Seasonal Topology Whitepaper

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Executive Summary

The Installed Reserve Margin (IRM) study represents internal New York Control Area (NYCA) transmission interfaces using simplified transfer limit assumptions within the GE Multi-Area Reliability Simulation (GE MARS) model. Historically, internal interface limits informed by NYISO studies have generally reflected summer system conditions and have been applied annually. With the emerging winter reliability risks on the NYCA system and the enhancements to the IRM study model to better reflect the winter conditions, it is prudent to consider potential updates to the IRM topology assumptions with applicable winter interface limits, especially for transmission interfaces with thermal constraints.

The primary objectives of seasonal topology modeling are to improve the representation of seasonal transmission constraints in the IRM study, improve alignment with applicable operating conditions and NYISO planning study assumptions, and establish a repeatable framework for evaluating seasonal topology updates during Preliminary Base Case (PBC) and Final Base Case (FBC) development. The seasonal topology process supplements the existing topology update process by systematically identifying interfaces that warrant further review for establishing distinct winter transfer limits.

This whitepaper reviewed the current IRM study process and topology assumptions, the available source studies that may support seasonal interface transfer limits and the timeline for opportunities when the most up-to-date information can be reflected in the IRM model. The whitepaper recommended a repeatable process to prioritize targeted interfaces and implement seasonal transfer limits starting with the 2027-2028 IRM study.

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1 Background

1.1 Current Annual Topology Update Process

The IRM study topology model is updated annually and on an as-needed basis. Changes to the IRM study topology are incorporated when additions, retirements, or other changes to the transmission system affect the modeled configuration. Interface limits are reviewed annually using the most current applicable information available during development of the IRM study. Within the annual IRM study process, there are two opportunities to update the topology model: one in July when finalizing the assumptions for the IRM Preliminary Base Case (PBC), and one in October when finalizing the assumptions for the IRM Final Base Case (FBC).

During the annual IRM study process, the most up-to-date technical studies are reviewed for any annual limit changes based on peak load conditions. As the occurrence of LOLE in the IRM study was limited to the summer months in the past, transfer limits reflect emergency transfer capabilities during strenuous operating conditions. With the emerging winter reliability risks on the NYCA system and the enhancements to the IRM study model to better reflect the winter conditions, it is prudent to consider potential updates to the IRM topology assumptions with applicable winter interface limits, especially for transmission interfaces with thermal constraints.

1.1.1 Sources for the IRM Topology Assumptions

Different information sources are used for different portions of the IRM topology model. Northeast Power Coordinating Council (NPCC) database information is the primary source used for interties with external control areas and interfaces within external control areas, including seasonal limits where available. Transfer limits for certain internal interfaces, including applicable interfaces associated with Load Zones J and K, are provided directly by the applicable Transmission Owners (TOs). The remaining internal NYCA interface limits are informed by applicable NYISO reliability planning studies (i.e., Reliability Needs Assessment (RNA) and Short-Term Assessment of Reliability (STAR)), NYISO seasonal operating studies, and supplementary transfer limit analyses. Currently, these topology assumptions generally reflect summer conditions and are applied annually, although some of the source studies may have included consideration of seasonal system conditions.

While information from the NPCC database and the TOs are generally aligned with the IRM study base case development process, remaining source studies, particularly the NYISO's reliability planning and operating studies, are conducted with various timelines and some of them may not reflect the system conditions of the IRM study. For example, topology assumptions in the NYISO's reliability planning studies are updated every two years, following the biennial RNA timeline. NYISO's Summer and Winter Operating Studies are conducted based on the system conditions of the upcoming season and the Winter Operating Studies do not assess all thermally constrained interfaces based on system operating experience.

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Updating the IRM topology assumptions to better reflect winter conditions will also need to consider timeline coordination between the IRM study process and the various source transfer limit studies.

1.1.2 Winter Transfer Limit Consideration

For thermally constrained interfaces, it is generally expected that such interfaces will have higher transfer limits in winter than summer due to higher equipment ratings under lower ambient temperature. As the current IRM study still shows the majority reliability risks occurring during summer, implementing seasonal transfer limits may have limited IRM impact, especially for interfaces that are not binding in the IRM model. See details in the Appendix for various testing results with potential model changes. Prioritization of select interfaces for seasonal transfer limit updates will support IRM model updates with relevant assumptions.

