLS T1Y	0.9840	0.9916	0.0076	0.9828	0.9851	0.0023	0.9884	0.9887	0.0003	0.9783	0.9808	0.0025	0.9847	0.9826	-0.0021
196336	DLK T1Y	0.9904	1.0129	0.0225	1.0050	1.0182	0.0132	1.0107	1.0209	0.0102	1.0071	1.0184	0.0113	1.0066	1.0100	0.0034
196338	BHL T1Y	1.0007	1.0281	0.0274	1.0226	1.0376	0.0150	1.0343	1.0448	0.0105	1.0195	1.0315	0.0120	1.0225	1.0248	0.0023
196340	PBN T1Y	1.0064	1.0376	0.0312	1.0353	1.0513	0.0160	1.0532	1.0635	0.0103	1.0241	1.0364	0.0122	1.0311	1.0321	0.0010
196348	MKS T1Y	0.9989	1.0357	0.0368	1.0131	1.0277	0.0146	1.0086	1.0159	0.0072	1.0112	1.0196	0.0084	1.0134	1.0084	-0.0050
196500	DLK NP	1.0338	1.0405	0.0067	1.0388	1.0427	0.0039	1.0414	1.0443	0.0029	1.0445	1.0478	0.0032	1.0453	1.0462	0.0009
196501	STX NP	1.0098	1.0444	0.0346	1.0166	1.0373	0.0207	1.0224	1.0340	0.0116	1.0278	1.0395	0.0117	1.0306	1.0290	-0.0016
196502	STG NP	1.0102	1.0447	0.0345	1.0164	1.0371	0.0207	1.0218	1.0334	0.0115	1.0282	1.0399	0.0116	1.0309	1.0292	-0.0016
196503	HAR NP	1.0097	1.0443	0.0346	1.0168	1.0375	0.0207	1.0229	1.0345	0.0116	1.0277	1.0393	0.0117	1.0306	1.0290	-0.0016
196504	GAL NP	1.0097	1.0444	0.0346	1.0168	1.0375	0.0207	1.0229	1.0345	0.0116	1.0277	1.0393	0.0117	1.0306	1.0290	-0.0016
196505	WHE TAP	1.0097	1.0443	0.0346	1.0168	1.0375	0.0207	1.0229	1.0345	0.0116	1.0277	1.0393	0.0117	1.0306	1.0290	-0.0016
196506	WHE NP	1.0605	1.0690	0.0084	1.0413	1.0439	0.0026	1.0331	1.0336	0.0005	1.0197	1.0225	0.0028	1.0208	1.0188	-0.0020
196507	GBY NP	0.9950	1.0019	0.0069	1.0003	1.0024	0.0022	1.0216	1.0219	0.0003	1.0263	1.0288	0.0025	1.0396	1.0377	-0.0020
196508	PAB NP	0.9923	0.9993	0.0069	0.9983	1.0004	0.0022	1.0204	1.0206	0.0003	1.0254	1.0278	0.0025	1.0391	1.0371	-0.0020
196509	LGL NP	0.9836	0.9899	0.0064	0.9908	0.9928	0.0020	1.0127	1.0130	0.0003	1.0159	1.0182	0.0024	1.0292	1.0275	-0.0018
196517	GFS NPT1	1.0346	1.0806	0.0460	1.0423	1.0689	0.0266	1.0332	1.0511	0.0180	1.0390	1.0597	0.0207	1.0388	1.0391	0.0004
196518	RUS NP	1.0355	1.0815	0.0459	1.0431	1.0696	0.0265	1.0341	1.0520	0.0179	1.0398	1.0605	0.0206	1.0396	1.0399	0.0003
196519	SBK NP	1.0420	1.0874	0.0454	1.0488	1.0748	0.0260	1.0407	1.0582	0.0174	1.0459	1.0661	0.0202	1.0457	1.0458	0.0001
196520	RBK NP	1.0194	1.0672	0.0478	1.0298	1.0568	0.0270	1.0314	1.0483	0.0169	1.0362	1.0557	0.0195	1.0391	1.0381	-0.0011
196521	NDJ NP	0.9969	1.0480	0.0511	1.0105	1.0396	0.0291	1.0166	1.0345	0.0179	1.0220	1.0422	0.0201	1.0267	1.0254	-0.0013
196522	LEW NP	0.9733	1.0241	0.0508	0.9934	1.0224	0.0290	1.0056	1.0234	0.0179	1.0129	1.0329	0.0201	1.0211	1.0198	-0.0014
196523	GAN NPT2	1.0217	1.0775	0.0557	1.0244	1.0564	0.0321	1.0222	1.0416	0.0194	1.0232	1.0443	0.0212	1.0226	1.0210	-0.0015
196524	COB NPT2	0.9834	1.0453	0.0619	1.0154	1.0541	0.0386	1.0118	1.0365	0.0247	0.9729	0.9976	0.0247	0.9817	0.9828	0.0011
196525	CLK NP	0.9380	1.0025	0.0645	0.9995	1.0390	0.0395	1.0095	1.0344	0.0249	0.9819	1.0069	0.0250	0.9962	0.9964	0.0002
196526	BOY NP	0.8964	0.9621	0.0657	0.9784	1.0182	0.0398	0.9996	1.0245	0.0250	0.9806	1.0058	0.0252	1.0002	0.9998	-0.0004
196527	FHD L54	0.8888	0.9543	0.0655	0.9735	1.0133	0.0398	0.9966	1.0216	0.0249	0.9786	1.0038	0.0252	0.9991	0.9987	-0.0004
196528	GAM NPT2	0.9530	1.0219	0.0690	0.9882	1.0300	0.0418	0.9924	1.0196	0.0272	1.0087	1.0366	0.0278	1.0180	1.0217	0.0037
196529	HBS NP	0.9552	1.0244	0.0692	0.9905	1.0324	0.0418	0.9947	1.0219	0.0272	1.0111	1.0390	0.0279	1.0203	1.0240	0.0036
196530	TRN NP	0.9567	1.0261	0.0694	0.9921	1.0340	0.0419	0.9963	1.0236	0.0272	1.0127	1.0406	0.0279	1.0220	1.0256	0.0036
196531	GPD NP	0.9577	1.0272	0.0695	0.9932	1.0351	0.0419	0.9974	1.0246	0.0273	1.0138	1.0417	0.0279	1.0231	1.0266	0.0036
196532	WES NP	0.9579	1.0274	0.0695	0.9933	1.0353	0.0419	0.9975	1.0248	0.0273	1.0140	1.0419	0.0279	1.0233	1.0268	0.0036
196533	CLV NPT1	0.9947	1.0448	0.0501	1.0074	1.0306	0.0232	1.0033	1.0170	0.0137	1.0100	1.0248	0.0148	1.0125	1.0105	-0.0020

ML = 158 MW Export

66 kV Bus	Bus Names	Peak Demand, ML= 158 MW			Int_Peak Demand, ML= 158 MW			Intermediate Demand, ML= 158 MW			Light Demand, ML= 158 MW			Extreme Light Demand, ML= 158 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196534	MIL NP	0.9966	1.0468	0.0502	1.0089	1.0321	0.0232	1.0049	1.0185	0.0137	1.0114	1.0262	0.0148	1.0138	1.0118	-0.0020
196535	LET NP	0.9994	1.0498	0.0504	1.0110	1.0342	0.0232	1.0073	1.0209	0.0136	1.0134	1.0282	0.0148	1.0156	1.0136	-0.0020
196536	SMV NP	1.0014	1.0518	0.0505	1.0123	1.0355	0.0232	1.0087	1.0224	0.0136	1.0145	1.0293	0.0148	1.0167	1.0146	-0.0021
196537	LOK NP	1.0017	1.0522	0.0505	1.0125	1.0357	0.0232	1.0090	1.0226	0.0136	1.0147	1.0295	0.0148	1.0168	1.0147	-0.0021
196538	PUN NP	1.0013	1.0518	0.0505	1.0121	1.0353	0.0232	1.0086	1.0222	0.0136	1.0143	1.0292	0.0148	1.0165	1.0144	-0.0021
196539	CAT NPT1	0.9983	1.0486	0.0503	1.0101	1.0333	0.0232	1.0063	1.0199	0.0136	1.0125	1.0273	0.0148	1.0148	1.0128	-0.0020
196540	SPT NP	1.0254	1.0546	0.0292	1.0240	1.0346	0.0106	1.0216	1.0251	0.0035	1.0224	1.0189	-0.0035	1.0170	1.0102	-0.0068
196541	LAU NP	1.0244	1.0392	0.0148	1.0279	1.0353	0.0073	1.0305	1.0328	0.0024	1.0216	1.0275	0.0060	1.0190	1.0127	-0.0064
196542	STL WIND	1.0251	1.0371	0.0120	1.0287	1.0345	0.0058	1.0312	1.0327	0.0015	1.0223	1.0289	0.0065	1.0198	1.0130	-0.0068
196543	WEBCV_NP	1.0261	1.0479	0.0218	1.0309	1.0435	0.0127	1.0346	1.0406	0.0060	1.0185	1.0263	0.0078	1.0169	1.0127	-0.0042
196544	GRH NP	1.0285	1.0537	0.0252	1.0333	1.0487	0.0153	1.0372	1.0450	0.0078	1.0173	1.0262	0.0089	1.0159	1.0128	-0.0030
196545	GAR NP	1.0259	1.0532	0.0273	1.0278	1.0406	0.0128	1.0286	1.0341	0.0055	1.0198	1.0221	0.0023	1.0165	1.0114	-0.0051
196546	BLK NPT3	1.0220	1.0715	0.0495	1.0359	1.0596	0.0237	1.0271	1.0400	0.0129	1.0312	1.0468	0.0155	1.0280	1.0259	-0.0021
196547	NHR NP	1.0150	1.0621	0.0470	1.0280	1.0500	0.0220	1.0178	1.0295	0.0117	1.0227	1.0370	0.0143	1.0203	1.0174	-0.0029
196548	ISL NP	1.0056	1.0497	0.0441	1.0172	1.0372	0.0200	1.0053	1.0155	0.0101	1.0112	1.0239	0.0127	1.0099	1.0059	-0.0040
196549	HCT NP	0.9985	1.0405	0.0420	1.0093	1.0278	0.0185	0.9963	1.0052	0.0089	1.0028	1.0143	0.0115	1.0024	0.9975	-0.0048
196550	NCH NP	1.0009	1.0430	0.0421	1.0102	1.0286	0.0185	0.9991	1.0080	0.0089	1.0045	1.0160	0.0115	1.0041	0.9992	-0.0049
196551	OPL NP	1.0012	1.0433	0.0421	1.0105	1.0289	0.0185	0.9994	1.0083	0.0089	1.0048	1.0162	0.0115	1.0044	0.9995	-0.0049
196552	CAR NP	0.9810	1.0186	0.0375	0.9925	1.0075	0.0150	0.9763	0.9823	0.0061	0.9852	0.9939	0.0087	0.9859	0.9792	-0.0067
196553	VIC NP	0.9812	1.0187	0.0375	0.9926	1.0076	0.0150	0.9765	0.9825	0.0061	0.9854	0.9941	0.0087	0.9861	0.9793	-0.0067
196554	HGR NP	0.9793	1.0167	0.0373	0.9908	1.0057	0.0149	0.9741	0.9800	0.0060	0.9833	0.9919	0.0086	0.9841	0.9773	-0.0068
196555	ILC NP	0.9761	1.0128	0.0367	0.9877	1.0021	0.0144	0.9703	0.9758	0.0056	0.9799	0.9881	0.0082	0.9810	0.9739	-0.0071
196556	BRB T2T3	0.9718	1.0080	0.0362	0.9834	0.9975	0.0141	0.9650	0.9702	0.0053	0.9752	0.9830	0.0078	0.9765	0.9692	-0.0073
196557	ULT TAP	1.0178	1.0631	0.0453	1.0243	1.0457	0.0214	1.0260	1.0318	0.0058	1.0275	1.0352	0.0077	1.0246	1.0179	-0.0067
196558	ULT NP	1.0178	1.0631	0.0453	1.0243	1.0457	0.0214	1.0260	1.0318	0.0058	1.0275	1.0352	0.0077	1.0246	1.0179	-0.0067
196559	SCV NP	1.0163	1.0624	0.0461	1.0231	1.0451	0.0220	1.0250	1.0312	0.0062	1.0266	1.0347	0.0080	1.0240	1.0174	-0.0066
196560	KEL NP	1.0067	1.0599	0.0532	1.0149	1.0425	0.0276	1.0176	1.0273	0.0097	1.0204	1.0314	0.0110	1.0192	1.0137	-0.0055
196561	CHA NP	1.0044	1.0602	0.0558	1.0118	1.0417	0.0299	1.0130	1.0241	0.0111	1.0167	1.0288	0.0121	1.0156	1.0116	-0.0040
196562	BCV NP	0.9985	1.0569	0.0584	1.0069	1.0389	0.0320	1.0087	1.0211	0.0124	1.0130	1.0262	0.0132	1.0128	1.0070	-0.0058
196563	GDL NP	1.0029	1.0602	0.0573	1.0101	1.0407	0.0306	1.0117	1.0232	0.0115	1.0152	1.0279	0.0128	1.0147	1.0105	-0.0042
196564	GOU NP	1.0043	1.0601	0.0559	1.0110	1.0403	0.0293	1.0131	1.0237	0.0107	1.0162	1.0282	0.0120	1.0158	1.0104	-0.0054
196565	KEN NP	1.0125	1.0633	0.0508	1.0170	1.0419	0.0249	1.0185	1.0263	0.0078	1.0210	1.0305	0.0094	1.0196	1.0132	-0.0063
196566	MOL NP	1.0083	1.0629	0.0546	1.0140	1.0418	0.0279	1.0161	1.0258	0.0097	1.0190	1.0301	0.0111	1.0180	1.0119	-0.0062
196567	SLA NP	1.0140	1.0671	0.0531	1.0181	1.0442	0.0261	1.0200	1.0286	0.0086	1.0222	1.0325	0.0102	1.0207	1.0144	-0.0063
196568	SJM NP	1.0075	1.0630	0.0554	1.0134	1.0416	0.0282	1.0161	1.0260	0.0100	1.0188	1.0302	0.0115	1.0181	1.0125	-0.0056
196569	MUN NP	1.0115	1.0655	0.0540	1.0163	1.0430	0.0267	1.0190	1.0280	0.0090	1.0214	1.0320	0.0106	1.0204	1.0143	-0.0061
196570	KBR NP	1.0101	1.0653	0.0552	1.0152	1.0427	0.0275	1.0186	1.0281	0.0095	1.0210	1.0320	0.0110	1.0203	1.0145	-0.0058
