



SIMULTANEOUS TRANSMISSION IMPORT LIMIT STUDY (SIL Study)

**Alfred B. Corbett P.E.
Group Manager
Division of Reliability and Engineering Services
Office of Electric Reliability (OER)
December 16, 2009**



I: Introduction

Disclaimer: Nothing New

The information which is presented during this SIL Study presentation reflects the Office of Electric Reliability's interpretation of existing FERC orders and directives. No new directives are being communicated through this presentation.



II: Background

Purpose of a SIL Study

Is to determine the simultaneous import level of available uncommitted capacity that can serve the relevant market load under the most limiting normal and single-contingency operating conditions.

The SIL study is intended to provide a reasonable simulation of historical conditions and is not intended to provide a theoretical maximum transfer capability or best import case scenario.

Order No. 697 P 354



II: Background

The SIL Study Directive

Requirement to perform a SIL study

A seller that owns, operates or controls transmission is required to conduct simultaneous transmission import capability studies for its home control area and each of its directly-interconnected first-tier control areas consistent with the requirements set forth in *AEP Power Marketing, Inc.*, 107 FERC ¶ 61,018 (2004 (the April 14, 2004 Order)), as clarified in *Pinnacle West Capital Corp.*, 110 FERC ¶ 61,127 (2005).

Order No. 697 P 346



II: Background

Defining SIL Study Areas

Two areas are analyzed in a SIL study, the First-Tier Area, which is the exporting area, and the Study Area, which is the importing area.

April 14 Order, Appendix E



II: Background

Defining SIL Study Areas

The First-Tier Area is a single, aggregate area representing the surrounding balancing authority areas (BAAs), that are directly interconnected to the Study Area through tie-lines and interconnection agreements.



II: Background

The SIL Study Directive

Historical Practices

To determine the amount of transfer capability under the SIL study, the Commission stated that historical operating conditions and practices of the applicable transmission provider should be used and the analysis should reasonably reflect the transmission provider's Open Access Same-Time Information System (OASIS) operating practices.

Order No. 697-A P 132

The Commission stated that when actual OASIS practices conflict with the instructions in Appendix E of the April 14 Order, sellers should follow OASIS practices and must provide documentation of these practices.

Order No. 697-A P 135



II: Background

The SIL Study Directive

Historical Practices

When centering the generation market power analysis on the transmission providing utility's First-Tier Area (i.e., markets), the transmission-providing seller should use the methodologies consistent with its implementation of its Commission-approved Open Access Transmission Tariff (OATT), thereby making a reasonable approximation of simultaneous import capability that would have been available to suppliers in surrounding First-Tier markets during each seasonal peak.

Order No. 697 P 346 and 354



II: Background

The SIL Study Directive

Historical Practices

The import capability calculation considers both the Transmission Provider's tariff as a basis and the transmission reliability margins existing on the applicant's flow gates during each seasonal peak being studied.

April 14 Order, Appendix E



II: Background

The SIL Study Directive

Historical Practices

The power flow cases should represent the Transmission Provider's tariff provisions, the operational practices historically used, all reliability margins (transmission reliability margin (TRM), capacity benefit margin (CBM), counter flow, generating operating limits, operating reserves) existing during each peak, and all firm/network reservations held by applicant/affiliate resources during the most recent seasonal peaks.

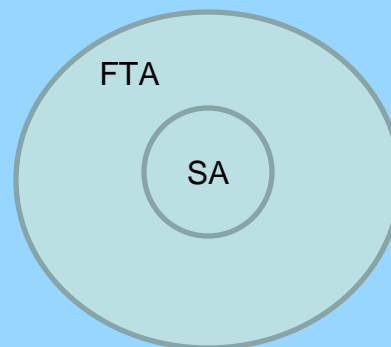
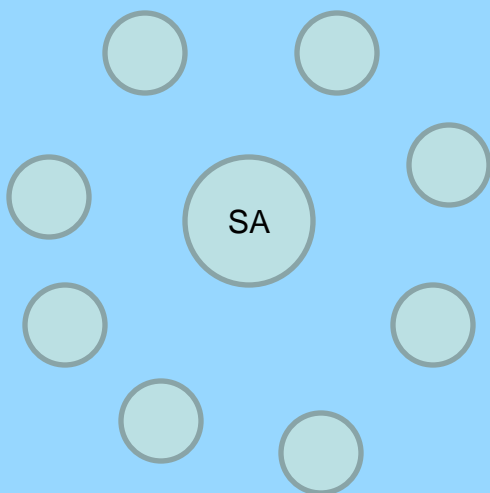
April 14 Order, Appendix E

II: Background

The SIL Study Directive –Two Areas

The First-Tier Area is modeled as a single aggregated area representing surrounding BAAs directly inter-connected (such as with physical tie-lines with interconnection agreements) to the Study Area.