1.2 Transmission Representation in the IRM Study

The IRM study uses a simplified "pipe-and-bubble" model to represent NYCA Load Zones and internal transmission interfaces, interties between the NYCA and external control areas, and selected interfaces within external control areas. In GE MARS, transfer capability between modeled areas is represented through directional interface and interface-group limits between these load zones. Such representation is different from the transfer limit studies where individual transmission facilities are modeled and monitored during a steady-state contingency simulation. Consistent interface definitions between the IRM study and various source studies are important foundations to ensure relevant transfer limit assumptions are applied in the IRM model.

2 Objective

The objective of this whitepaper is to develop a repeatable annual process for identifying internal NYCA interfaces that are thermally limited in the IRM study assumptions and warrant further review for the incorporation of technically supported seasonal limits into the IRM study. The process is intended to improve the representation of winter conditions in the IRM study topology assumption and alignment with applicable NYISO study assumptions while remaining consistent with the existing topology update process used for the IRM study.

3 Considerations for Enhancement

As previously noted, the implementation of seasonal topology assumptions may have limited impact on the IRM studies in the near-term. This whitepaper focuses on the process within the annual IRM study to capture relevant winter topology assumptions. Considerations for the process include:

- Identification of candidate interfaces to prioritize updating with seasonal assumptions

- Identification of available and relevant transfer limit studies
- Consideration between study timeline and topology assumption update opportunities

3.1 Identification of Candidate Interfaces

The first step to identify candidate interfaces is to screen for thermally constrained interfaces currently in the IRM model. Table 3 in the Appendix lists all internal NYCA interfaces and associated limiting phenomenon.

In addition, the annual IRM study involves conducting several sensitivity cases on major assumptions on a repeated basis. One of these sensitivity cases is the S02 sensitivity case, which removes all internal transfer limits and returns the NYCA system back to 0.1 LOLE. Results from the S02 sensitivity case include measuring maximum flow on interfaces with all internal interfaces for each month after removing the transfer limits. These results show where winter flow could exceed the annual limit and implementing seasonal transfer limits on these interfaces may have meaningful impact on the IRM study. See appendix for detailed results example of the S02 sensitivity case.

3.2 Available Transfer Limit Studies

Sources of transfer limit studies and associated timelines for study results that inform the IRM topology assumptions include:

- NPCC database for the upcoming year with intertie transfer limits and external area topology assumptions is typically available in May
- Transfer limits for certain interfaces in Load Zones J and K for the upcoming year are generally provided by the relevant TOs in June
- Topology assumptions for the resource adequacy model of the RNA are updated every two years for Year 4 to Year 10 of the RNA study period.
    - The STAR is conducted quarterly and based on the most recent completed RNA study. The topology assumptions of the STAR are typically not updated between RNA studies.
- The NYISO's operating studies are conducted for the current system, in advance of the upcoming season. The Summer Operating Study is completed and approved in the April-May timeframe for the upcoming summer, and the Winter Operating Study is completed and approved in October-November timeframe for the upcoming winter.
- In addition to thermal transfer limits, the NYISO also performs transfer limit analysis for voltage-limited interfaces and stability constraints, as major equipment changes on the system and affects these limitations.

Leveraging various sources of transfer limit studies requires consideration of (1) relevance of the transfer limit study (i.e., whether the studies are conducted for the consistent system conditions of the IRM model); and (2) timing of available study results in conjunction with the IRM study timelines.