196571	PEP NP	1.0086	1.0645	0.0559	1.0141	1.0421	0.0279	1.0180	1.0277	0.0098	1.0204	1.0317	0.0113	1.0199	1.0141	-0.0058
196572	RRD NP	1.0157	1.0693	0.0536	1.0193	1.0455	0.0262	1.0215	1.0301	0.0086	1.0236	1.0338	0.0102	1.0220	1.0160	-0.0060
196573	VIR NP	1.0082	1.0661	0.0579	1.0139	1.0432	0.0293	1.0180	1.0286	0.0106	1.0204	1.0325	0.0121	1.0200	1.0143	-0.0058
196574	PUL NP	0.9955	1.0631	0.0676	1.0046	1.0410	0.0364	1.0121	1.0273	0.0152	1.0152	1.0312	0.0161	1.0168	1.0135	-0.0033
196575	BIG NP	1.0019	1.0532	0.0513	1.0094	1.0356	0.0262	1.0125	1.0214	0.0089	1.0155	1.0260	0.0105	1.0161	1.0097	-0.0064
196576	MOB NP	1.0044	1.0450	0.0406	1.0120	1.0312	0.0192	1.0163	1.0211	0.0048	1.0188	1.0255	0.0067	1.0209	1.0125	-0.0084
196577	TCV NP	1.0049	1.0454	0.0405	1.0124	1.0316	0.0192	1.0167	1.0215	0.0048	1.0192	1.0259	0.0067	1.0214	1.0130	-0.0084
196578	ROP NP	1.0045	1.0441	0.0396	1.0118	1.0304	0.0186	1.0161	1.0205	0.0044	1.0186	1.0249	0.0063	1.0208	1.0122	-0.0086
196579	MRP NP	1.0046	1.0443	0.0396	1.0119	1.0305	0.0186	1.0162	1.0206	0.0045	1.0186	1.0249	0.0063	1.0208	1.0123	-0.0086
196580	HCP TAP NP	1.0043	1.0381	0.0337	1.0115	1.0261	0.0146	1.0160	1.0180	0.0020	1.0186	1.0221	0.0035	1.0213	1.0114	-0.0099
196581	HCP NP	1.0048	1.0386	0.0337	1.0115	1.0263	0.0148	1.0159	1.0180	0.0021	1.0185	1.0221	0.0036	1.0212	1.0113	-0.0099
196582	CAB NP	1.0041	1.0349	0.0308	1.0115	1.0241	0.0125	1.0165	1.0172	0.0008	1.0191	1.0213	0.0021	1.0221	1.0117	-0.0104
196583	FER NP	1.0065	1.0206	0.0141	1.0149	1.0187	0.0037	1.0208	1.0175	-0.0033	1.0238	1.0194	-0.0044	1.0272	1.0169	-0.0104
196584	FER WIND	1.0068	1.0200	0.0132	1.0152	1.0185	0.0033	1.0211	1.0175	-0.0036	1.0240	1.0193	-0.0047	1.0275	1.0172	-0.0104
196585	SUM NP	0.8964	0.9621	0.0657	0.9784	1.0182	0.0398	0.9996	1.0245	0.0250	0.9806	1.0058	0.0252	1.0002	0.9998	-0.0004
196586	TWG NP	0.8855	0.9521	0.0666	0.9747	1.0147	0.0401	0.9979	1.0230	0.0250	0.9834	1.0087	0.0253	1.0029	1.0022	-0.0007
196587	HRD OUTS	1.0183	1.0633	0.0450	1.0248	1.0459	0.0212	1.0264	1.0320	0.0056	1.0278	1.0354	0.0076	1.0248	1.0180	-0.0068

ML = 0 MW

66 kV Bus	Bus Names	Peak Demand, ML=0 MW			Int_Peak Demand, ML=0 MW			Intermediate Demand, ML=0 MW			Light Demand, ML=0 MW			Extreme Light Demand, ML=0 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0334	1.0366	0.0033	1.0382	1.0408	0.0027	1.0412	1.0423	0.0011	1.0441	1.0440	-0.0001	1.0463	1.0448	-0.0016
195601	WDL TAP	1.0276	1.0376	0.0100	1.0353	1.0428	0.0074	1.0411	1.0452	0.0040	1.0454	1.0453	-0.0002	1.0490	1.0473	-0.0017
195602	WDL B1	1.0274	1.0374	0.0100	1.0353	1.0427	0.0074	1.0412	1.0452	0.0040	1.0455	1.0453	-0.0002	1.0490	1.0473	-0.0017
195603	GLB L29	1.0243	1.0343	0.0100	1.0333	1.0407	0.0074	1.0403	1.0443	0.0040	1.0452	1.0450	-0.0002	1.0493	1.0475	-0.0017
195604	RHR TAP	1.0198	1.0391	0.0193	1.0303	1.0443	0.0140	1.0385	1.0467	0.0082	1.0441	1.0438	-0.0002	1.0487	1.0470	-0.0017
195605	RHR B1	1.0191	1.0391	0.0200	1.0298	1.0443	0.0145	1.0382	1.0467	0.0085	1.0439	1.0436	-0.0002	1.0486	1.0469	-0.0017
195606	BHL T1	0.9970	1.0101	0.0130	1.0052	1.0151	0.0099	1.0047	1.0088	0.0041	1.0013	1.0011	-0.0003	0.9982	0.9930	-0.0052
195607	SCV L27	0.9962	1.0110	0.0147	1.0049	1.0160	0.0111	1.0048	1.0097	0.0049	1.0017	1.0014	-0.0003	0.9987	0.9935	-0.0052
195608	CHD B1	0.9941	1.0115	0.0173	1.0035	1.0165	0.0130	1.0041	1.0102	0.0061	1.0013	1.0010	-0.0003	0.9987	0.9935	-0.0053
195609	PPD L27	1.0498	1.0665	0.0167	1.0551	1.0667	0.0116	1.0499	1.0541	0.0042	1.0469	1.0451	-0.0018	1.0484	1.0414	-0.0070
195610	DHR B1B2	1.0512	1.0659	0.0147	1.0559	1.0660	0.0101	1.0502	1.0535	0.0033	1.0470	1.0451	-0.0018	1.0482	1.0412	-0.0070
195611	PBN B2	1.0516	1.0660	0.0144	1.0561	1.0660	0.0099	1.0502	1.0534	0.0032	1.0469	1.0451	-0.0018	1.0481	1.0411	-0.0070
195612	HBY B1	1.0356	1.0500	0.0144	1.0453	1.0553	0.0099	1.0442	1.0474	0.0031	1.0434	1.0415	-0.0019	1.0469	1.0398	-0.0071
195620	DLP B1B4	1.0383	1.0411	0.0029	1.0419	1.0444	0.0024	1.0441	1.0453	0.0012	1.0466	1.0471	0.0005	1.0482	1.0471	-0.0011
195621	PAS B1	1.0252	1.0291	0.0039	1.0300	1.0334	0.0034	1.0330	1.0349	0.0020	1.0371	1.0385	0.0014	1.0392	1.0379	-0.0014
195622	MMT NP	1.0233	1.0279	0.0047	1.0270	1.0311	0.0041	1.0289	1.0313	0.0024	1.0335	1.0353	0.0018	1.0351	1.0334	-0.0017
195624	MDR B2B3	1.0244	1.0415	0.0171	1.0353	1.0480	0.0128	1.0286	1.0351	0.0065	1.0280	1.0313	0.0033	1.0331	1.0284	-0.0047
195625	MDR B4	1.0237	1.0287	0.0050	1.0268	1.0312	0.0044	1.0280	1.0306	0.0026	1.0326	1.0346	0.0020	1.0339	1.0321	-0.0018
195626	CBPP B	1.0149	1.0193	0.0044	1.0170	1.0211	0.0041	1.0178	1.0206	0.0028	1.0209	1.0234	0.0025	1.0218	1.0205	-0.0013
195627	CBPP D	1.0149	1.0194	0.0045	1.0170	1.0212	0.0042	1.0178	1.0207	0.0029	1.0210	1.0235	0.0026	1.0218	1.0205	-0.0013
195628	CBPP E	1.0150	1.0195	0.0045	1.0171	1.0213	0.0041	1.0179	1.0207	0.0028	1.0211	1.0236	0.0025	1.0220	1.0207	-0.0013
195629	CBP&P A	1.0057	1.0055	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0057	0.0000	1.0057	1.0057	0.0000
195630	DLP 50HZ	1.0386	1.0384	-0.0002	1.0386	1.0384	-0.0001	1.0386	1.0384	-0.0001	1.0386	1.0385	-0.0001	1.0386	1.0385	0.0000
195631	BRKFIELD	1.0072	1.0071	-0.0001	1.0072	1.0071	-0.0001	1.0072	1.0071	-0.0001	1.0072	1.0072	0.0000	1.0072	1.0072	0.0000
195632	CBP&P C	1.0057	1.0056	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0057	0.0000	1.0057	1.0057	0.0000
195633	WATSONS	1.0060	1.0058	-0.0001	1.0060	1.0059	-0.0001	1.0060	1.0059	-0.0001	1.0060	1.0060	0.0000	1.0060	1.0060	0.0000
195635	SVL B2	1.0097	1.0348	0.0251	1.0167	1.0332	0.0165	1.0228	1.0309	0.0081	1.0276	1.0243	-0.0033	1.0306	1.0266	-0.0039
195636	BBK T2	1.0601	1.0587	-0.0014	1.0409	1.0391	-0.0018	1.0327	1.0297	-0.0030	1.0193	1.0156	-0.0037	1.0204	1.0161	-0.0043
195637	DLS B1	1.0479	1.0467	-0.0012	1.0389	1.0372	-0.0018	1.0481	1.0451	-0.0031	1.0491	1.0454	-0.0037	1.0570	1.0527	-0.0042
195639	BUC B2	1.0346	1.0373	0.0026	1.0423	1.0460	0.0037	1.0321	1.0316	-0.0005	1.0291	1.0241	-0.0049	1.0335	1.0237	-0.0099
195640	DPD L64	1.0363	1.0389	0.0026	1.0440	1.0477	0.0037	1.0339	1.0333	-0.0006	1.0308	1.0258	-0.0050	1.0353	1.0253	-0.0099
195641	SLK L80	1.0473	1.0494	0.0021	1.0505	1.0537	0.0032	1.0462	1.0450	-0.0012	1.0449	1.0390	-0.0059	1.0468	1.0356	-0.0112
195643	ACG GFL	1.0030	1.0038	0.0007	1.0050	1.0060	0.0010	1.0048	1.0048	0.0000	1.0038	1.0031	-0.0007	1.0051	1.0034	-0.0018
195644	ACG BFL	1.0148	1.0153	0.0005	1.0162	1.0168	0.0007	1.0160	1.0160	-0.0001	1.0154	1.0148	-0.0006	1.0163	1.0150	-0.0013
195650	WAV B2	1.0455	1.0457	0.0003	1.0443	1.0570	0.0128	1.0453	1.0538	0.0085	1.0431	1.0400	-0.0031	1.0407	1.0170	-0.0237
195652	HRD B6B7	1.0272	1.0423	0.0150	1.0312	1.0500	0.0187	1.0290	1.0393	0.0103	1.0241	1.0218	-0.0023	1.0355	1.0119	-0.0235
195654	OPD B2B5	1.0255	1.0459	0.0204	1.0253	1.0465	0.0213	1.0182	1.0301	0.0119	1.0168	1.0149	-0.0018	1.0341	1.0100	-0.0241
195655	HWD B7B8	1.0163	1.0355	0.0191	1.0219	1.0435	0.0216	1.0184	1.0305	0.0121	1.0104	1.0095	-0.0009	1.0260	1.0034	-0.0226
195675	CHF T601	1.0088	1.0167	0.0079	1.0088	1.0165	0.0077	1.0088	1.0136	0.0048	1.0165	1.0203	0.0038	1.0166	1.0179	0.0014
195676	CHF T602	1.0088	1.0167	0.0079	1.0088	1.0165	0.0077	1.0088	1.0136	0.0048	1.0165	1.0203	0.0038	1.0166	1.0179	0.0014
195677	CHF AIRPORT	1.0073	1.0153	0.0080	1.0073	1.0151	0.0078	1.0073	1.0122	0.0049	1.0151	1.0190	0.0038	1.0152	1.0165	0.0014
195678	BRDG CAMP	1.0050	1.0131	0.0081	1.0050	1.0128	0.0079	1.0050	1.0099	0.0050	1.0128	1.0167	0.0039	1.0129	1.0143	0.0014
195679	LOGANTWR	1.0055	1.0136	0.0081	1.0055	1.0133	0.0078	1.0055	1.0104	0.0049	1.0133	1.0172	0.0039	1.0134	1.0148	0.0014
195680	WHITEFISH	1.0041	1.0122	0.0081	1.0041	1.0119	0.0079	1.0040	1.0090	0.0050	1.0119	1.0158	0.0039	1.0120	1.0133	0.0014
195681	JACOPIE	1.0041	1.0122	0.0081	1.0041	1.0119	0.0079	1.0041	1.0090	0.0050	1.0119	1.0158	0.0039	1.0120	1.0134	0.0014
195682	TWIN TAP	1.0045	1.0126	0.0082	1.0045	1.0124	0.0079	1.0044	1.0094	0.0050	1.0123	1.0162	0.0039	1.0124	1.0138	0.0014
195683	ATIKONAK	0.9881	0.9965	0.0084	0.9881	0.9963	0.0081	0.9881	0.9933	0.0051	0.9962	1.0002	0.0040	0.9963	0.9977	0.0014
195684	LOB LODGE	0.9876	0.9960	0.0084	0.9876	0.9957	0.0081	0.9876	0.9927	0.0051	0.9957	0.9997	0.0040	0.9958	0.9972	0.0014
195685	LOBSTICK	0.9826	0.9910	0.0084	0.9826	0.9907	0.0082	0.9825	0.9877	0.0052	0.9907	0.9947	0.0040	0.9908	0.9922	0.0014
195686	LOB TAP	0.9871	0.9955	0.0084	0.9871	0.9952	0.0081	0.9870	0.9922	0.0051	0.9952	0.9991	0.0040	0.9952	0.9966	0.0014
195687	GABBRO	0.9858	0.9942	0.0084	0.9858	0.9939	0.0081	0.9858	0.9909	0.0051	0.9939	0.9979	0.0040	0.9940	0.9954	0.0014