Order No. 697 P 232





II: Background

The SIL Study Directive

Two Areas: Study Area and First Tier

The Transmission Provider applicant is required to treat its balancing authority area as a single area (“Study Area”) and treat the First-Tier markets (single aggregated balancing authority area) as a single area (representing the surrounding/available balancing authority areas to import power from).

April 14 Order, Appendix E



II: Background

SIL Study Support Files Directive

Aggregate all Study Area and First Tier Area Contingencies

Apply an aggregation of all Study Area and First-Tier Area single-contingencies and of all monitored facilities historically used and identified in the seller's available transfer capability (ATC) methodology and OASIS practices documentation.

April 14 Order, Appendix E

The "contingency" model should use the same assumptions used historically by the transmission provider in approximating its BAA import capability.

April 14 Order P 84



II: Background

The SIL Study Directive

Transfer Study portion of the SIL Study

A transfer study is performed to:

Identify the most limiting non-contingency incremental transfer capability (NITC) or first-contingency incremental transfer capability (FCITC) simultaneous incremental transfer limit due to thermal, voltage, or stability limits.

The transfer capability should also include any other limits (such as stability, voltage, CBM, or TRM as defined in the tariff and that existed during each seasonal peak.

Order No. 697 P 346



II: Background

The SIL Study Directive

The Transfer Study must be Simultaneous

The import capability of the Study Area is the simultaneous transfer limit from the aggregated First-Tier market area into the Study Area.

April 14 Order, Appendix E



II: Background

The SIL Study Directive

Transfer Study – Generation Shift Methodology

In addition, the applicant shall scale-up available generation in the exporting (aggregated First-Tier Areas) and scale-down the Study Area resources according to the same methods used historically in assessing available transmission for non-affiliate resources.

April 14 Order, Appendix E



II: Background

SIL Study Support Files Directive

Transfer Study: Generation Shift Methodology

To simulate First-Tier Area simultaneous transfer capability to the Study Area, scale-up available uncommitted generation in the First-Tier Area while simultaneously scaling-down on-line generation in the Study Area (the generation shift methodology).

April 14 Order, Appendix E



II: Background

SIL Study Support Files Directive

Transfer Study: Load Shift Methodology

The seller may scale-down load in the First-Tier Area while simultaneously scaling-up load in the Study Area (the load shift methodology) if this practice is historically used and identified in the seller's ATC methodology and OASIS practices documentation.



II: Background

The SIL Study Directive

Transfer Study – What it Represents

Therefore, this calculation represents an estimate of the total import capability available to remote resources.

April 14 Order, Appendix E

The transfer study is an ATC study that estimates the capability of the aggregated First-Tier Area to simultaneously export available uncommitted generation to serve load of an associated Study Area.



II: Background

The SIL Study Directive

TTC values as SIL value

Determining the SIL value:

The SIL value is not an incremental transfer capability value, it is a total transfer capability (TTC) value. The SIL value is determined by applying the net area interchange to the incremental transfer capability identified by the transfer study.



II: Background

The SIL Study Directive

TTC values as SIL value

Thus TTC must be appropriately adjusted for all applicable firm transmission commitments held by affiliated companies that represent transfer capability not available to First-Tier Area supply.

Order No. 697 P 364, n.364 and Order No. 697-A P 142



II: Background

The SIL Study Directive

TTC values as SIL value

Determining the SIL value.

Furthermore, when using a TTC value in the SIL study the TTC value must properly account for all firm transmission reservations, transmission reliability margin, and capacity benefit margin.

