

Eversource 2023 ASO Study Customer Kickoff Meeting

Western Massachusetts & Greater Boston Areas

January 31, 2023

Agenda

- Introduction
- Lessons learned from previous ASO Studies
- Study types and definitions
- Overview of ASO areas
- Level 3 ASO Study technical data
- Process and next steps
- Q&A

Challenges in Previous ASO Studies

- Change of scope and non-standard scope requests after ISO-NE review and concurrence
 - ISO-NE requested change of the minimum load case dispatch which resulted in 2 weeks of re-study.
 - ISO-NE made non-standard study requests to assess a minimum load level of 5000 MW. This is not a load level defined in the ISO-NE planning procedures and Transmission Planning Technical Guide and needed an additional 2 weeks to study.
 - Stability study assumption change after Eversource was far along into the study, which led to 2 weeks of re-study
- Long lead time (4 months) to get models for relevant FERC queue projects models.
 - 4 months for ISO-NE to provide steady state and stability models
 - ES had to work with FERC QP developers on NDA's
- PSCAD models with poor qualities
 - Significant effort and time in model corrections
- PSCAD Models requirement
 - ISO-NE now requires GSU transformer saturation data to be included in PSCAD models for subsequent ASO studies

Proposed Improvements

- Improve communication to customers:
 - Eversource will provide bi-weekly email updates to ASO Study Participants
 - The updates will include more details about study activities, such as models, basecases, scope review and comment requests made to ISO-NE etc.
- Study process improvements
 - Automation of repetitive modeling tasks
 - Optimize study process – early model submission means early review

ASO Overview – Study Types

- Level 0 - [No Studies](#)
 - Collection and validation of PSCAD models for each project will be required for all projects
- Level 0 - [Transfer Limit Analysis](#)
 - Conduct transfer limit assessment to ensure no degradation of ISO-NE Interface Limits. If adverse impacts found, a Level 3 study will be required.
 - Level 0 screenings need to be completed before Level 3 studies start
 - Some Level 0 may require more detailed Level 3 studies, pending findings in Level 0 analysis
 - Collection and validation of PSCAD models
- Level 3 studies
 - Conduct thermal and voltage steady state, short circuit, stability analysis
 - PSCAD analysis will be required
 - Technical data will be requested from projects and is required to start studies

ASO Overview – Study Types (continued)

- Project Sizes

- > 1 MW and < 5 MW = [Level 0 - No Study](#) for substation or group of substations less than 5 MW
- > 1 MW and < 5 MW = [Level 0 - Transfer Limit Analysis](#) for substations less than 20 MW
- > 1 MW and < 5 MW = Level 3 ASO Study for substation with 20 MW
- ≥ 5 MW = Level 3 ASO Study
- ≤ 1 MW = No ASO analysis/study (provided not co-located)

Notes: Distribution studies/progress is separate from content in this presentation

Study Level Spreadsheet

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2021 ASO

DJO

Notices and Information

- 2021 ASO Notification
- [2021 ASO Customer Kickoff Meeting – Greater Boston & WMA](#)
- 2021 ASO Customer Kickoff Meeting – SEMA and Cape
- 2021 ASO Customer Update Meeting – SEMA/Cape Level 0 and Level 3

Reports to Impacted Customers

Monthly

- December 2022
- November 2022
- October 2022
- September 2022
- August 2022
- July 2022
- June 2022

Initial Determination Requests

When an ASO Impact Screen results in the potential need for a DG project to undergo an ASO study, Eversource will submit the project's data to ISO-New England (ISO-NE) with a request for determination on being included in an ASO study. Eversource will post those projects in this section along with any response it receives from ISO-NE.

- [See the initial Eastern Massachusetts determinations](#)
- [See the initial Western Massachusetts determinations](#)

- [Eversource's ASO Study Website](#)

- Eastern MA study level determinations
- Western MA study level determinations

Slide 7

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Please get a snapshot of the latest website

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ASO Overview – Western Massachusetts