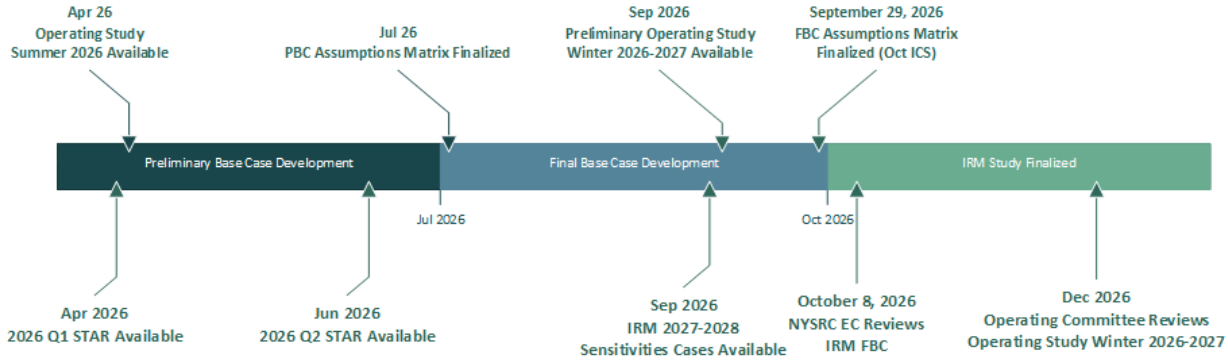
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3.3 Study Timeline

The annual IRM study is forward-looking for the next Capability Year. The study process typically starts early in the year as system condition assumptions for the following year, such as new generation development, Special Case Resource (SCR) enrollment and load forecast, become available. The IRM study has two major milestones: the Preliminary Base Case (PBC) and the Final Base Case (FBC), with assumptions for the PBC typically finalized in July and assumptions for the FBC typically finalized in October. While the final IRM and the base case are officially typically approved at the December NYSRC Executive Committee meeting, October is considered the major deadline for finalizing FBC assumptions, including topology. Therefore, transfer limit study results that are not available by October would have limited opportunity to inform the IRM topology assumptions, unless such results represent significant late changes to the base case assumption.

The following Figure 1 visualizes the IRM study timeline and the timeline for available transfer limit study results, which identifies the opportunity for potential topology assumption updates and associated transfer limit studies.

Figure 1: Timeline of the 2027-2028 IRM study with Available Transfer Limit Study Results



4 Recommended Seasonal Topology Update Process

The recommended seasonal topology update process consists of three primary phases:

1. Identification of candidate interfaces for seasonal topology updates.
   - Use the results from the S02 sensitivity case from the prior year IRM study and identify internal NYCA interfaces where unconstrained winter flow exceeds the applicable annual transfer limit that is based on summer conditions.
   - Confirm whether the identified interface was binding during the winter months in the prior year PBC when the summer transfer limit was applied annually.
2. PBC Topology Update
   - Update intertie transfer limits and external area topology assumptions based on NPCC database (consistent with current practice)

- Update NYCA internal interfaces that are voltage or stability limited using most recent relevant NYISO transfer limit studies. (consistent with current practice)
- Update remaining NYCA internal interfaces summer transfer limits using most recent relevant information (consistent with current practice)
    - Consider NYISO's Summer Operating Study for the upcoming summer and information from the most recent RNA and/or STAR.
- For candidate interfaces identified for seasonal topology updates, use the most recent relevant information for the associated winter transfer limits
    - Consider NYISO's Winter Operating Study for the past winter and information from the most recent RNA/STAR
- Update transfer limits for certain interfaces for Load Zone J and Load Zone K using information from relevant TOs, if available (consistent with current practice)
    - Collaborate with TOs for potential seasonal transfer limit inputs

3. FBC Topology Update
    - Update NYCA internal interfaces transfer limits using the most recent relevant information, if applicable (consistent with current practice)
        - Consider any changes to the NYCA system identified since the PBC based on information from the most recent NYISO transfer limit studies, Operating Studies and/or RNA and STAR
    - For candidate interfaces identified for seasonal topology updates, confirm or update with most recent relevant information for the associated winter transfer limits
        - Consider the preliminary results from the NYISO's Winter Operating Study for the upcoming winter
    - Update transfer limits for certain interfaces for Load Zone J and Load Zone K using information from relevant TOs, if applicable
        - Collaborate with TOs for potential seasonal transfer limit inputs

The seasonal topology update process is recommended to be implemented starting with 2027-2028 IRM study.

4.1 Identification of Candidate Interfaces

As shown in the Appendix, the S02 sensitivity case results show monthly maximum interface flow when unconstrained against the interface limits in the study base case, which helps to identify interfaces with unconstrained flow higher than the limit during winter. However, the removal of transmission constraints can affect the paths selected by GE MARS and the S02 sensitivity case also returns the NYCA system back to 0.1 LOLE. It is recommended that S02 results are used as a screening tool and require further review before an interface is identified for a seasonal update.