Order No. 697-A P 142



II: Background

The SIL Study Directive

TTC values as SIL value

Simultaneous import, total transfer capability for the transmission provider's Study Area, is an energy transfer study to determine the amount of competitive supply that could have historically been utilized from remote resources to serve load in the Study Area.

Order No. 697 P 361



II: Background

The SIL Study Directive

SIL Study Boundary Conditions

SIL study boundary conditions: Upper Limit

The SIL value may be limited by the lesser of the First-Tier Area available uncommitted generation, Study Area peak load, or the total transfer capability determined by the transfer study.

The SIL study is a benchmark of historical conditions, including peak load. It is a study to determine how much competitive supply from remote resources can serve load in the study area.

Order No. 697 P 361

When transfer exceeds study area peak load, it becomes interchange.



II: Background

The SIL Study Directive

SIL Study Boundary Conditions

SIL study boundary conditions:

The source (first-tier remote resources) can only deliver power to load in the seller's balancing authority area if adequate transmission is available out of its first-tier area, adequate transmission is available at the seller's balancing authority area interface, and transmission is internally available in the First-Tier and Study Areas.

Order No. 697 P 364



II: Background

The SIL Study Directive

SIL Study Boundary Conditions

SIL Study boundary conditions: Lower limit

Negative SIL values are caused by N-0 or N-1 base case overloads. Only when these overloads can be addressed, can they be ignored.



II: Background

The SIL Study Directive

Some possible explanations for N-0 or N-1 overloads:
modeling errors

justify construction projects

have associated operating guides
switching reconfigurations
reduced duration re-ratings
sacrificial re-ratings
re-dispatch solutions

Note: Should always coordinate with BAA engineer to confirm that mitigation of these base case overloads does occur or that these overloads are not serious modeling errors.



II: Background

The SIL Study Directive

Summary

The SIL study is intended to provide a reasonable simulation of historical conditions and is not intended to provide a theoretical maximum energy transfer capability or best import case scenario.

Order No. 697 at P 354



III. Performing a SIL Study

Performing the SIL Study Directive

In determining the transfer capability, the analysis should not deviate from and must reasonably reflect the seller's OASIS operating practices.

Scaling methods should represent historical OASIS practices when conducting a SIL. Using historical practices provides an appropriate method to obtain a transparent and measurable analysis of a seller's actual balancing authority area transmission conditions and practices. "Improper or theoretical scaling methods which do not represent a seller's actual transmission practices may have the effect of allowing more competing generation into the balancing authority area than could actually be accommodated."

Order No. 697 P 357



III. Performing a SIL Study

Performing the SIL Study Directive

Sellers shall use the same OASIS methods when:

- determining simultaneous operating limits;

- determining generation dispatch;

- applying operating guides;

- identifying contingencies; and

- monitoring facilities when estimating transfers between the Study Area and First-Tier Area.



III. Performing a SIL Study

Performing the SIL Study Directive

Although every seller may not be familiar with each Study Areas' and First-Tier Areas' system limits; they should be familiar with major constraints, path limits, and delivery problems in these neighboring power systems through participation in regional studies and through day-to-day coordination with neighboring power system engineers.

Order No. 697 n.361



III. Performing a SIL Study

Selecting the Reference Case

Four Seasonal Eastern Interconnection Reliability Assessment Group (ERAG), regional or OASIS Reliability Models for the relevant study period

Winter (December of previous year to February)

Spring (March to May)

Summer (June to August)

Fall (September to October)

See Order No. 697-A, Appendix D-1 for a list of the regions and study periods.



III. Performing a SIL Study

SIL Study Model Development

The seller is required to provide reference base cases that were used as a starting point for developing the seasonal benchmark cases analyzed in the transfer study.

Benefits of using a uniform transmission import model include: transparency, consistency, clarity, and reasonable assurance that system conditions have been adequately captured.

Order No. 697 n.357



III. Performing a SIL Study

SIL Study Model Development

In addition, the seller is required to provide documentation listing all historical assumptions used to develop each historical, seasonal benchmark case.

April 14 Order, Appendix E



III. Performing a SIL Study

SIL Study Model Development

Seasonal benchmark cases represent historical operating conditions and practices, the seller's tariff provisions, and firm/network reservations held by seller resources during the most recent seasonal peak loads.