195688	JWF TAP	1.0048	1.0129	0.0081	1.0048	1.0127	0.0079	1.0048	1.0098	0.0050	1.0127	1.0165	0.0039	1.0127	1.0141	0.0014
195824	STG MID2	1.0067	1.0317	0.0250	1.0117	1.0281	0.0163	1.0161	1.0241	0.0080	1.0249	1.0216	-0.0033	1.0270	1.0231	-0.0039
195843	GOU MID1	1.0068	1.0299	0.0231	1.0128	1.0392	0.0264	1.0127	1.0272	0.0144	1.0067	1.0069	0.0001	1.0241	1.0011	-0.0231
195844	MOB MID3	1.0025	1.0163	0.0138	1.0077	1.0227	0.0150	1.0102	1.0167	0.0066	1.0071	1.0028	-0.0043	1.0219	0.9998	-0.0221
195845	CHA MID1	1.0089	1.0349	0.0260	1.0167	1.0442	0.0274	1.0159	1.0318	0.0159	1.0089	1.0110	0.0021	1.0254	1.0026	-0.0227
195870	CHF T601	1.0088	1.0167	0.0079	1.0088	1.0165	0.0077	1.0088	1.0136	0.0048	1.0165	1.0203	0.0038	1.0166	1.0179	0.0014
196312	OPD T3Y	0.9977	1.0096	0.0119	1.0079	1.0218	0.0139	1.0129	1.0208	0.0079	1.0028	0.9987	-0.0041	1.0305	1.0060	-0.0245
196316	OPD T1Y	0.9977	1.0096	0.0119	1.0079	1.0218	0.0139	1.0129	1.0208	0.0079	1.0028	0.9987	-0.0041	1.0305	1.0060	-0.0245
196318	HWD T4Y	1.0046	1.0124	0.0078	1.0130	1.0234	0.0105	1.0161	1.0221	0.0060	1.0071	1.0020	-0.0051	1.0336	1.0087	-0.0249
196324	HWD T1Y	1.0046	1.0124	0.0078	1.0130	1.0234	0.0105	1.0161	1.0221	0.0060	1.0071	1.0020	-0.0051	1.0336	1.0087	-0.0249
196326	MDR T3Y	0.9971	1.0053	0.0082	1.0042	1.0108	0.0065	1.0079	1.0106	0.0027	1.0065	1.0067	0.0002	1.0098	1.0052	-0.0046
196330	MDR T1Y	0.9971	1.0053	0.0082	1.0042	1.0108	0.0065	1.0079	1.0106	0.0027	1.0065	1.0067	0.0002	1.0098	1.0052	-0.0046
196334	DLS T1Y	0.9840	0.9828	-0.0012	0.9828	0.9810	-0.0018	0.9884	0.9854	-0.0030	0.9783	0.9747	-0.0036	0.9847	0.9806	-0.0041
196336	DLK T1Y	0.9963	1.0062	0.0099	1.0094	1.0180	0.0086	1.0149	1.0190	0.0041	1.0100	1.0111	0.0011	1.0153	1.0115	-0.0039
196338	BHL T1Y	1.0067	1.0184	0.0117	1.0270	1.0361	0.0092	1.0385	1.0423	0.0037	1.0225	1.0223	-0.0002	1.0315	1.0262	-0.0053
196340	PBN T1Y	1.0123	1.0245	0.0123	1.0396	1.0485	0.0089	1.0573	1.0602	0.0028	1.0272	1.0257	-0.0015	1.0402	1.0336	-0.0067
196348	MKS T1Y	1.0110	1.0162	0.0052	1.0117	1.0235	0.0117	1.0188	1.0242	0.0054	1.0069	1.0033	-0.0036	1.0204	0.9977	-0.0226
196500	DLK NP	1.0348	1.0379	0.0031	1.0393	1.0419	0.0026	1.0422	1.0433	0.0011	1.0450	1.0452	0.0002	1.0470	1.0457	-0.0013
196501	STX NP	1.0098	1.0349	0.0251	1.0166	1.0330	0.0164	1.0224	1.0305	0.0081	1.0278	1.0245	-0.0033	1.0306	1.0267	-0.0039
196502	STG NP	1.0102	1.0353	0.0251	1.0164	1.0329	0.0164	1.0218	1.0299	0.0080	1.0282	1.0249	-0.0033	1.0309	1.0269	-0.0039
196503	HAR NP	1.0097	1.0348	0.0251	1.0168	1.0333	0.0165	1.0229	1.0310	0.0081	1.0277	1.0243	-0.0033	1.0306	1.0267	-0.0039
196504	GAL NP	1.0097	1.0349	0.0251	1.0168	1.0333	0.0165	1.0229	1.0310	0.0081	1.0277	1.0244	-0.0033	1.0306	1.0267	-0.0039
196505	WHE TAP	1.0097	1.0348	0.0251	1.0168	1.0333	0.0165	1.0229	1.0310	0.0081	1.0277	1.0243	-0.0033	1.0306	1.0267	-0.0039
196506	WHE NP	1.0605	1.0591	-0.0014	1.0413	1.0395	-0.0018	1.0331	1.0301	-0.0031	1.0197	1.0160	-0.0037	1.0208	1.0165	-0.0043
196507	GBY NP	0.9950	0.9940	-0.0010	1.0003	0.9986	-0.0016	1.0216	1.0188	-0.0028	1.0263	1.0228	-0.0034	1.0396	1.0357	-0.0039
196508	PAB NP	0.9923	0.9913	-0.0010	0.9983	0.9967	-0.0016	1.0204	1.0175	-0.0028	1.0254	1.0219	-0.0034	1.0391	1.0351	-0.0039
196509	LGL NP	0.9836	0.9826	-0.0009	0.9908	0.9893	-0.0015	1.0127	1.0101	-0.0026	1.0159	1.0127	-0.0032	1.0292	1.0256	-0.0036
196517	GFS NPT1	1.0385	1.0593	0.0208	1.0431	1.0636	0.0205	1.0355	1.0457	0.0102	1.0363	1.0380	0.0017	1.0384	1.0264	-0.0120
196518	RUS NP	1.0394	1.0601	0.0207	1.0439	1.0643	0.0204	1.0364	1.0465	0.0102	1.0372	1.0388	0.0016	1.0393	1.0273	-0.0120
196519	SBK NP	1.0455	1.0656	0.0201	1.0495	1.0694	0.0199	1.0428	1.0526	0.0098	1.0435	1.0449	0.0014	1.0454	1.0334	-0.0120
196520	RBK NP	1.0213	1.0415	0.0202	1.0290	1.0501	0.0211	1.0326	1.0428	0.0102	1.0350	1.0356	0.0006	1.0388	1.0247	-0.0141
196521	NDJ NP	0.9985	1.0206	0.0220	1.0085	1.0321	0.0235	1.0176	1.0292	0.0116	1.0211	1.0220	0.0008	1.0263	1.0109	-0.0154
196522	LEW NP	0.9749	0.9969	0.0219	0.9914	1.0148	0.0234	1.0067	1.0182	0.0116	1.0120	1.0128	0.0008	1.0207	1.0054	-0.0153
196523	GAN NPT2	1.0229	1.0476	0.0247	1.0211	1.0479	0.0268	1.0232	1.0366	0.0135	1.0229	1.0241	0.0012	1.0221	1.0053	-0.0169
196524	COB NPT2	0.9947	1.0254	0.0308	1.0316	1.0653	0.0337	1.0102	1.0285	0.0184	0.9646	0.9683	0.0036	0.9791	0.9635	-0.0156
196525	CLK NP	0.9524	0.9838	0.0314	1.0171	1.0510	0.0338	1.0018	1.0207	0.0189	0.9731	0.9759	0.0028	0.9935	0.9766	-0.0169
196526	BOY NP	0.9126	0.9440	0.0314	0.9969	1.0307	0.0338	0.9882	1.0074	0.0192	0.9716	0.9739	0.0023	0.9974	0.9798	-0.0176
196527	FHD L54	0.9052	0.9365	0.0314	0.9922	1.0259	0.0337	0.9852	1.0045	0.0193	0.9696	0.9719	0.0023	0.9963	0.9787	-0.0176
196528	GAM NPT2	0.9642	0.9996	0.0354	0.9894	1.0264	0.0370	0.9986	1.0196	0.0210	1.0020	1.0098	0.0078	1.0181	0.9993	-0.0188
196529	HBS NP	0.9664	1.0019	0.0354	0.9917	1.0288	0.0370	1.0010	1.0219	0.0209	1.0043	1.0121	0.0078	1.0205	1.0016	-0.0189
196530	TRN NP	0.9680	1.0035	0.0355	0.9933	1.0304	0.0370	1.0026	1.0235	0.0209	1.0059	1.0136	0.0077	1.0221	1.0032	-0.0190
196531	GPD NP	0.9690	1.0045	0.0355	0.9944	1.0314	0.0370	1.0036	1.0246	0.0209	1.0070	1.0147	0.0077	1.0232	1.0042	-0.0190
196532	WES NP	0.9692	1.0047	0.0355	0.9946	1.0316	0.0370	1.0038	1.0247	0.0209	1.0072	1.0149	0.0077	1.0234	1.0044	-0.0190
196533	CLV NPT1	1.0063	1.0191	0.0128	1.0067	1.0261	0.0194	1.0120	1.0225	0.0105	1.0063	1.0063	0.0000	1.0174	0.9948	-0.0225
196534	MIL NP	1.0078	1.0205	0.0128	1.0082	1.0276	0.0194	1.0134	1.0238	0.0104	1.0078	1.0078	-0.0001	1.0185	0.9960	-0.0226
196535	LET NP	1.0100	1.0227	0.0128	1.0104	1.0297	0.0194	1.0153	1.0257	0.0104	1.0100	1.0099	-0.0001	1.0201	0.9975	-0.0226
196536	SMV NP	1.0113	1.0240	0.0128	1.0117	1.0310	0.0194	1.0163	1.0267	0.0104	1.0114	1.0112	-0.0001	1.0209	0.9982	-0.0227

66 kV Bus	Bus Names	Peak Demand, ML=0 MW			Int_Peak Demand, ML=0 MW			Intermediate Demand, ML=0 MW			Light Demand, ML=0 MW			Extreme Light Demand, ML=0 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196537	LOK NP	1.0115	1.0242	0.0128	1.0119	1.0312	0.0194	1.0164	1.0268	0.0104	1.0116	1.0114	-0.0001	1.0210	0.9983	-0.0226
196538	PUN NP	1.0111	1.0239	0.0128	1.0115	1.0309	0.0194	1.0161	1.0265	0.0104	1.0112	1.0111	-0.0001	1.0206	0.9980	-0.0226
196539	CAT NPT1	1.0090	1.0218	0.0128	1.0094	1.0288	0.0194	1.0144	1.0249	0.0104	1.0091	1.0090	-0.0001	1.0194	0.9968	-0.0226
196540	SPT NP	1.0437	1.0501	0.0064	1.0231	1.0306	0.0075	1.0288	1.0304	0.0015	1.0180	1.0141	-0.0039	1.0307	1.0084	-0.0223
196541	LAU NP	1.0404	1.0493	0.0089	1.0272	1.0350	0.0078	1.0368	1.0389	0.0021	1.0172	1.0148	-0.0025	1.0327	1.0137	-0.0190
196542	STL WIND	1.0411	1.0490	0.0079	1.0279	1.0347	0.0068	1.0375	1.0390	0.0015	1.0180	1.0150	-0.0030	1.0335	1.0149	-0.0185
196543	WEBCV_NP	1.0399	1.0548	0.0149	1.0302	1.0425	0.0123	1.0400	1.0454	0.0054	1.0141	1.0150	0.0009	1.0306	1.0106	-0.0200
196544	GRH NP	1.0412	1.0590	0.0178	1.0328	1.0473	0.0145	1.0421	1.0491	0.0070	1.0129	1.0154	0.0025	1.0296	1.0092	-0.0204
196545	GAR NP	1.0416	1.0533	0.0117	1.0270	1.0378	0.0107	1.0348	1.0388	0.0040	1.0154	1.0145	-0.0009	1.0302	1.0087	-0.0214
196546	BLK NPT3	1.0285	1.0389	0.0104	1.0330	1.0545	0.0215	1.0286	1.0427	0.0140	1.0319	1.0328	0.0009	1.0311	1.0070	-0.0241
196547	NHR NP	1.0201	1.0278	0.0077	1.0251	1.0449	0.0198	1.0209	1.0339	0.0130	1.0223	1.0220	-0.0003	1.0244	1.0004	-0.0240
196548	ISL NP	1.0086	1.0133	0.0047	1.0144	1.0322	0.0178	1.0104	1.0220	0.0116	1.0094	1.0076	-0.0018	1.0153	0.9914	-0.0239
196549	HCT NP	1.0002	1.0028	0.0026	1.0066	1.0229	0.0163	1.0027	1.0133	0.0106	1.0000	0.9971	-0.0029	1.0086	0.9848	-0.0238
196550	NCH NP	1.0023	1.0049	0.0025	1.0078	1.0241	0.0163	1.0044	1.0150	0.0106	1.0022	0.9993	-0.0029	1.0096	0.9857	-0.0238
196551	OPL NP	1.0026	1.0051	0.0025	1.0080	1.0243	0.0163	1.0047	1.0152	0.0106	1.0025	0.9995	-0.0029	1.0098	0.9860	-0.0239
196552	CAR NP	0.9808	0.9788	-0.0020	0.9895	1.0024	0.0129	0.9858	0.9939	0.0081	0.9801	0.9747	-0.0053	0.9940	0.9701	-0.0239
196553	VIC NP	0.9810	0.9790	-0.0021	0.9896	1.0026	0.0129	0.9860	0.9941	0.0081	0.9803	0.9749	-0.0053	0.9941	0.9702	-0.0239
196554	HGR NP	0.9789	0.9768	-0.0021	0.9878	1.0006	0.0128	0.9840	0.9921	0.0081	0.9779	0.9725	-0.0054	0.9925	0.9686	-0.0239
196555	ILC NP	0.9754	0.9727	-0.0027	0.9846	0.9970	0.0124	0.9808	0.9886	0.0077	0.9742	0.9684	-0.0058	0.9897	0.9658	-0.0239
196556	BRB T2T3	0.9706	0.9676	-0.0030	0.9803	0.9924	0.0121	0.9764	0.9839	0.0075	0.9689	0.9628	-0.0061	0.9858	0.9621	-0.0238
196557	ULT TAP	1.0256	1.0411	0.0155	1.0300	1.0493	0.0193	1.0280	1.0387	0.0107	1.0231	1.0210	-0.0021	1.0348	1.0113	-0.0235
196558	ULT NP	1.0256	1.0412	0.0155	1.0300	1.0493	0.0193	1.0280	1.0387	0.0107	1.0231	1.0210	-0.0021	1.0348	1.0113	-0.0235