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The initially screened interfaces will then be reviewed in the actual base case of the PBC from prior year to confirm whether such interfaces are binding during winter months. Actual winter-binding interfaces will be identified as candidate interfaces for seasonal transfer limit updates and proceed to the next step of the recommended process.

4.2 Considerations for Source Transfer Limit Studies

When updating the transfer limits for thermally limited NYCA internal interfaces, the NYISO operating studies and RNA/STAR may be considered as potential sources for the IRM study assumptions. When selecting the proper source transfer limit studies, consideration should be given to:

- Studies that reflect the most up-to-date system information
- Studies that reflect the system conditions that are consistent with the IRM model

Special considerations are required for updating the winter transfer limits using the NYISO Winter Operating Study due to the study timeline. During the PBC topology update, the most recent available Winter Operating Study reflects the system conditions for the prior winter season. Winter Operating Study results for the upcoming winter are expected to be available in October and approved by the NYISO Operating Committee in November. To have the most up-to-date inputs for the IRM model, preliminary results from the Winter Operating Study for the upcoming winter will be reviewed for potential adoption during the topology update for the FBC.

In addition to the NYISO studies, relevant TOs also provide transfer limits for certain interfaces for Load Zone J and Load Zone K where there are opportunities to capture seasonal transfer limit inputs. While TOs have historically provided relevant topology inputs during the PBC assumptions update, developing seasonal transfer limits may require TOs to perform additional studies, which can delay the availability of some IRM topology inputs to the FBC assumptions update.

5 Impact Assessment based on 2027-2028 IRM Study

Applying the recommended seasonal topology update process to the 2027-2028 IRM study results in:

- 4 interfaces are identified for seasonal topology updates
  - West-Central reverse
  - Marcy-South forward
  - Y49/Y50 reverse
  - Jamaica Ties forward and reverse
- PBC topology update included separate winter transfer limit for West-Central Reverse interface

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- FBC topology update included seasonal transfer limit for selected Load Zone K interfaces and interface groups with TOs support
- Aggregated seasonal topology updates decreased the IRM by 0.15% IRM

5.1 Identification of Candidate Interfaces for Seasonal Topology Update

Using the results from 2026-2027 IRM S02 sensitivity case, interfaces exhibiting unconstrained winter flows that exceed the applicable annual transfer limit were identified.

The 2026–2027 IRM PBC was then reviewed and confirmed the following interfaces are binding during winter months and hence recommended for seasonal transfer limit updates:

- West-Central Reverse
- Y49/Y50 Reverse
- Jamaica Ties forward and reserve

5.2 PBC Topology Update

In addition to the current practice of updating topology assumptions for the 2027-2028 IRM study model, the West-Central Reverse interface was updated in the PBC with a separate winter transfer limit, based on the 2025-2026 NYISO Winter Operating Study results.

Table 1: West-Central Reverse Transfer Limits

Assumption	West-Central Reverse Limit (MW)
2026-2027 IRM Study Annual Limit	2,225
2025-2026 NYISO Winter Operating Study Limit	2,750
2027-2028 IRM PBC Winter Limit	2,750
2026 NYISO Summer Operating Study Limit	2,125
2027-2028 IRM PBC Summer Limit	2,125

5.3 FBC Topology Update

In addition to the current practice of capturing incremental updates to the topology assumptions for the 2027-2028 IRM FBC, the following Load Zone K interfaces were updated with seasonal transfer limits based on inputs provided by applicable TOs.