April 14 Order, Appendix E



III. Performing a SIL Study

SIL Study Model Development

These cases should simulate historical seasonal conditions that were present including:

1. seasonal generation and transmission facility ratings,
2. seasonal thermal, voltage, or stability operating limits (SOL, IROL)
3. facility de-ratings used to maintain reserve margins (TRM, CBM),
4. generator operating limits (Pmax, Pmin),
5. wind generator output limitations (capacity factors),
6. short-term firm (greater than 28 days) and long-term firm reservations, Order No. 697 P 368
7. generating unit dispatch historically used,
8. uncommitted generation which is unavailable for dispatch should be “blocked” from participating in First-Tier Area export transfers (units off-line for maintenance, mothballed units, uncommitted generating units which are not available for dispatch by the seller, and hydro units limited by drought conditions),
9. seasonal peak loads.



III. Performing a SIL Study

Conditioning the Reference Cases Development of Seasonal Benchmark Cases

Changes are consistent with Transmission Provider documented OASIS practices

Document Changes made to each Reference Case

Four Seasonal Benchmark Cases

Winter (December of previous year to February)

Spring (March to May)

Summer (June to August)

Fall (September to October)



III. Performing a SIL Study

Development of First-Tier Area

Identify all BAAs directly interconnected to the Study Area.

Create an aggregated First-Tier Area consisting of all BAAs directly interconnected to the Study Area. (sub-system file, “join” command)



III. Performing a SIL Study

Development of Contingency File

Identify all single-contingencies used by the appropriate First-Tier and Study Area TPs when calculating ATC. Coordinate with BAA engineers. Consider OASIS practices. You're trying to get a set of valid contingencies which may have embedded operating guides or flowgates.



III. Performing a SIL Study

Development of Monitor File

Identify all transmission and generation facilities to be monitored as limiting elements used by the appropriate First-Tier and Study Area when calculating ATC. Coordinate with BAA engineers. Consider OASIS practices. You're trying to get a set of valid monitored elements.



III. Performing a SIL Study

Development of Sub-system File

Scale-up all available uncommitted generation in the First-Tier Area, and scale-down on-line generation in the Study Area. Coordinate with BAA engineers. Consider OASIS practices.



III. Performing a SIL Study

Ready to Conduct the Transfer Study

Determine which transfer distribution factor (TDF) to use. Make sure the value is low enough to accommodate each First-Tier and Study Area's TDF value.

AC Contingency Calculation or DC Contingency Calculation

Transfer Limit



III. Performing a SIL Study

Selecting the Correct Transfer Level From the Results

Check the TDF value

Investigate each negative FCITC limit with the BAA engineer in whose area the limiting element is located, and verify the contingency with the BAA engineer.

For each transfer limit results, verify the limiting element and contingency with the BAA engineer. Check for operating guides and valid contingencies.



III. Performing a SIL Study

Determining the Study Area's Net Area Interchange

Use the load flow report to determine the First-Tier Area interchange value by summing up all First-Tier Area BAA's interchange values.



III. Performing a SIL Study

Determining The Calculated SIL Value

The SIL value is calculated by applying the Study Areas' net area interchange to the FCITC or NITC value selected from the Managing and Utilizing System Transmission (MUST) analysis results.

$$\text{SIL Value} = (\text{FCITC or NITC}) - (+/- \text{ Study Areas' net area interchange})$$

When the Study Areas' net area interchange is positive, the Study Area is exporting power, and:

$$\text{SIL Value} = (\text{FCITC or NITC}) - (\text{Study Areas' net area interchange})$$

When the Study Areas' net area interchange is negative, the Study Area is importing power, and:

$$\text{SIL Value} = (\text{FCITC or NITC}) + (\text{Study Area's net area interchange})$$



III. Performing a SIL Study

Determining The Reported SIL Value

The reported SIL value is determined from the lesser of:

1. The Study Area peak load.
2. The First-Tier Area available uncommitted generation.
3. The calculated SIL value.

Carolina Power & Light Company P 9



IV. Submittals

The SIL Study Documentation Submittals

Power Flow Benchmark Cases of Historical Monthly Peaks. In addition, we will require Transmission Provider applicants to submit power flow benchmark cases (with supporting data) used in calculating total simultaneous import capability for each of the previous four seasonal peaks.