196559	SCV NP	1.0240	1.0400	0.0161	1.0287	1.0487	0.0199	1.0270	1.0381	0.0111	1.0221	1.0202	-0.0019	1.0341	1.0107	-0.0235
196560	KEL NP	1.0129	1.0335	0.0206	1.0202	1.0456	0.0253	1.0200	1.0346	0.0146	1.0144	1.0143	-0.0001	1.0291	1.0060	-0.0231
196561	CHA NP	1.0089	1.0349	0.0261	1.0167	1.0442	0.0275	1.0159	1.0319	0.0160	1.0089	1.0110	0.0021	1.0254	1.0026	-0.0227
196562	BCV NP	1.0022	1.0213	0.0191	1.0117	1.0412	0.0295	1.0118	1.0291	0.0173	1.0045	1.0036	-0.0009	1.0225	0.9999	-0.0226
196563	GDL NP	1.0066	1.0332	0.0266	1.0141	1.0422	0.0281	1.0130	1.0292	0.0162	1.0067	1.0086	0.0020	1.0243	1.0014	-0.0229
196564	GOU NP	1.0079	1.0314	0.0235	1.0143	1.0410	0.0267	1.0130	1.0281	0.0152	1.0077	1.0079	0.0002	1.0254	1.0023	-0.0231
196565	KEN NP	1.0162	1.0371	0.0209	1.0196	1.0421	0.0225	1.0153	1.0280	0.0127	1.0119	1.0106	-0.0013	1.0298	1.0062	-0.0236
196566	MOL NP	1.0120	1.0365	0.0244	1.0168	1.0423	0.0255	1.0138	1.0284	0.0146	1.0099	1.0088	-0.0011	1.0282	1.0047	-0.0234
196567	SLA NP	1.0177	1.0398	0.0220	1.0202	1.0440	0.0238	1.0153	1.0289	0.0135	1.0130	1.0118	-0.0012	1.0311	1.0072	-0.0238
196568	SJM NP	1.0112	1.0352	0.0239	1.0159	1.0417	0.0258	1.0131	1.0278	0.0147	1.0098	1.0097	-0.0001	1.0282	1.0046	-0.0236
196569	MUN NP	1.0152	1.0386	0.0234	1.0182	1.0426	0.0244	1.0140	1.0279	0.0139	1.0121	1.0113	-0.0008	1.0308	1.0069	-0.0239
196570	KBR NP	1.0138	1.0390	0.0252	1.0170	1.0421	0.0252	1.0130	1.0274	0.0144	1.0116	1.0113	-0.0003	1.0307	1.0067	-0.0240
196571	PEP NP	1.0124	1.0383	0.0259	1.0159	1.0415	0.0256	1.0123	1.0270	0.0147	1.0110	1.0107	-0.0003	1.0304	1.0064	-0.0240
196572	RRD NP	1.0194	1.0432	0.0238	1.0209	1.0448	0.0239	1.0154	1.0291	0.0136	1.0141	1.0136	-0.0006	1.0324	1.0084	-0.0240
196573	VIR NP	1.0119	1.0401	0.0281	1.0155	1.0425	0.0270	1.0120	1.0275	0.0156	1.0109	1.0107	-0.0002	1.0305	1.0065	-0.0240
196574	PUL NP	0.9993	1.0371	0.0378	1.0063	1.0403	0.0341	1.0060	1.0262	0.0202	1.0057	1.0095	0.0039	1.0274	1.0034	-0.0240
196575	BIG NP	1.0051	1.0256	0.0205	1.0122	1.0355	0.0233	1.0125	1.0251	0.0126	1.0078	1.0067	-0.0012	1.0249	1.0020	-0.0229
196576	MOB NP	1.0067	1.0208	0.0141	1.0138	1.0296	0.0158	1.0162	1.0234	0.0072	1.0132	1.0094	-0.0038	1.0278	1.0060	-0.0218
196577	TCV NP	1.0071	1.0212	0.0140	1.0142	1.0300	0.0157	1.0166	1.0238	0.0072	1.0136	1.0098	-0.0038	1.0282	1.0064	-0.0218
196578	ROP NP	1.0066	1.0202	0.0136	1.0136	1.0287	0.0151	1.0160	1.0228	0.0068	1.0131	1.0091	-0.0040	1.0277	1.0059	-0.0217
196579	MRP NP	1.0068	1.0204	0.0136	1.0137	1.0288	0.0152	1.0161	1.0229	0.0068	1.0132	1.0092	-0.0040	1.0276	1.0059	-0.0217
196580	HCP TAP NP	1.0062	1.0169	0.0106	1.0130	1.0242	0.0113	1.0160	1.0198	0.0039	1.0132	1.0079	-0.0053	1.0282	1.0069	-0.0213
196581	HCP NP	1.0066	1.0172	0.0106	1.0129	1.0243	0.0114	1.0158	1.0198	0.0040	1.0132	1.0080	-0.0052	1.0281	1.0067	-0.0213
196582	CAB NP	1.0060	1.0152	0.0092	1.0131	1.0224	0.0093	1.0164	1.0188	0.0024	1.0137	1.0076	-0.0061	1.0289	1.0079	-0.0210
196583	FER NP	1.0084	1.0147	0.0062	1.0165	1.0206	0.0041	1.0207	1.0197	-0.0010	1.0184	1.0119	-0.0065	1.0341	1.0167	-0.0174
196584	FER WIND	1.0087	1.0148	0.0061	1.0167	1.0205	0.0038	1.0210	1.0198	-0.0012	1.0187	1.0121	-0.0065	1.0343	1.0171	-0.0172
196585	SUM NP	0.9126	0.9440	0.0314	0.9969	1.0307	0.0338	0.9882	1.0074	0.0192	0.9716	0.9739	0.0023	0.9974	0.9798	-0.0176
196586	TWG NP	0.9025	0.9340	0.0315	0.9935	1.0273	0.0338	0.9864	1.0057	0.0194	0.9744	0.9763	0.0020	1.0000	0.9821	-0.0179
196587	HRD OUTS	1.0262	1.0416	0.0153	1.0304	1.0496	0.0191	1.0284	1.0389	0.0106	1.0234	1.0213	-0.0022	1.0350	1.0115	-0.0235

ML = 150 MW Import

66 kV Bus	Bus Names	Peak Demand, ML= -150 MW			Int_Peak Demand, ML= -150 MW			Intermediate Demand, ML= -150 MW			Light Demand, ML= -150 MW			Extreme Light Demand, ML= -150 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0331	1.0376	0.0046	1.0383	1.0399	0.0016	1.0417	1.0407	-0.0010	1.0440	1.0421	-0.0019	1.0470	1.0454	-0.0016
195601	WDL TAP	1.0272	1.0387	0.0115	1.0355	1.0418	0.0063	1.0417	1.0405	-0.0012	1.0453	1.0433	-0.0020	1.0496	1.0479	-0.0018
195602	WDL B1	1.0271	1.0386	0.0115	1.0355	1.0418	0.0063	1.0417	1.0405	-0.0012	1.0454	1.0433	-0.0020	1.0497	1.0480	-0.0018
195603	GLB L29	1.0240	1.0355	0.0115	1.0335	1.0398	0.0063	1.0408	1.0396	-0.0012	1.0451	1.0430	-0.0021	1.0499	1.0481	-0.0018
195604	RHR TAP	1.0195	1.0403	0.0208	1.0305	1.0434	0.0129	1.0391	1.0379	-0.0012	1.0439	1.0419	-0.0021	1.0494	1.0476	-0.0018
195605	RHR B1	1.0188	1.0403	0.0215	1.0300	1.0434	0.0134	1.0388	1.0376	-0.0012	1.0437	1.0417	-0.0021	1.0493	1.0475	-0.0018
195606	BHL T1	0.9967	1.0143	0.0176	1.0075	1.0136	0.0061	1.0087	1.0052	-0.0034	1.0029	0.9967	-0.0062	1.0011	0.9952	-0.0058
195607	SCV L27	0.9959	1.0153	0.0193	1.0071	1.0145	0.0074	1.0088	1.0053	-0.0035	1.0032	0.9970	-0.0062	1.0016	0.9957	-0.0059
195608	CHD B1	0.9938	1.0158	0.0219	1.0058	1.0150	0.0092	1.0081	1.0046	-0.0035	1.0029	0.9967	-0.0062	1.0016	0.9957	-0.0059
195609	PPD L27	1.0354	1.0586	0.0232	1.0573	1.0649	0.0076	1.0538	1.0485	-0.0054	1.0486	1.0406	-0.0080	1.0515	1.0439	-0.0076
195610	DHR B1B2	1.0369	1.0580	0.0211	1.0582	1.0643	0.0061	1.0541	1.0488	-0.0054	1.0487	1.0407	-0.0080	1.0512	1.0437	-0.0076
195611	PBN B2	1.0372	1.0580	0.0208	1.0584	1.0642	0.0059	1.0542	1.0488	-0.0054	1.0486	1.0407	-0.0080	1.0511	1.0436	-0.0076
195612	HBY B1	1.0209	1.0418	0.0208	1.0477	1.0535	0.0059	1.0482	1.0428	-0.0054	1.0451	1.0370	-0.0080	1.0499	1.0423	-0.0076
195620	DLP B1B4	1.0381	1.0418	0.0037	1.0422	1.0437	0.0016	1.0446	1.0444	-0.0002	1.0466	1.0453	-0.0013	1.0488	1.0476	-0.0012
195621	PAS B1	1.0250	1.0299	0.0049	1.0303	1.0326	0.0023	1.0335	1.0338	0.0004	1.0372	1.0357	-0.0015	1.0399	1.0385	-0.0015
195622	MMT NP	1.0230	1.0288	0.0059	1.0273	1.0301	0.0028	1.0293	1.0300	0.0007	1.0335	1.0318	-0.0017	1.0359	1.0341	-0.0018
195624	MDR B2B3	1.0233	1.0437	0.0204	1.0355	1.0447	0.0092	1.0286	1.0305	0.0019	1.0272	1.0254	-0.0018	1.0349	1.0299	-0.0050
195625	MDR B4	1.0234	1.0297	0.0062	1.0271	1.0300	0.0029	1.0283	1.0291	0.0008	1.0326	1.0307	-0.0019	1.0347	1.0328	-0.0020
195626	CBPP B	1.0147	1.0200	0.0054	1.0172	1.0203	0.0031	1.0180	1.0195	0.0015	1.0209	1.0196	-0.0013	1.0224	1.0210	-0.0014
195627	CBPP D	1.0147	1.0201	0.0054	1.0173	1.0204	0.0031	1.0181	1.0196	0.0016	1.0210	1.0197	-0.0013	1.0224	1.0210	-0.0014
195628	CBPP E	1.0148	1.0202	0.0054	1.0174	1.0205	0.0031	1.0182	1.0197	0.0015	1.0211	1.0198	-0.0013	1.0226	1.0212	-0.0014
195629	CBP&P A	1.0057	1.0057	0.0000	1.0057	1.0057	0.0000	1.0057	1.0056	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0056	0.0000
195630	DLP 50HZ	1.0386	1.0385	0.0000	1.0386	1.0385	-0.0001	1.0386	1.0385	-0.0001	1.0386	1.0385	-0.0001	1.0386	1.0385	-0.0001
195631	BRKFIELD	1.0072	1.0072	0.0000	1.0072	1.0072	0.0000	1.0072	1.0071	-0.0001	1.0072	1.0071	-0.0001	1.0072	1.0072	0.0000
195632	CBP&P C	1.0057	1.0057	0.0000	1.0057	1.0057	0.0000	1.0057	1.0056	-0.0001	1.0057	1.0056	-0.0001	1.0057	1.0057	0.0000
195633	WATSONS	1.0060	1.0060	0.0000	1.0060	1.0060	0.0000	1.0060	1.0059	-0.0001	1.0060	1.0059	-0.0001	1.0060	1.0059	0.0000
195635	SVL B2	1.0097	1.0381	0.0284	1.0167	1.0321	0.0154	1.0228	1.0187	-0.0041	1.0276	1.0231	-0.0045	1.0306	1.0266	-0.0039
195636	BBK T2	1.0601	1.0622	0.0021	1.0409	1.0381	-0.0029	1.0327	1.0282	-0.0045	1.0193	1.0145	-0.0048	1.0204	1.0162	-0.0042
195637	DLS B1	1.0479	1.0498	0.0019	1.0389	1.0363	-0.0027	1.0481	1.0438	-0.0043	1.0491	1.0444	-0.0047	1.0570	1.0528	-0.0042
195639	BUC B2	1.0333	1.0425	0.0091	1.0421	1.0382	-0.0039	1.0307	1.0199	-0.0107	1.0264	1.0121	-0.0143	1.0376	1.0272	-0.0103
195640	DPD L64	1.0351	1.0442	0.0092	1.0438	1.0398	-0.0040	1.0324	1.0216	-0.0108	1.0281	1.0137	-0.0143	1.0393	1.0289	-0.0104
195641	SLK L80	1.0467	1.0563	0.0096	1.0504	1.0452	-0.0053	1.0456	1.0336	-0.0120	1.0438	1.0283	-0.0155	1.0485	1.0368	-0.0117
195643	ACG GFL	1.0029	1.0049	0.0021	1.0050	1.0052	0.0002	1.0045	1.0029	-0.0017	1.0033	1.0008	-0.0026	1.0065	1.0046	-0.0018
195644	ACG BFL	1.0147	1.0162	0.0015	1.0162	1.0163	0.0001	1.0159	1.0146	-0.0012	1.0150	1.0132	-0.0019	1.0172	1.0158	-0.0013
195650	WAV B2	1.0452	1.0703	0.0250	1.0434	1.0541	0.0107	1.0463	1.0296	-0.0166	1.0376	1.0168	-0.0208	1.0421	1.0173	-0.0249
195652	HRD B6B7	1.0269	1.0640	0.0371	1.0266	1.0446	0.0180	1.0370	1.0222	-0.0148	1.0190	1.0007	-0.0183	1.0351	1.0103	-0.0248
195654	OPD B2B5	1.0251	1.0670	0.0419	1.0210	1.0416	0.0205	1.0330	1.0188	-0.0142	1.0219	1.0014	-0.0205	1.0292	1.0039	-0.0252
195655	HWD B7B8	1.0160	1.0559	0.0399	1.0136	1.0346	0.0209	1.0287	1.0153	-0.0134	1.0145	0.9960	-0.0185	1.0219	0.9982	-0.0237