Table 2: Load Zone K Seasonal Limits

Interface	27-28 IRM PBC Annual Limit (MW)	Winter Limit Update (MW)	*Delta (MW)*
Y49/Y50 Forward	1,293	1,434	*+141*
Y49/Y50 Reverse	385	1,060	*+675*
Jamaica Ties Reverse	485	584	*+99*
I+J to K Forward	1,598	1,736	*+138*
I+J to K Reverse	120	790	*+670*
LI West Reverse	34	704	*+670*

5.4 IRM Impacts

The aggregated impact of all topology updates included in the 2027-2028 IRM study resulted in a net 0.09% decrease in IRM. [1] [2] The isolated impact of all seasonal topology updates accounts for a 0.15% decrease in the IRM. The addition of higher winter transfer limits in Load Zone K was the primary driver of IRM impact out of all topology updates during the 2027-2028 IRM study. [1]

6 Conclusion

The seasonal topology update process provides a consistent, repeatable, and efficient framework for considering applicable winter transfer limits as part of the annual IRM study topology update process. The process focuses additional modeling efforts on internal NYCA interfaces for which seasonal treatment may be relevant/impactful. It also retains the broader annual and as-needed topology review and preserves the engineering judgment needed to maintain alignment of IRM study assumptions with applicable planning, operating, and Transmission Owner information.

The supporting assessments and initial implementation in the 2027–2028 IRM study demonstrated that the process can be incorporated into the existing PBC and FBC development schedule alongside other annual topology updates. The process creates a foundation for adapting the IRM study and model to capture more accurate study assumptions as winter risk increases and the grid continues to evolve. The NYSRC recommends continuing the seasonal topology update process approved by the ICS on April 28, 2026 [2] as part of

each annual IRM study. The process should continue to be monitored and updated, as appropriate, to reflect changes in system conditions, available source studies, and IRM study modeling needs.

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7 References

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Appendix

Additional Transmission Limit Background Information

Table 3: Annual Internal NYCA Interface Limits Represented in the 2026-2027 IRM Study [3]

Abbreviation	Full Name	Limiting Phenomenon	Forward Limit	Reverse Limit
A_TO_B	DYSINGER EAST	Thermal	1,925	1,999
B_TO_C	WEST CENTRAL	Thermal	1,500	2,225
C_TO_E	VOLNEY EAST	Thermal	5,650	1,999
D_TO_E	MOSES SOUTH	Thermal	3,500	1,600
E_TO_F	CENTRAL EAST	Voltage	3,885	1,999
E_TO_G	MARCY SOUTH	Thermal	2,300	1,600
F_TO_G	CAPITAL HUDSON VALLEY	Thermal	5,400	1,999
G_TO_H	UPNY - CONED	Voltage	7,050	1,999
H_TO_I	MILLWOOD SOUTH	Thermal	8,450	1,999
I_TO_J	SPRNBRK/ DUNWOODIE SOUTH	Thermal	4,400	1,999
I_TO_K	Y49/Y50	Thermal	1,293	460
J_TO_K	JAMAICA TIES	Thermal	305	505

Impact of Individual Limit Changes

To assess the potential IRM impact due to implementing seasonal transfer limits, testing was conducted on the 2026-2027 IRM PBC using a 10% increase on the winter transfer limits for the interfaces that were screened for higher unconstrained flow during winter than the annual limit, using S02 Sensitivity Case (see Table 4).

The results of this analysis indicated that a small change to an interface limit, when isolated, can reduce the monthly hours that the interface is transmission constrained, but this may not materially impact LOLE.[4] Non-material decreases in LOLE and EUE were observed when all internal NYCA transmission limits were increased by 10% during the winter months (see table 5).

Table 4: Hours at Interface Limit in Winter Months for Short-Listed Interfaces

Hours At Interface Limit in Winter			
Interface	2026-2027 IRM PBC	+10% Winter Limit Increase	Delta
Marcy-South forward	21.5	15.9	-5.6
West-Central reverse	13.0	1.5	-11.5
Y49/Y50 reverse	149.1	107.6	-41.5
Jamaica Ties forward	5.4	4.3	-1.1
Jamaica Ties Reverse	302.3	285.0	-17.3

Table 5: Reliability Metrics for 2026-2027 IRM PBC, 10% Winter Limit Increase Cases

Reliability Metrics			
Interface	2026-2027 IRM PBC	+10% Winter Limit Increase	Delta
LOLE (days/year)	0.10027	0.09997	-0.0003
EUE (MWh, winter)	21.520	21.254	-0.266
EUE (MWh, annual)	168.504	168.351	-0.153