April 14 Order, Appendix E



IV. Submittals

The SIL Study Documentation Submittals

The applicant is required to provide documentation listing all historical assumptions used to develop each historical seasonal benchmark case. Additionally, the applicant should include the referenced base case, regional or Multiregional Modeling Working Group (MMWG), NERC planning loadflow case) case was used as a starting point.

April 14 Order, Appendix E



IV. Submittals

The SIL Study Documentation Submittals

The benchmark cases should reasonably simulate the historical conditions that were present including; facility/line de-ratings used to maintain capacity benefit margins (CBM) and transmission reliability (TRM/CBM), actual unit dispatch used to fulfill network and firm reservation obligation, the actual peak demand, generator operating limits imposed on all resources in real time, other limits/constraints imposed during the season peaks.

April 14 Order, Appendix E



IV. Submittals

The SIL Study Documentation Submittals

1. SIL Study methodology.
2. Documentation describing OASIS practices (methodology, studies, participation in regional study forums, coordination with neighboring power system engineers) historically used for determining operational limits (thermal, voltage, or stability limits) and identifying monitored facilities and contingencies.
3. Description of any conflict between OASIS practices and instructions directed by the Commission in Order Nos. 697, 697A, and the April 14, 2004 Order Appendix E.



IV. Submittals

SIL Study Model Documentation Submittals

These cases should simulate historical seasonal conditions that were present including:

1. seasonal generation and transmission facility ratings,
2. seasonal thermal, voltage, or stability operating limits (SOL, IROL)
3. facility de-ratings used to maintain reserve margins (TRM, CBM),
4. generator operating limits (Pmax, Pmin),
5. wind generator output limitations (capacity factors),
6. short-term firm (greater than 28 days) and long-term firm reservations, Order No. 697 P 368
7. generating unit dispatch historically used,
8. uncommitted generation that is unavailable for dispatch should be “blocked” from participating in First-Tier Area export transfers (units off-line for maintenance, mothballed units, uncommitted generating units that are not available for dispatch by the seller, and hydro units limited by drought conditions), and
9. seasonal peak loads.



IV. Submittals

SIL Study Model Documentation Submittals

1. Provide reference base cases (example: regional, OASIS or ERAG cases) used as a starting point for developing seasonal benchmark cases in .sav and .raw file format.

Winter (November – February)

Spring (March – May)

Summer (June – August)

Fall (September – November)

See Order No. 697-A, Appendix D-1, Order No. 697-C, Appendix D-2, and errata notice issued in Docket No. RM04-7-006 (July 9, 2009) for a list of the regions and study periods.

2. Provide documentation listing all historical assumptions applied to each reference base case which was necessary in developing each seasonal benchmark case.



IV. Submittals

SIL Study Model Documentation Submittals

3. Provide seasonal benchmark cases in .sav or .raw file format.
 - Winter (November – February)
 - Spring (March – May)
 - Summer (June – August)
 - Fall (September – November)



IV. Submittals

Study Area Documentation Submittals

The Study Area

1. Provide a listing of each Study Areas' load modeled for each seasonal benchmark case.
2. Provide a listing of each Study Areas' net area interchange modeled for each seasonal benchmark case.



IV. Submittals

First-Tier Area Documentation Submittals

The First-Tier Area

1. Provide a listing of the aggregated BAAs representing each Study Areas' First-Tier Area.
2. If the seller is using the generating shift methodology, provide a listing of each First-Tier Areas' available uncommitted generation modeled for each seasonal benchmark case.
3. If the seller is using the load shift methodology, provide a listing of the First-Tier Areas' aggregated load modeled for each seasonal benchmark case.



IV. Submittals

The Contingency File Documentation Submittals

Provide a listing of each Study Areas' and its First-Tier Areas' single-contingency file for each seasonal benchmark case, an aggregation of all Study Area and First-Tier Area transmission and generation contingencies historically used and identified in the seller's ATC methodology and OASIS practices documentation.