195675	CHF T601	1.0088	1.0158	0.0070	1.0088	1.0165	0.0077	1.0087	1.0119	0.0032	1.0166	1.0186	0.0020	1.0166	1.0175	0.0009
195676	CHF T602	1.0088	1.0158	0.0070	1.0088	1.0165	0.0077	1.0087	1.0119	0.0032	1.0166	1.0186	0.0020	1.0166	1.0175	0.0009
195677	CHF AIRPORT	1.0073	1.0144	0.0071	1.0073	1.0151	0.0078	1.0073	1.0105	0.0032	1.0152	1.0172	0.0021	1.0152	1.0161	0.0009
195678	BRDG CAMP	1.0050	1.0122	0.0072	1.0050	1.0128	0.0079	1.0049	1.0082	0.0032	1.0129	1.0150	0.0021	1.0129	1.0138	0.0009
195679	LOGANTWR	1.0055	1.0127	0.0072	1.0055	1.0133	0.0078	1.0055	1.0087	0.0032	1.0134	1.0155	0.0021	1.0134	1.0143	0.0009
195680	WHITEFISH	1.0041	1.0112	0.0072	1.0041	1.0119	0.0079	1.0040	1.0073	0.0032	1.0120	1.0140	0.0021	1.0119	1.0129	0.0009
195681	JACOPIE	1.0041	1.0112	0.0072	1.0041	1.0119	0.0079	1.0040	1.0073	0.0032	1.0120	1.0140	0.0021	1.0120	1.0129	0.0009
195682	TWIN TAP	1.0045	1.0117	0.0072	1.0045	1.0124	0.0079	1.0044	1.0077	0.0033	1.0124	1.0145	0.0021	1.0124	1.0133	0.0009
195683	ATIKONAK	0.9881	0.9956	0.0074	0.9881	0.9963	0.0081	0.9881	0.9915	0.0034	0.9963	0.9984	0.0021	0.9963	0.9972	0.0010
195684	LOB LODGE	0.9876	0.9950	0.0074	0.9876	0.9957	0.0081	0.9876	0.9909	0.0034	0.9957	0.9979	0.0021	0.9957	0.9967	0.0010
195685	LOBSTICK	0.9826	0.9900	0.0074	0.9825	0.9907	0.0082	0.9825	0.9859	0.0034	0.9908	0.9929	0.0021	0.9907	0.9917	0.0010
195686	LOB TAP	0.9871	0.9945	0.0074	0.9870	0.9952	0.0082	0.9870	0.9904	0.0034	0.9952	0.9974	0.0021	0.9952	0.9962	0.0010
195687	GABBRO	0.9858	0.9932	0.0074	0.9858	0.9939	0.0082	0.9857	0.9891	0.0034	0.9940	0.9961	0.0021	0.9939	0.9949	0.0010
195688	JWF TAP	1.0048	1.0120	0.0072	1.0048	1.0127	0.0079	1.0048	1.0080	0.0032	1.0127	1.0148	0.0021	1.0127	1.0136	0.0009
195824	STG MID2	1.0067	1.0349	0.0283	1.0117	1.0270	0.0152	1.0161	1.0121	-0.0040	1.0249	1.0204	-0.0045	1.0270	1.0231	-0.0039
195843	GOU MID1	1.0065	1.0541	0.0476	1.0068	1.0326	0.0257	1.0232	1.0114	-0.0117	1.0106	0.9914	-0.0192	1.0202	0.9962	-0.0241
195844	MOB MID3	1.0024	1.0360	0.0336	1.0044	1.0197	0.0153	1.0184	1.0046	-0.0137	1.0097	0.9913	-0.0184	1.0188	0.9962	-0.0226
195845	CHA MID1	1.0085	1.0566	0.0480	1.0090	1.0358	0.0268	1.0258	1.0158	-0.0100	1.0115	0.9962	-0.0152	1.0218	0.9980	-0.0238
195870	CHF T601	1.0088	1.0158	0.0070	1.0088	1.0165	0.0077	1.0087	1.0119	0.0032	1.0166	1.0186	0.0020	1.0166	1.0175	0.0009
196312	OPD T3Y	0.9973	1.0277	0.0304	1.0057	1.0189	0.0132	1.0168	1.0007	-0.0161	1.0083	0.9871	-0.0211	1.0252	0.9994	-0.0257
196316	OPD T1Y	0.9973	1.0277	0.0304	1.0057	1.0189	0.0132	1.0168	1.0007	-0.0161	1.0083	0.9871	-0.0211	1.0252	0.9994	-0.0257
196318	HWD T4Y	1.0042	1.0295	0.0253	1.0110	1.0207	0.0097	1.0205	1.0032	-0.0173	1.0127	0.9910	-0.0216	1.0287	1.0026	-0.0261
196324	HWD T1Y	1.0042	1.0295	0.0253	1.0110	1.0207	0.0097	1.0205	1.0032	-0.0173	1.0127	0.9910	-0.0216	1.0287	1.0026	-0.0261
196326	MDR T3Y	0.9961	1.0074	0.0113	1.0045	1.0075	0.0031	1.0079	1.0061	-0.0018	1.0057	1.0009	-0.0048	1.0116	1.0067	-0.0049
196330	MDR T1Y	0.9961	1.0074	0.0113	1.0045	1.0075	0.0031	1.0079	1.0061	-0.0018	1.0057	1.0009	-0.0048	1.0116	1.0067	-0.0049
196334	DLS T1Y	0.9840	0.9859	0.0019	0.9828	0.9801	-0.0027	0.9884	0.9841	-0.0043	0.9783	0.9737	-0.0046	0.9847	0.9806	-0.0041
196336	DLK T1Y	0.9961	1.0090	0.0129	1.0116	1.0165	0.0049	1.0191	1.0172	-0.0018	1.0115	1.0067	-0.0048	1.0182	1.0136	-0.0046
196338	BHL T1Y	1.0064	1.0226	0.0162	1.0292	1.0346	0.0053	1.0426	1.0392	-0.0034	1.0241	1.0179	-0.0062	1.0344	1.0285	-0.0059
196340	PBN T1Y	1.0119	1.0302	0.0183	1.0418	1.0467	0.0049	1.0613	1.0561	-0.0051	1.0289	1.0213	-0.0076	1.0432	1.0360	-0.0073
196348	MKS T1Y	1.0108	1.0364	0.0256	1.0116	1.0173	0.0057	1.0224	1.0086	-0.0137	1.0052	0.9810	-0.0242	1.0162	0.9934	-0.0229
196500	DLK NP	1.0346	1.0388	0.0042	1.0395	1.0411	0.0016	1.0427	1.0420	-0.0007	1.0449	1.0433	-0.0016	1.0476	1.0462	-0.0014
196501	STX NP	1.0098	1.0382	0.0284	1.0166	1.0319	0.0153	1.0224	1.0183	-0.0041	1.0278	1.0233	-0.0045	1.0306	1.0267	-0.0039
196502	STG NP	1.0102	1.0386	0.0284	1.0164	1.0318	0.0153	1.0218	1.0178	-0.0041	1.0282	1.0237	-0.0045	1.0309	1.0269	-0.0039
196503	HAR NP	1.0097	1.0381	0.0284	1.0168	1.0321	0.0154	1.0229	1.0188	-0.0041	1.0277	1.0232	-0.0045	1.0306	1.0267	-0.0039
196504	GAL NP	1.0097	1.0382	0.0284	1.0168	1.0322	0.0154	1.0229	1.0188	-0.0041	1.0277	1.0232	-0.0045	1.0306	1.0267	-0.0039
196505	WHE TAP	1.0097	1.0381	0.0284	1.0168	1.0321	0.0154	1.0229	1.0188	-0.0041	1.0277	1.0232	-0.0045	1.0306	1.0267	-0.0039
196506	WHE NP	1.0605	1.0626	0.0021	1.0413	1.0385	-0.0029	1.0331	1.0286	-0.0045	1.0197	1.0149	-0.0048	1.0208	1.0166	-0.0042
196507	GBY NP	0.9950	0.9968	0.0018	1.0003	0.9978	-0.0025	1.0216	1.0177	-0.0040	1.0263	1.0220	-0.0043	1.0396	1.0357	-0.0039
196508	PAB NP	0.9923	0.9941	0.0018	0.9983	0.9958	-0.0025	1.0204	1.0164	-0.0040	1.0254	1.0210	-0.0043	1.0391	1.0352	-0.0039
196509	LGL NP	0.9836	0.9852	0.0016	0.9908	0.9885	-0.0023	1.0127	1.0091	-0.0037	1.0159	1.0119	-0.0040	1.0292	1.0257	-0.0036
196517	GFS NPT1	1.0385	1.0734	0.0348	1.0439	1.0578	0.0138	1.0422	1.0371	-0.0051	1.0361	1.0193	-0.0168	1.0427	1.0300	-0.0128
196518	RUS NP	1.0394	1.0741	0.0347	1.0447	1.0584	0.0138	1.0429	1.0378	-0.0051	1.0369	1.0202	-0.0168	1.0435	1.0307	-0.0128
196519	SBK NP	1.0455	1.0796	0.0342	1.0502	1.0636	0.0134	1.0487	1.0435	-0.0052	1.0433	1.0266	-0.0167	1.0492	1.0365	-0.0127
196520	RBK NP	1.0214	1.0607	0.0393	1.0302	1.0452	0.0150	1.0354	1.0296	-0.0057	1.0343	1.0152	-0.0191	1.0414	1.0272	-0.0142
196521	NDJ NP	0.9988	1.0429	0.0440	1.0104	1.0277	0.0173	1.0194	1.0137	-0.0057	1.0200	0.9992	-0.0208	1.0289	1.0136	-0.0153
196522	LEW NP	0.9753	1.0191	0.0438	0.9933	1.0105	0.0172	1.0084	1.0027	-0.0057	1.0108	0.9901	-0.0208	1.0233	1.0080	-0.0153
196523	GAN NPT2	1.0236	1.0739	0.0503	1.0238	1.0442	0.0204	1.0237	1.0182	-0.0055	1.0214	0.9985	-0.0228	1.0248	1.0082	-0.0166
196524	COB NPT2	0.9907	1.0473	0.0567	1.0164	1.0422	0.0258	1.0110	1.0076	-0.0035	0.9602	0.9393	-0.0210	0.9828	0.9670	-0.0158
196525	CLK NP	0.9476	1.0062	0.0586	1.0007	1.0265	0.0258	1.0084	1.0044	-0.0040	0.9688	0.9464	-0.0224	0.9971	0.9800	-0.0170
196526	BOY NP	0.9073	0.9667	0.0594	0.9797	1.0053	0.0257	0.9983	0.9939	-0.0043	0.9674	0.9441	-0.0232	1.0010	0.9831	-0.0179
196527	FHD L54	0.8999	0.9591	0.0592	0.9748	1.0004	0.0256	0.9953	0.9910	-0.0043	0.9653	0.9421	-0.0232	0.9999	0.9820	-0.0179
196528	GAM NPT2	0.9622	1.0208	0.0586	0.9890	1.0185	0.0295	1.0064	1.0053	-0.0011	0.9976	0.9735	-0.0241	1.0195	1.0007	-0.0189
196529	HBS NP	0.9644	1.0231	0.0587	0.9913	1.0208	0.0295	1.0088	1.0076	-0.0012	1.0000	0.9757	-0.0243	1.0219	1.0030	-0.0190
196530	TRN NP	0.9659	1.0248	0.0588	0.9929	1.0224	0.0295	1.0104	1.0092	-0.0013	1.0016	0.9772	-0.0244	1.0236	1.0045	-0.0190
196531	GPD NP	0.9670	1.0259	0.0589	0.9939	1.0235	0.0295	1.0115	1.0102	-0.0013	1.0026	0.9782	-0.0244	1.0246	1.0056	-0.0191
196532	WES NP	0.9671	1.0261	0.0589	0.9941	1.0236	0.0295	1.0117	1.0104	-0.0013	1.0028	0.9784	-0.0244	1.0248	1.0057	-0.0191
196533	CLV NPT1	1.0058	1.0414	0.0356	1.0067	1.0197	0.0130	1.0160	1.0047	-0.0113	1.0046	0.9783	-0.0263	1.0147	0.9920	-0.0227
196534	MIL NP	1.0074	1.0430	0.0356	1.0082	1.0212	0.0130	1.0172	1.0059	-0.0113	1.0061	0.9798	-0.0263	1.0160	0.9932	-0.0228
196535	LET NP	1.0096	1.0453	0.0357	1.0104	1.0233	0.0130	1.0188	1.0075	-0.0114	1.0084	0.9820	-0.0264	1.0177	0.9949	-0.0228
196536	SMV NP	1.0109	1.0467	0.0357	1.0117	1.0246	0.0129	1.0197	1.0083	-0.0114	1.0098	0.9834	-0.0265	1.0186	0.9957	-0.0229
196537	LOK NP	1.0111	1.0469	0.0357	1.0119	1.0248	0.0129	1.0198	1.0084	-0.0114	1.0101	0.9836	-0.0265	1.0187	0.9959	-0.0229
196538	PUN NP	1.0108	1.0465	0.0357	1.0115	1.0245	0.0129	1.0195	1.0081	-0.0114	1.0097	0.9832	-0.0265	1.0184	0.9955	-0.0228
196539	CAT NPT1	1.0087	1.0443	0.0357	1.0095	1.0224	0.0130	1.0181	1.0067	-0.0114	1.0075	0.9811	-0.0264	1.0169	0.9941	-0.0228
196540	SPT NP	1.0389	1.0594	0.0205	1.0230	1.0154	-0.0076	1.0314	1.0215	-0.0099	1.0163	0.9957	-0.0207	1.0199	0.9976	-0.0223

ML = 150 MW Import

66 kV Bus	Bus Names	Peak Demand, ML= -150 MW			Int_Peak Demand, ML= -150 MW			Intermediate Demand, ML= -150 MW			Light Demand, ML= -150 MW			Extreme Light Demand, ML= -150 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196541	LAU NP	1.0361	1.0505	0.0144	1.0271	1.0339	0.0069	1.0390	1.0340	-0.0050	1.0156	1.0013	-0.0143	1.0219	1.0025	-0.0194
196542	STL WIND	1.0369	1.0491	0.0122	1.0278	1.0356	0.0078	1.0397	1.0346	-0.0051	1.0163	1.0024	-0.0140	1.0227	1.0037	-0.0190
196543	WEBCV_NP	1.0363	1.0575	0.0213	1.0301	1.0389	0.0088	1.0420	1.0404	-0.0016	1.0125	0.9997	-0.0128	1.0198	0.9995	-0.0203
196544	GRH NP	1.0379	1.0625	0.0247	1.0327	1.0425	0.0098	1.0439	1.0441	0.0001	1.0112	0.9992	-0.0120	1.0188	0.9981	-0.0207