Impact of Multiple Limit Changes

In addition to the screened interfaces using the S02 Sensitivity Case results, some major interface groups within the IRM model are historically impactful when transfer limits are modified. Impact analyses for major interface group limits were conducted to assess the potential impact from implementation of seasonal transfer limits. It should be noted that no potential transfer limit changes are anticipated with these interface groups for seasonal topology updates, and the assessments were conducted for testing purposes only. [5]

1. For the Total-East interface group (which includes the Marcy-South (E-G) and Central-East (E-F) interfaces), an increase on the Marcy-South with a decrease on the Central-East interface was studied. The assessment assumed a lower winter limit for the voltage-constrained Central-East interface.
2. For the UPNY-SENY interface group (which includes Marcy-South (E-G) and Capital-Hudson Valley (F-G) interfaces), an increase to both interfaces during winter months were assessed.

3. A simultaneous increase on all upstate internal interface transfer limits (all A-F interfaces), and a decrease on all downstate internal interface limits (all G-K interfaces) during winter months was assessed.

Table 6: Impact of Group Interface Limit Changes

Interface Group	Interfaces	Winter Limit Change	LOLE	Delta from Base Case (0.1)
Total East	Central-East	-10%	0.10027	0.00000
	Marcy-South	+10%		
UPNY-SENY	Marcy-South	+10%	0.10027	0.00000
	Capital-Hudson	+10%		
Upstate-Downstate	Load Zones A-F	+10%	0.10262	0.00235
	Load Zones G-K	-10%		

No material impact on LOLE during the winter months was observed with these assessments except for Upstate-Downstate simultaneous transfer limit changes. The results of these assessments indicate that a decrease in downstate winter interface limits would not necessarily be mitigated by an increase in upstate transmission capability during that period. Based on these assessments, winter LOLE risk in the 2026-2027 IRM study model was not observed to be materially impacted by increases or decreases in transmission capability during the winter period. As winter risks increase, continued monitoring of the impacts of seasonal topology updates on resource adequacy metrics will remain part of annual PBC development.

IRM 2027-2028 Sensitivities Analysis

Following development of the 2027–2028 PBC, the S02 sensitivity case initiated the screening process for the 2028–2029 IRM study cycle [6]. The results identified interfaces for further review under the approved process. The results identified the Dysinger-East reverse, West-Central reverse, Y49/Y50 reverse, and Jamaica Ties interfaces as potential candidates for seasonal topology updates for the 2028-2029 IRM study.

Figure 2: IRM 2027-2028 S02: Forward Interface Monthly Maximum Flows

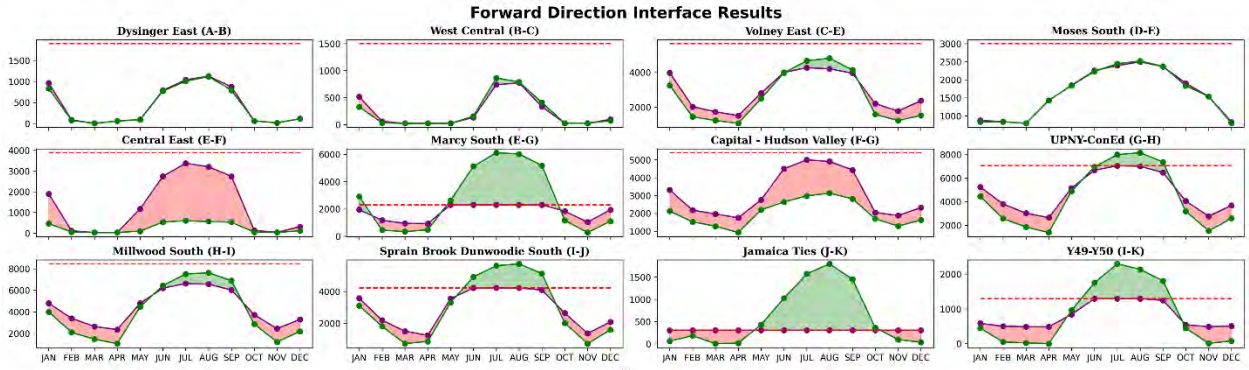


Figure 3: IRM 2027-2028 S02: Reverse Interface Monthly Maximum Flows