April 14 Order, Appendix E; Order No. 697 P 346 and P 354



IV. Submittals

The Exclude File Documentation Submittals

Filers have the option to provide an exclude file for each seasonal benchmark case, which is an aggregation of any Study Area or First-Tier Area transmission and generation facility contingencies that should not be included in the contingency file. When an exclude file is provided, please provide a written description of why the facilities or contingencies have been excluded.



IV. Submittals

The Monitor File Documentation Submittals

Provide a monitor file for each seasonal benchmark case, which is an aggregation of all Study Area and First-Tier Area transmission and generation facilities historically used and identified in the seller's ATC methodology and OASIS practices documentation.

April 14 Order, Appendix E



IV. Submittals

The Sub-System File Documentation Submittals

Sub-system file (generation shift methodology):

1. For each seasonal benchmark case, provide a listing of the aggregated BAAs representing each Study Areas' First-Tier Area.
2. Scale-up First-Tier Area available uncommitted generation for export, while respecting generator maximum outputs (P_{max}). Do not include off-line generating units that are unavailable for dispatch (units off-line for maintenance, mothballed units, uncommitted generating units which are not available for dispatch by the seller, and hydro units limited by drought conditions).
3. Scale-down Study Area on-line generation for import, while respecting generator minimum outputs (P_{min}).



IV. Submittals

The Sub-System File Documentation Submittals

Sub-system file (load shift methodology):

1. For each seasonal benchmark case, provide a listing of the aggregated BAAs representing each Study Areas' First-Tier Area.
2. Scale-down First-Tier Area load for export.
3. Provide the scaling factors used in load shift methodology.
4. Provide adequate support and justification for the scaling factor used in the load shift methodology.
5. Provide an explanation for how the resulting SIL value compares had a generation shift methodology been used.



IV. Submittals

The MUST Analysis Results Documentation Submittal

Identify the Transfer Distribution Factor (TDF) cut-off/threshold value used in seller's transfer study analysis.



IV. Submittals

The MUST Analysis Results Documentation Submittal

1. Provide the Study Areas' First-Contingency Incremental Transfer Capability (FCITC) or Non-Contingency Incremental Transfer Capability (NITC) import value selected from the transfer study results, and indicate if the value is a thermal, voltage, or stability limit.
 - a. Provide an explanation why any lesser FCITC or NITC value was not selected from the transfer study results. (noted on the output)
 - b. Describe any operating guide used to mitigate a limiting constraint to increase the transfer limit. An operating guide used to mitigate a limiting constraint shall be tested to determine whether it successfully mitigates the limiting constraint thereby increasing the transfer limit.



IV. Submittals

The MUST Analysis Results Documentation Submittal

- c. Verify the limiting constraint rating. Base case N-1 overloads should not be considered as limiting constraints, unless this constraint is within the Study Area or First-Tier Area and is further explained by the seller. The seller may apply facility rating adjustments historically used and identified in the seller's ATC methodology and OASIS practices documentation.

- d. Verify the validity of the contingency. Valid contingencies are contingencies which are historically used and identified in the seller's ATC methodology and OASIS practices documentation.



IV. Submittals

SIL Study Support Files Directive

Load Shift Methodology

When sellers use the load shift methodology, the seller shall submit adequate justification for scaling factors, explain how the resulting SIL value compares had the seller used the generation shift methodology, MUST analysis, and the selected SIL value using the generation shift methodology.

Order No. 697-A P 145



V: References

- *AEP Power Marketing, Inc.*, 107 FERC ¶ 61,018 (April 14 Order), *order on reh'g*, 108 FERC ¶ 61,026 (2004) (July 8 Order).
- *Market-Based Rates for Wholesale Sales of Electric Energy, Capacity and Ancillary Services by Public Utilities*, Order No. 697, FERC Stats. & Regs. ¶ 31,252, *clarified*, 121 FERC ¶ 61,260 (2007), *order on reh'g*, Order No. 697-A, FERC Stats. & Regs. ¶ 1,268, *clarified*, 124 FERC ¶ 61,055, *order on reh'g*, Order No. 697-B, FERC Stats. & Regs. ¶ 31,285 (2008), Order No. 697-C, FERC Stats. & Regs. ¶ 31,291 (2009).
- *Carolina Power and Light Company*, 128 FERC ¶ 61,039 (July 16, 2009)