196545	GAR NP	1.0375	1.0599	0.0224	1.0270	1.0274	0.0004	1.0370	1.0318	-0.0052	1.0137	0.9972	-0.0166	1.0194	0.9978	-0.0216
196546	BLK NPT3	1.0282	1.0659	0.0377	1.0316	1.0511	0.0195	1.0343	1.0223	-0.0120	1.0291	1.0127	-0.0164	1.0306	1.0055	-0.0251
196547	NHR NP	1.0197	1.0551	0.0354	1.0223	1.0403	0.0179	1.0262	1.0130	-0.0132	1.0204	1.0030	-0.0174	1.0238	0.9988	-0.0250
196548	ISL NP	1.0083	1.0410	0.0327	1.0099	1.0259	0.0160	1.0151	1.0005	-0.0146	1.0087	0.9900	-0.0186	1.0146	0.9897	-0.0249
196549	HCT NP	0.9999	1.0307	0.0308	1.0009	1.0154	0.0146	1.0070	0.9914	-0.0156	1.0001	0.9806	-0.0195	1.0078	0.9830	-0.0248
196550	NCH NP	1.0021	1.0328	0.0308	1.0028	1.0174	0.0146	1.0081	0.9925	-0.0157	1.0022	0.9827	-0.0195	1.0089	0.9841	-0.0248
196551	OPL NP	1.0023	1.0331	0.0308	1.0031	1.0177	0.0146	1.0084	0.9928	-0.0157	1.0025	0.9830	-0.0195	1.0092	0.9843	-0.0248
196552	CAR NP	0.9804	1.0071	0.0266	0.9811	0.9923	0.0112	0.9897	0.9716	-0.0181	0.9811	0.9597	-0.0214	0.9929	0.9681	-0.0248
196553	VIC NP	0.9806	1.0073	0.0267	0.9813	0.9925	0.0112	0.9898	0.9717	-0.0181	0.9812	0.9598	-0.0214	0.9930	0.9682	-0.0248
196554	HGR NP	0.9785	1.0050	0.0265	0.9790	0.9902	0.0111	0.9879	0.9697	-0.0182	0.9791	0.9576	-0.0215	0.9914	0.9666	-0.0248
196555	ILC NP	0.9750	1.0009	0.0259	0.9754	0.9861	0.0107	0.9847	0.9662	-0.0185	0.9755	0.9538	-0.0217	0.9886	0.9638	-0.0247
196556	BRB T2T3	0.9702	0.9957	0.0255	0.9703	0.9807	0.0104	0.9803	0.9616	-0.0187	0.9706	0.9487	-0.0219	0.9846	0.9600	-0.0246
196557	ULT TAP	1.0252	1.0631	0.0379	1.0252	1.0439	0.0186	1.0361	1.0215	-0.0146	1.0183	1.0001	-0.0182	1.0343	1.0096	-0.0247
196558	ULT NP	1.0252	1.0631	0.0379	1.0252	1.0439	0.0186	1.0361	1.0215	-0.0146	1.0184	1.0002	-0.0182	1.0343	1.0096	-0.0247
196559	SCV NP	1.0236	1.0623	0.0387	1.0239	1.0431	0.0192	1.0352	1.0208	-0.0143	1.0177	0.9996	-0.0181	1.0335	1.0088	-0.0247
196560	KEL NP	1.0126	1.0582	0.0457	1.0141	1.0388	0.0247	1.0290	1.0166	-0.0124	1.0131	0.9963	-0.0168	1.0272	1.0029	-0.0243
196561	CHA NP	1.0085	1.0566	0.0481	1.0090	1.0359	0.0269	1.0258	1.0158	-0.0100	1.0115	0.9962	-0.0152	1.0219	0.9980	-0.0238
196562	BCV NP	1.0019	1.0526	0.0507	1.0033	1.0322	0.0289	1.0221	1.0088	-0.0133	1.0087	0.9902	-0.0185	1.0183	0.9947	-0.0236
196563	GDL NP	1.0063	1.0557	0.0494	1.0067	1.0342	0.0275	1.0240	1.0139	-0.0101	1.0109	0.9920	-0.0189	1.0201	0.9962	-0.0239
196564	GOU NP	1.0076	1.0555	0.0480	1.0078	1.0339	0.0260	1.0244	1.0127	-0.0117	1.0119	0.9927	-0.0192	1.0212	0.9970	-0.0242
196565	KEN NP	1.0158	1.0587	0.0428	1.0140	1.0358	0.0219	1.0286	1.0150	-0.0136	1.0167	0.9969	-0.0198	1.0251	1.0004	-0.0247
196566	MOL NP	1.0117	1.0583	0.0466	1.0109	1.0357	0.0248	1.0267	1.0132	-0.0134	1.0146	0.9950	-0.0196	1.0236	0.9990	-0.0246
196567	SLA NP	1.0174	1.0623	0.0450	1.0152	1.0383	0.0231	1.0294	1.0158	-0.0135	1.0179	0.9978	-0.0201	1.0262	1.0013	-0.0250
196568	SJM NP	1.0109	1.0583	0.0474	1.0104	1.0355	0.0251	1.0262	1.0139	-0.0122	1.0144	0.9947	-0.0198	1.0236	0.9989	-0.0247
196569	MUN NP	1.0149	1.0607	0.0459	1.0134	1.0371	0.0237	1.0282	1.0151	-0.0131	1.0170	0.9971	-0.0200	1.0259	1.0009	-0.0250
196570	KBR NP	1.0134	1.0605	0.0471	1.0124	1.0369	0.0245	1.0275	1.0150	-0.0125	1.0166	0.9969	-0.0198	1.0258	1.0007	-0.0251
196571	PEP NP	1.0120	1.0597	0.0478	1.0113	1.0363	0.0250	1.0269	1.0144	-0.0125	1.0160	0.9962	-0.0199	1.0255	1.0004	-0.0251
196572	RRD NP	1.0191	1.0645	0.0454	1.0165	1.0398	0.0232	1.0302	1.0174	-0.0128	1.0192	0.9990	-0.0202	1.0275	1.0023	-0.0252
196573	VIR NP	1.0116	1.0613	0.0497	1.0111	1.0374	0.0263	1.0268	1.0144	-0.0124	1.0160	0.9958	-0.0202	1.0256	1.0004	-0.0252
196574	PUL NP	0.9989	1.0583	0.0594	1.0018	1.0352	0.0334	1.0209	1.0130	-0.0078	1.0108	0.9906	-0.0202	1.0224	0.9972	-0.0251
196575	BIG NP	1.0048	1.0485	0.0437	1.0066	1.0292	0.0226	1.0229	1.0105	-0.0124	1.0116	0.9925	-0.0190	1.0210	0.9972	-0.0238
196576	MOB NP	1.0065	1.0402	0.0337	1.0100	1.0252	0.0152	1.0243	1.0110	-0.0133	1.0157	0.9977	-0.0181	1.0248	1.0024	-0.0224
196577	TCV NP	1.0069	1.0406	0.0337	1.0104	1.0256	0.0152	1.0248	1.0115	-0.0133	1.0162	0.9981	-0.0181	1.0252	1.0029	-0.0224
196578	ROP NP	1.0064	1.0393	0.0329	1.0099	1.0245	0.0146	1.0241	1.0107	-0.0134	1.0156	0.9976	-0.0180	1.0247	1.0024	-0.0223
196579	MRP NP	1.0066	1.0394	0.0329	1.0100	1.0247	0.0146	1.0241	1.0107	-0.0134	1.0157	0.9977	-0.0180	1.0246	1.0024	-0.0222
196580	HCP TAP NP	1.0061	1.0337	0.0276	1.0098	1.0208	0.0110	1.0241	1.0100	-0.0141	1.0156	0.9980	-0.0175	1.0252	1.0034	-0.0217
196581	HCP NP	1.0064	1.0341	0.0277	1.0099	1.0210	0.0111	1.0240	1.0098	-0.0141	1.0154	0.9980	-0.0174	1.0250	1.0032	-0.0218
196582	CAB NP	1.0058	1.0309	0.0251	1.0099	1.0191	0.0092	1.0245	1.0102	-0.0143	1.0161	0.9987	-0.0174	1.0259	1.0045	-0.0214
196583	FER NP	1.0082	1.0216	0.0133	1.0133	1.0181	0.0048	1.0288	1.0161	-0.0128	1.0207	1.0061	-0.0146	1.0311	1.0130	-0.0180
196584	FER WIND	1.0085	1.0212	0.0127	1.0135	1.0181	0.0046	1.0291	1.0164	-0.0127	1.0210	1.0066	-0.0144	1.0313	1.0135	-0.0178
196585	SUM NP	0.9073	0.9667	0.0594	0.9797	1.0053	0.0257	0.9983	0.9939	-0.0043	0.9674	0.9441	-0.0232	1.0010	0.9831	-0.0179
196586	TWG NP	0.8970	0.9570	0.0600	0.9761	1.0017	0.0256	0.9965	0.9921	-0.0044	0.9701	0.9464	-0.0237	1.0036	0.9853	-0.0183
196587	HRD OUTS	1.0258	1.0634	0.0376	1.0257	1.0441	0.0184	1.0364	1.0217	-0.0147	1.0186	1.0003	-0.0182	1.0346	1.0098	-0.0248

66 kV Bus	Bus Names	Peak Demand, ML= -320 MW			Int Peak Demand, ML= -320 MW			Intermediate Demand, ML= -320 MW			Light Demand, ML= -320 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
195600	DLK B2	1.0326	1.0384	0.0058	1.0376	1.0396	0.0020	1.0406	1.0406	0.0000	1.0436	1.0432	-0.0004
195601	WDL TAP	1.0268	1.0398	0.0130	1.0348	1.0416	0.0068	1.0405	1.0405	0.0000	1.0450	1.0445	-0.0005
195602	WDL B1	1.0266	1.0397	0.0130	1.0348	1.0415	0.0068	1.0405	1.0405	0.0000	1.0450	1.0446	-0.0005
195603	GLB L29	1.0235	1.0366	0.0131	1.0328	1.0396	0.0068	1.0397	1.0396	0.0000	1.0447	1.0442	-0.0005
195604	RHR TAP	1.0190	1.0415	0.0225	1.0298	1.0432	0.0134	1.0379	1.0379	0.0000	1.0436	1.0431	-0.0005
195605	RHR B1	1.0183	1.0415	0.0232	1.0293	1.0432	0.0139	1.0376	1.0376	0.0000	1.0434	1.0429	-0.0005
195606	BHL T1	0.9996	1.0390	0.0394	1.0072	1.0138	0.0066	1.0075	1.0071	-0.0004	1.0037	1.0015	-0.0022
195607	SCV L27	0.9988	1.0400	0.0412	1.0069	1.0147	0.0078	1.0076	1.0072	-0.0004	1.0040	1.0018	-0.0022
195608	CHD B1	0.9967	1.0406	0.0438	1.0055	1.0152	0.0097	1.0069	1.0065	-0.0004	1.0036	1.0014	-0.0022
195609	PPD L27	1.0384	1.0892	0.0507	1.0435	1.0520	0.0085	1.0531	1.0520	-0.0011	1.0494	1.0464	-0.0030
195610	DHR B1B2	1.0399	1.0885	0.0486	1.0444	1.0514	0.0070	1.0534	1.0523	-0.0011	1.0495	1.0464	-0.0030
195611	PBN B2	1.0402	1.0885	0.0483	1.0446	1.0513	0.0068	1.0535	1.0524	-0.0011	1.0494	1.0464	-0.0030
195612	HBY B1	1.0240	1.0725	0.0484	1.0336	1.0404	0.0068	1.0475	1.0464	-0.0012	1.0459	1.0428	-0.0031
195620	DLP B1B4	1.0381	1.0417	0.0036	1.0418	1.0436	0.0018	1.0439	1.0444	0.0005	1.0464	1.0466	0.0002
195621	PAS B1	1.0254	1.0338	0.0084	1.0299	1.0324	0.0026	1.0326	1.0340	0.0014	1.0368	1.0378	0.0010
195622	MMT NP	1.0233	1.0359	0.0125	1.0267	1.0299	0.0032	1.0281	1.0301	0.0020	1.0329	1.0344	0.0016
195624	MDR B2B3	1.0230	1.0739	0.0509	1.0332	1.0439	0.0107	1.0247	1.0303	0.0055	1.0381	1.0413	0.0032
195625	MDR B4	1.0238	1.0379	0.0141	1.0264	1.0298	0.0034	1.0270	1.0292	0.0022	1.0318	1.0336	0.0017
195626	CBPP B	1.0150	1.0239	0.0089	1.0168	1.0202	0.0034	1.0172	1.0197	0.0025	1.0205	1.0228	0.0023
195627	CBPP D	1.0150	1.0240	0.0090	1.0169	1.0203	0.0034	1.0173	1.0198	0.0025	1.0205	1.0229	0.0024
195628	CBPP E	1.0151	1.0241	0.0089	1.0170	1.0203	0.0034	1.0174	1.0199	0.0025	1.0206	1.0230	0.0023
195629	CBP&P A	1.0057	1.0049	-0.0007	1.0057	1.0056	-0.0001	1.0057	1.0057	0.0000	1.0057	1.0057	0.0001
195630	DLP 50HZ	1.0386	1.0382	-0.0003	1.0386	1.0385	-0.0001	1.0386	1.0386	0.0000	1.0386	1.0386	0.0000
195631	BRKFIELD	1.0072	1.0065	-0.0007	1.0072	1.0071	-0.0001	1.0072	1.0072	0.0000	1.0072	1.0073	0.0001
195632	CBP&P C	1.0057	1.0050	-0.0007	1.0057	1.0056	-0.0001	1.0057	1.0057	0.0000	1.0057	1.0058	0.0001
195633	WATSONS	1.0060	1.0052	-0.0007	1.0060	1.0059	-0.0001	1.0060	1.0060	0.0000	1.0060	1.0060	0.0001
195635	SVL B2	1.0097	1.0898	0.0801	1.0167	1.0328	0.0161	1.0228	1.0214	-0.0015	1.0276	1.0257	-0.0019
195636	BBK T2	1.0601	1.1139	0.0538	1.0409	1.0389	-0.0020	1.0327	1.0311	-0.0016	1.0193	1.0172	-0.0021
195637	DLS B1	1.0479	1.0960	0.0481	1.0389	1.0371	-0.0019	1.0481	1.0466	-0.0015	1.0491	1.0471	-0.0020
195639	BUC B2	1.0322	1.0678	0.0356	1.0375	1.0377	0.0002	1.0223	1.0193	-0.0030	1.0308	1.0251	-0.0057
195640	DPD L64	1.0339	1.0697	0.0358	1.0392	1.0394	0.0002	1.0241	1.0210	-0.0031	1.0325	1.0268	-0.0057
195641	SLK L80	1.0462	1.0872	0.0409	1.0485	1.0494	0.0009	1.0421	1.0395	-0.0026	1.0456	1.0403	-0.0054
195643	ACG GFL	1.0028	0.9973	-0.0055	1.0042	1.0047	0.0005	1.0028	1.0023	-0.0005	1.0020	1.0009	-0.0011
195644	ACG BFL	1.0147	1.0083	-0.0064	1.0157	1.0160	0.0003	1.0147	1.0143	-0.0004	1.0141	1.0133	-0.0008
195650	WAV B2	1.0460	1.0734	0.0274	1.0405	1.0515	0.0111	1.0394	1.0323	-0.0070	1.0407	1.0225	-0.0183
195652	HRD B6B7	1.0322	1.0682	0.0359	1.0243	1.0444	0.0201	1.0250	1.0187	-0.0063	1.0241	1.0029	-0.0212
195654	OPD B2B5	1.0236	1.0647	0.0411	1.0186	1.0413	0.0227	1.0175	1.0119	-0.0056	1.0208	0.9977	-0.0231
195655	HWD B7B8	1.0197	1.0593	0.0396	1.0113	1.0344	0.0231	1.0158	1.0111	-0.0047	1.0165	0.9943	-0.0222
195675	CHF T601	1.0088	1.0153	0.0066	1.0088	1.0145	0.0058	1.0087	1.0105	0.0018	1.0166	1.0175	0.0009
195676	CHF T602	1.0088	1.0153	0.0066	1.0088	1.0145	0.0058	1.0087	1.0105	0.0018	1.0166	1.0175	0.0009
195677	CHF AIRPORT	1.0074	1.0140	0.0066	1.0073	1.0132	0.0058	1.0073	1.0091	0.0018	1.0152	1.0161	0.0009
195678	BRDG CAMP	1.0050	1.0117	0.0067	1.0050	1.0109	0.0059	1.0049	1.0067	0.0019	1.0129	1.0138	0.0009
195679	LOGANTWR	1.0055	1.0122	0.0067	1.0055	1.0114	0.0059	1.0054	1.0073	0.0018	1.0134	1.0143	0.0009
195680	WHITEFISH	1.0041	1.0108	0.0067	1.0040	1.0100	0.0059	1.0040	1.0058	0.0019	1.0119	1.0129	0.0009
195681	JACOPIE	1.0041	1.0108	0.0067	1.0041	1.0100	0.0059	1.0040	1.0058	0.0019	1.0120	1.0129	0.0009
195682	TWIN TAP	1.0045	1.0112	0.0067	1.0044	1.0104	0.0059	1.0044	1.0062	0.0019	1.0124	1.0133	0.0009
195683	ATIKONAK	0.9882	0.9951	0.0070	0.9881	0.9943	0.0061	0.9881	0.9900	0.0019	0.9963	0.9972	0.0010
195684	LOB LODGE	0.9876	0.9946	0.0070	0.9876	0.9937	0.0061	0.9875	0.9894	0.0019	0.9957	0.9967	0.0010
195685	LOBSTICK	0.9826	0.9895	0.0070	0.9825	0.9887	0.0061	0.9825	0.9844	0.0019	0.9907	0.9917	0.0010
195686	LOB TAP	0.9871	0.9940	0.0070	0.9870	0.9932	0.0061	0.9870	0.9889	0.0019	0.9952	0.9962	0.0010
195687	GABBRO	0.9858	0.9928	0.0070	0.9858	0.9919	0.0061	0.9857	0.9876	0.0019	0.9939	0.9949	0.0010
195688	JWF TAP	1.0048	1.0115	0.0067	1.0048	1.0107	0.0059	1.0047	1.0066	0.0019	1.0127	1.0136	0.0009
195824	STG MID2	1.0067	1.0863	0.0796	1.0117	1.0277	0.0160	1.0161	1.0147	-0.0014	1.0249	1.0230	-0.0019
195843	GOU MID1	1.0087	1.0579	0.0492	1.0047	1.0328	0.0281	1.0104	1.0075	-0.0029	1.0120	0.9901	-0.0219
195844	MOB MID3	1.0030	1.0536	0.0506	1.0036	1.0217	0.0181	1.0088	1.0046	-0.0042	1.0104	0.9917	-0.0187
195845	CHA MID1	1.0125	1.0602	0.0477	1.0066	1.0356	0.0290	1.0130	1.0117	-0.0013	1.0140	0.9952	-0.0188
195870	CHF T601	1.0088	1.0153	0.0066	1.0088	1.0145	0.0058	1.0087	1.0105	0.0018	1.0166	1.0175	0.0009
196312	OPD T3Y	1.0063	1.0346	0.0284	1.0033	1.0184	0.0151	1.0264	1.0184	-0.0080	1.0057	0.9825	-0.0232
196316	OPD T1Y	1.0063	1.0346	0.0284	1.0033	1.0184	0.0151	1.0264	1.0184	-0.0080	1.0057	0.9825	-0.0232
196318	HWD T4Y	1.0123	1.0352	0.0229	1.0087	1.0203	0.0116	1.0272	1.0180	-0.0091	1.0094	0.9857	-0.0237
196324	HWD T1Y	1.0123	1.0352	0.0229	1.0087	1.0203	0.0116	1.0272	1.0180	-0.0091	1.0094	0.9857	-0.0237
196326	MDR T3Y	0.9957	1.0365	0.0408	1.0022	1.0068	0.0045	1.0041	1.0059	0.0018	1.0033	1.0034	0.0001
196330	MDR T1Y	0.9957	1.0365	0.0408	1.0022	1.0068	0.0045	1.0041	1.0059	0.0018	1.0033	1.0034	0.0001
196334	DLS T1Y	0.9840	1.0322	0.0482	0.9828	0.9809	-0.0019	0.9884	0.9868	-0.0015	0.9783	0.9763	-0.0020
196336	DLK T1Y	0.9990	1.0293	0.0303	1.0115	1.0164	0.0049	1.0175	1.0177	0.0002	1.0123	1.0107	-0.0015
196338	BHL T1Y	1.0093	1.0471	0.0378	1.0290	1.0348	0.0058	1.0414	1.0410	-0.0004	1.0249	1.0227	-0.0022
196340	PBN T1Y	1.0147	1.0592	0.0445	1.0415	1.0472	0.0058	1.0606	1.0595	-0.0010	1.0296	1.0268	-0.0028
196348	MKS T1Y	1.0138	1.0464	0.0326	1.0091	1.0190	0.0099	1.0122	1.0088	-0.0034	1.0074	0.9892	-0.0182
196500	DLK NP	1.0343	1.0391	0.0048	1.0390	1.0409	0.0019	1.0417	1.0420	0.0003	1.0446	1.0445	-0.0001
196501	STX NP	1.0098	1.0899	0.0800	1.0166	1.0327	0.0161	1.0224	1.0209	-0.0015	1.0278	1.0259	-0.0019
196502	STG NP	1.0102	1.0901	0.0799	1.0164	1.0325	0.0160	1.0218	1.0204	-0.0015	1.0282	1.0263	-0.0019
196503	HAR NP	1.0097	1.0898	0.0801	1.0168	1.0329	0.0161	1.0229	1.0214	-0.0015	1.0277	1.0257	-0.0019
196504	GAL NP	1.0097	1.0899	0.0801	1.0168	1.0329	0.0161	1.0229	1.0214	-0.0015	1.0277	1.0258	-0.0019
196505	WHE TAP	1.0097	1.0898	0.0801	1.0168	1.0329	0.0161	1.0229	1.0214	-0.0015	1.0277	1.0257	-0.0019
196506	WHE NP	1.0605	1.1143	0.0538	1.0413	1.0393	-0.0020	1.0331	1.0315	-0.0016	1.0197	1.0176	-0.0021
196507	GBY NP	0.9950	1.0383	0.0433	1.0003	0.9986	-0.0017	1.0216	1.0202	-0.0014	1.0263	1.0244	-0.0018
196508	PAB NP	0.9923	1.0357	0.0433	0.9983	0.9966	-0.0017	1.0204	1.0190	-0.0014	1.0254	1.0235	-0.0018
196509	LGL NP	0.9836	1.0228	0.0393	0.9908	0.9893	-0.0016	1.0127	1.0114	-0.0013	1.0159	1.0142	-0.0017
196517	GFS NPT1	1.0388	1.0860	0.0472	1.0423	1.0586	0.0163	1.0377	1.0355	-0.0022	1.0387	1.0293	-0.0093
196518	RUS NP	1.0396	1.0868	0.0472	1.0431	1.0593	0.0162	1.0385	1.0363	-0.0022	1.0395	1.0302	-0.0093
196519	SBK NP	1.0457	1.0928	0.0471	1.0488	1.0646	0.0158	1.0447	1.0425	-0.0023	1.0456	1.0363	-0.0093
196520	RBK NP	1.0210	1.0721	0.0511	1.0285	1.0473	0.0187	1.0321	1.0312	-0.0009	1.0351	1.0246	-0.0104

ML = 320 MW Import

66 kV Bus	Bus Names	Peak Demand, ML= -320 MW			Int Peak Demand, ML= -320 MW			Intermediate Demand, ML= -320 MW			Light Demand, ML= -320 MW		
		Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)	Voltage (pu)		delta (pu)
		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault		pre-fault	post-fault	
196521	NDJ NP	0.9979	1.0517	0.0538	1.0082	1.0299	0.0217	1.0157	1.0156	0.0000	1.0201	1.0087	-0.0113
196522	LEW NP	0.9743	1.0278	0.0535	0.9911	1.0127	0.0216	1.0047	1.0046	0.0000	1.0109	0.9996	-0.0113
196523	GAN NPT2	1.0222	1.0799	0.0577	1.0213	1.0468	0.0255	1.0198	1.0208	0.0010	1.0206	1.0082	-0.0124
196524	COB NPT2	0.9899	1.0502	0.0602	1.0365	1.0668	0.0302	0.9904	0.9917	0.0013	0.9613	0.9492	-0.0121
196525	CLK NP	0.9467	1.0102	0.0635	1.0209	1.0513	0.0304	0.9938	0.9948	0.0010	0.9700	0.9572	-0.0128
196526	BOY NP	0.9063	0.9717	0.0653	1.0000	1.0304	0.0304	0.9873	0.9881	0.0008	0.9686	0.9553	-0.0132
196527	FHD L54	0.8989	0.9640	0.0651	0.9953	1.0256	0.0303	0.9843	0.9851	0.0008	0.9665	0.9533	-0.0132
196528	GAM NPT2	0.9627	1.0267	0.0640	0.9840	1.0164	0.0324	0.9931	0.9994	0.0063	0.9981	0.9830	-0.0151
196529	HBS NP	0.9650	1.0293	0.0643	0.9863	1.0187	0.0324	0.9954	1.0017	0.0063	1.0004	0.9852	-0.0151
196530	TRN NP	0.9665	1.0311	0.0646	0.9879	1.0203	0.0324	0.9970	1.0033	0.0063	1.0020	0.9868	-0.0152
196531	GPD NP	0.9675	1.0323	0.0647	0.9889	1.0214	0.0324	0.9980	1.0043	0.0063	1.0031	0.9878	-0.0152
196532	WES NP	0.9677	1.0325	0.0647	0.9891	1.0216	0.0324	0.9982	1.0045	0.0063	1.0032	0.9880	-0.0152
196533	CLV NPT1	1.0080	1.0514	0.0435	1.0046	1.0207	0.0161	1.0065	1.0061	-0.0004	1.0059	0.9871	-0.0189
196534	MIL NP	1.0094	1.0530	0.0436	1.0061	1.0222	0.0161	1.0080	1.0076	-0.0004	1.0075	0.9885	-0.0189
196535	LET NP	1.0115	1.0553	0.0438	1.0084	1.0245	0.0161	1.0102	1.0098	-0.0005	1.0097	0.9907	-0.0190
196536	SMV NP	1.0128	1.0567	0.0439	1.0098	1.0259	0.0161	1.0115	1.0111	-0.0005	1.0110	0.9920	-0.0190
196537	LOK NP	1.0129	1.0569	0.0439	1.0101	1.0261	0.0161	1.0117	1.0113	-0.0005	1.0112	0.9922	-0.0190
196538	PUN NP	1.0126	1.0565	0.0439	1.0097	1.0258	0.0161	1.0114	1.0109	-0.0005	1.0109	0.9919	-0.0190
196539	CAT NPT1	1.0106	1.0544	0.0438	1.0075	1.0236	0.0161	1.0093	1.0089	-0.0005	1.0088	0.9898	-0.0189
196540	SPT NP	1.0364	1.0708	0.0344	1.0212	1.0281	0.0069	1.0242	1.0219	-0.0022	1.0185	1.0025	-0.0160
196541	LAU NP	1.0340	1.0609	0.0269	1.0255	1.0320	0.0064	1.0327	1.0304	-0.0023	1.0177	1.0041	-0.0136
196542	STL WIND	1.0347	1.0609	0.0262	1.0263	1.0316	0.0053	1.0335	1.0304	-0.0031	1.0184	1.0046	-0.0138
196543	WEBCV_NP	1.0344	1.0609	0.0265	1.0288	1.0402	0.0113	1.0366	1.0384	0.0018	1.0146	1.0037	-0.0109
196544	GRH NP	1.0361	1.0625	0.0263	1.0315	1.0453	0.0138	1.0390	1.0428	0.0038	1.0134	1.0037	-0.0096
196545	GAR NP	1.0353	1.0659	0.0306	1.0254	1.0355	0.0101	1.0309	1.0314	0.0006	1.0159	1.0029	-0.0129
196546	BLK NPT3	1.0261	1.0662	0.0401	1.0267	1.0472	0.0204	1.0266	1.0246	-0.0020	1.0298	1.0159	-0.0138
196547	NHR NP	1.0174	1.0549	0.0375	1.0190	1.0378	0.0189	1.0185	1.0152	-0.0033	1.0220	1.0070	-0.0150
196548	ISL NP	1.0056	1.0401	0.0345	1.0085	1.0255	0.0170	1.0076	1.0027	-0.0049	1.0114	0.9949	-0.0165
196549	HCT NP	0.9970	1.0293	0.0323	1.0007	1.0163	0.0156	0.9996	0.9936	-0.0060	1.0036	0.9861	-0.0175
196550	NCH NP	0.9997	1.0321	0.0324	1.0028	1.0184	0.0156	1.0018	0.9958	-0.0061	1.0051	0.9876	-0.0175
196551	OPL NP	1.0000	1.0324	0.0324	1.0030	1.0186	0.0156	1.0021	0.9960	-0.0061	1.0054	0.9879	-0.0175
196552	CAR NP	0.9765	1.0044	0.0279	0.9827	0.9953	0.0126	0.9811	0.9726	-0.0084	0.9862	0.9666	-0.0196
196553	VIC NP	0.9767	1.0046	0.0279	0.9829	0.9955	0.0126	0.9813	0.9728	-0.0084	0.9864	0.9668	-0.0196
196554	HGR NP	0.9745	1.0022	0.0276	0.9809	0.9934	0.0125	0.9792	0.9706	-0.0086	0.9845	0.9648	-0.0197
196555	ILC NP	0.9708	0.9978	0.0270	0.9776	0.9897	0.0121	0.9758	0.9669	-0.0089	0.9812	0.9612	-0.0200
196556	BRB T2T3	0.9658	0.9922	0.0264	0.9731	0.9849	0.0118	0.9711	0.9619	-0.0092	0.9768	0.9565	-0.0203
196557	ULT TAP	1.0305	1.0673	0.0367	1.0229	1.0436	0.0207	1.0240	1.0180	-0.0061	1.0233	1.0022	-0.0211
196558	ULT NP	1.0305	1.0673	0.0367	1.0229	1.0436	0.0207	1.0241	1.0180	-0.0061	1.0233	1.0022	-0.0211
196559	SCV NP	1.0288	1.0664	0.0376	1.0215	1.0429	0.0213	1.0231	1.0173	-0.0058	1.0226	1.0016	-0.0210
196560	KEL NP	1.0173	1.0621	0.0449	1.0117	1.0385	0.0268	1.0166	1.0128	-0.0038	1.0170	0.9970	-0.0200
196561	CHA NP	1.0125	1.0602	0.0477	1.0066	1.0357	0.0291	1.0130	1.0117	-0.0013	1.0140	0.9952	-0.0188
196562	BCV NP	1.0056	1.0561	0.0504	1.0009	1.0320	0.0312	1.0092	1.0045	-0.0047	1.0107	0.9885	-0.0222
196563	GDL NP	1.0090	1.0589	0.0500	1.0044	1.0342	0.0298	1.0108	1.0095	-0.0013	1.0123	0.9902	-0.0221
196564	GOU NP	1.0094	1.0586	0.0492	1.0055	1.0339	0.0283	1.0110	1.0081	-0.0029	1.0129	0.9908	-0.0221
196565	KEN NP	1.0160	1.0583	0.0423	1.0115	1.0356	0.0241	1.0140	1.0089	-0.0050	1.0167	0.9939	-0.0227
196566	MOL NP	1.0124	1.0586	0.0462	1.0084	1.0355	0.0270	1.0123	1.0075	-0.0048	1.0149	0.9923	-0.0226
196567	SLA NP	1.0167	1.0612	0.0445	1.0128	1.0381	0.0253	1.0143	1.0094	-0.0049	1.0174	0.9946	-0.0228
196568	SJM NP	1.0111	1.0587	0.0475	1.0080	1.0354	0.0274	1.0117	1.0082	-0.0035	1.0145	0.9919	-0.0225
196569	MUN NP	1.0140	1.0593	0.0453	1.0110	1.0369	0.0259	1.0130	1.0086	-0.0045	1.0164	0.9938	-0.0226
196570	KBR NP	1.0123	1.0587	0.0465	1.0099	1.0366	0.0267	1.0121	1.0083	-0.0039	1.0158	0.9934	-0.0224
196571	PEP NP	1.0107	1.0578	0.0471	1.0089	1.0360	0.0272	1.0114	1.0076	-0.0038	1.0152	0.9927	-0.0225
196572	RRD NP	1.0177	1.0624	0.0447	1.0141	1.0395	0.0254	1.0147	1.0105	-0.0042	1.0182	0.9954	-0.0228
196573	VIR NP	1.0101	1.0592	0.0490	1.0086	1.0371	0.0285	1.0112	1.0074	-0.0038	1.0150	0.9922	-0.0228
196574	PUL NP	0.9975	1.0562	0.0587	0.9993	1.0350	0.0356	1.0052	1.0061	0.0008	1.0098	0.9870	-0.0227
196575	BIG NP	1.0064	1.0558	0.0493	1.0045	1.0297	0.0251	1.0107	1.0075	-0.0032	1.0125	0.9914	-0.0210
196576	MOB NP	1.0076	1.0570	0.0494	1.0086	1.0265	0.0179	1.0148	1.0108	-0.0040	1.0164	0.9977	-0.0187
196577	TCV NP	1.0080	1.0574	0.0493	1.0090	1.0269	0.0179	1.0153	1.0112	-0.0040	1.0169	0.9982	-0.0187
196578	ROP NP	1.0075	1.0569	0.0494	1.0086	1.0258	0.0173	1.0147	1.0105	-0.0042	1.0163	0.9977	-0.0186
196579	MRP NP	1.0077	1.0570	0.0494	1.0087	1.0260	0.0173	1.0147	1.0106	-0.0041	1.0163	0.9978	-0.0185
196580	HCP TAP NP	1.0070	1.0561	0.0491	1.0086	1.0222	0.0136	1.0146	1.0095	-0.0051	1.0163	0.9985	-0.0178
196581	HCP NP	1.0073	1.0565	0.0492	1.0088	1.0225	0.0137	1.0144	1.0095	-0.0049	1.0161	0.9985	-0.0177
196582	CAB NP	1.0067	1.0555	0.0487	1.0087	1.0204	0.0118	1.0150	1.0093	-0.0058	1.0168	0.9992	-0.0176
196583	FER NP	1.0092	1.0521	0.0429	1.0121	1.0178	0.0058	1.0194	1.0105	-0.0088	1.0214	1.0044	-0.0170
196584	FER WIND	1.0095	1.0521	0.0426	1.0123	1.0178	0.0054	1.0196	1.0106	-0.0090	1.0217	1.0047	-0.0170
196585	SUM NP	0.9063	0.9717	0.0653	1.0000	1.0304	0.0304	0.9873	0.9881	0.0008	0.9686	0.9553	-0.0132
196586	TWG NP	0.8960	0.9626	0.0667	0.9966	1.0270	0.0304	0.9888	0.9895	0.0007	0.9714	0.9579	-0.0135
196587	HRD OUTS	1.0312	1.0676	0.0364	1.0234	1.0439	0.0205	1.0244	1.0182	-0.0061	1.0236	1.0025	-0.0212

LIL BP Import Limit[1] (MW)															
Island Load (MW)	**ML Exports[2]**														
	150	**175**	**200**	**225**	**250**	**275**	**300**	**325**	**350**	**375**	**400**	**425**	**450**	**475**	**500**
400	359	391	422	454	485	517	548	569	589	610	630	653	677	700	724
425	363	395	426	458	489	521	552	573	593	614	635	659	683	707	731
450	367	399	430	462	493	525	556	577	598	619	640	665	689	714	739
475	372	403	434	466	497	528	560	581	602	624	645	670	696	721	747
500	376	407	438	469	501	532	564	585	607	628	650	676	702	728	754
525	380	411	442	473	505	536	568	590	611	633	655	682	709	735	762
550	385	415	446	477	508	540	572	594	616	638	660	687	715	742	770
575	389	419	450	481	512	544	576	598	620	643	665	693	721	749	778
600	393	424	454	484	516	548	580	602	625	647	670	699	728	756	785
625	397	428	458	488	520	552	583	606	629	652	675	705	734	764	793
650	402	432	462	492	524	556	587	611	634	657	680	710	740	771	801
675	406	436	466	496	528	559	591	615	638	662	685	716	747	778	808
700	410	440	470	499	531	563	595	619	643	666	690	722	753	785	816
725	415	444	474	503	535	567	599	623	647	671	695	727	759	792	824
750	419	448	478	507	539	571	603	627	652	676	700	733	766	799	832
775	423	452	482	511	543	575	607	632	656	681	705	739	772	806	839
800	428	457	485	514	547	579	611	636	661	685	710	744	779	813	847
825	432	461	489	518	550	583	615	640	665	690	715	750	785	820	855
850	436	465	493	522	554	587	619	644	669	695	720	756	791	827	862
875	440	469	497	526	558	590	623	648	674	699	725	761	798	834	870
900	445	473	501	530	562	594	627	653	678	704	730	767	804	841	878
925	449	477	505	533	566	598	631	657	683	709	735	773	810	848	886
950	453	481	509	537	570	602	635	661	687	714	740	780	820	860	900
975	458	485	513	541	573	606	639	665	692	718	745	784	823	861	900
1000	462	489	517	545	577	610	643	669	696	723	750	788	825	863	900
1025	466	494	521	548	581	614	646	674	701	728	755	791	828	864	900
1050	470	498	525	552	585	618	650	678	705	733	760	795	830	865	900
1075	475	502	529	556	589	622	654	682	710	737	765	799	833	866	900
1100	479	506	533	560	593	625	658	686	714	742	770	803	835	868	900
1125	483	510	537	563	596	629	662	690	719	747	775	806	838	869	900
1150	488	514	541	567	600	633	666	695	723	752	780	810	840	870	900
1175	492	518	545	571	604	637	670	699	728	756	785	814	843	871	900
1200	496	522	549	575	608	641	674	703	732	761	790	818	845	873	900
1225	501	527	553	578	612	645	678	707	736	766	795	821	848	874	900
1250	505	531	556	582	615	649	682	711	741	770	800	825	850	875	900
1275	509	535	560	586	619	653	686	716	745	775	805	829	853	876	900
1300	513	539	564	590	623	656	690	720	750	780	810	833	855	878	900
1325	518	543	568	594	627	660	694	724	754	785	815	836	858	879	900
1350	522	547	572	597	631	664	698	728	759	789	820	840	860	880	900
1375	526	551	576	601	635	668	702	732	763	794	825	844	863	881	900
1400	531	555	580	605	638	672	706	737	768	799	830	848	865	883	900
1425	535	560	584	609	642	676	709	741	772	804	835	851	868	884	900
1450	539	564	588	612	646	680	713	745	777	808	840	855	870	885	900
1475	544	568	592	616	650	684	717	749	781	813	845	859	873	886	900
1500	548	572	596	620	654	687	721	753	786	818	850	863	875	888	900
1525	552	586	619	652	679	705	731	762	793	824	855	866	878	889	900
1550	556	591	625	660	687	714	741	771	801	830	860	870	880	890	900
1575	561	596	631	667	695	723	751	779	808	836	865	874	883	891	900
1600	565	601	638	674	703	732	760	795	830	865	900	900	900	900	900
1625	569	607	644	681	711	741	770	803	835	868	900	900	900	900	900
1650	574	612	650	689	719	749	780	810	840	870	900	900	900	900	900
1675	578	617	656	696	727	758	790	817	845	872	900	900	900	900	900
1700	582	622	663	703	735	767	799	824	850	875	900	900	900	900	900
1725	587	628	669	710	743	776	809	832	854	877	900	900	900	900	900
1750	591	633	675	718	751	785	819	839	859	880	900	900	900	900	900
1775	606	646	685	725	759	794	828	846	864	882	900	900	900	900	900
1800	620	657	695	732	767	803	838	854	869	885	900	900	900	900	900
1825	633	669	704	739	775	812	848	861	874	887	900	900	900	900	900
1850	647	680	713	747	783	820	857	868	879	889	900	900	900	900	900
1875	660	692	723	754	792	829	867	875	884	892	900	900	900	900	900
1900	674	703	732	761	800	838	877	883	888	894	900	900	900	900	900
1925	687	714	741	768	808	847	887	890	893	897	900	900	900	900	900
1950	701	726	751	776	816	856	896	897	898	899	900	900	900	900	900
1975	715	737	760	783	824	865	900	900	900	900	900	900	900	900	900
2000	728	749	769	790	832	874	900	900	900	900	900	900	900	900	900
2025	742	760	779	797	840	883	900	900	900	900	900	900	900	900	900
2050	755	772	788	805	848	891	900	900	900	900	900	900	900	900	900
2075	769	783	797	812	856	900	900	900	900	900	900	900	900	900	900
2100	782	794	807	819	864	900	900	900	900	900	900	900	900	900	900

Note 1: LIL Import Limit - As measured at MFA.
Note 2: ML Exports - As measured at Bottom Brook.