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Station Capacity (MW)	Level 0 - No Study	Level 0 - Transfer Limit Analysis	Level 3 - Transmission Study	Grand Total(MW)	Number of Applications	Level 0 - No Study	Level 0 - Transfer Limit Analysis	Level 3 - Transmission Study	Grand Total
PITTSFIELD AREA	0	0	135	135	PITTSFIELD AREA	0	0	15	15
AMHERST 17K			4	4	AMHERST 17K			1	1
ASHFIELD 38A			9	9	ASHFIELD 38A			2	2
BERKSHIRE 18C			16	16	BERKSHIRE 18C			2	2
DOREEN 19A			36	36	DOREEN 19A			2	2
FRENCH KING 21B			2	2	FRENCH KING 21B			1	1
MONTAGUE 21C			20	20	MONTAGUE 21C			2	2
OSWALD 30B			2	2	OSWALD 30B			1	1
PARTRIDGE 15E			4	4	PARTRIDGE 15E			1	1
PLEASANT 16B			3	3	PLEASANT 16B			1	1
PODICK 18G			39	39	PODICK 18G			2	2
SPRINGFIELD AREA	5	13	55	73	SPRINGFIELD AREA	1	5	12	18
BLANDFORD 19J			29	29	BLANDFORD 19J			7	7
CLINTON 21S	5	2		7	CLINTON 21S	1	1		2
GUNN 15A		2		2	GUNN 15A		1		1
ORCHARD 27A		4		4	ORCHARD 27A		2		2
PIPER 21N		5		5	PIPER 21N		1		1
SILVER 30A			15	15	SILVER 30A			2	2
SOUTHWICK 29A			7	7	SOUTHWICK 29A			2	2
W SPRINGFIELD 8C			4	4	W SPRINGFIELD 8C			1	1
Grand Total	5	13	189	207	Grand Total	1	5	27	33

- 18 substations impacted
- Level 0 - [No Study](#)
 - 5MW
 - 1 application
- Level 0 - [Transfer Limit Analysis](#)
 - 13 MW
 - 5 applications
- Level 3 - [Transmission Study](#)
 - 189 MW
 - 27 applications

* indicates that projects at substation are still awaiting PPA level concurrence from ISO-NE

ASO Overview – Greater Boston

Station Capacity (MW)	Level 0 - No Study	Level 0 - Transfer Limit Analysis	Level 3 - Transmission Study	Grand Total(MW)
BAKER ST 110	5			5
BURLINGTON 391		2		2
HOPKINTON 126			5	5
MAYNARD 416			7	7
MEDWAY 65			15	15
MYSTIC 250		8		8
NO. WOBURN 375		3		3
SEAFOOD WAY 99	2			2
SPEEN ST 433	5	5		10
SHERBORN 274		5		5
Grand Total	12	23	27	62

Number of Applications	Level 0 - No Study	Level 0 - Transfer Limit Analysis	Level 3 - Transmission Study	Grand Total
BAKER ST 110	1			1
BURLINGTON 391		1		1
HOPKINTON 126			1	1
MAYNARD 416			2	2
MEDWAY 65			2	2
MYSTIC 250		2		2
NO. WOBURN 375		2		2
SEAFOOD WAY 99	1			1
SPEEN ST 433	1	1		2
SHERBORN 274		1		1
Grand Total	3	7	5	15

- 11 substations impacted
- Level 0 - [No Study](#)
 - 12MW
 - 3 applications
- Level 0 – [Transfer Limit Analysis](#)
 - 23 MW
 - 7 applications
- Level 3 – [Transmission Study](#)
 - 27 MW
 - 5 applications

Slide 9

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Please remove the decimal points.

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Technical Data Required

- Data required to support Level 0 PPA approval
 - Fully functioning PSCAD model that meets the PSCAD model requirements
 - Inverter model information (e.g., BESS description if applicable, frequency and voltage relay trip settings)
 - Stamped one-line diagram including inverters
 - Project market information (e.g., In-service date, whether in ISO-NE market per OP-14 generator definition)
- Data required for Level 3 study (**in addition to all of above**)
 - Detailed project technical data including the collector system and step-up transformer information.
 - Project specific stability model in PSS/E standard library format (for projects ≥ 5 MW).
- **Please read and follow the Technical Data Request Requirements.**

[EVERSOURCE MODEL AND TECHNICAL DATA REQUEST LIST FOR AFFECTED SYSTEM OPERATOR \(ASO\) TRANSMISSION STUDIES](#)

EVERSOURCE

[illegible]

EVERSOURCE

- ### ■ ASO Study Schedule for Level 0 PPA Study

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Next Steps

- Review technical data requirements sheet on the ASO website for modeling requirements, in preparation for uploading
- Look for an email from the PowerClerk portal requesting that you opt in or out of the study, make payment and submit technical data and models
 - No response will indicate an “opt out”
- Stay up to date with study schedule via biweekly reports, monthly reports and ad-hoc updates

OPEN Q&A

Thank You!

APPENDICES

Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram
- Additional_Attach
 - ESS_Questionnaire.xlsx if applicable
- Additional_Attach
 - PSCAD model supplier checklist
- Inverter Specification
 - Manufacturer datasheet(s) for inverter(s)
- PSCAD_Model
 - A ZIP file of site-specific PSCAD model & documentation

Note: These requirements reflect the ASO study only and are not intended to capture distribution impact study requirements or others

Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - Project total size (kW-AC and kWh if applicable)
 - GSU information (impedance, X/R, kVA, voltages, grounding)
 - Inverter information (make, model, version, quantity, rated kW & kVA)
 - Presence of 32 or 32R directional power relay if applicable
 - Inverter trip settings for frequency and voltage
 - Inverter ride-through settings for frequency and voltage

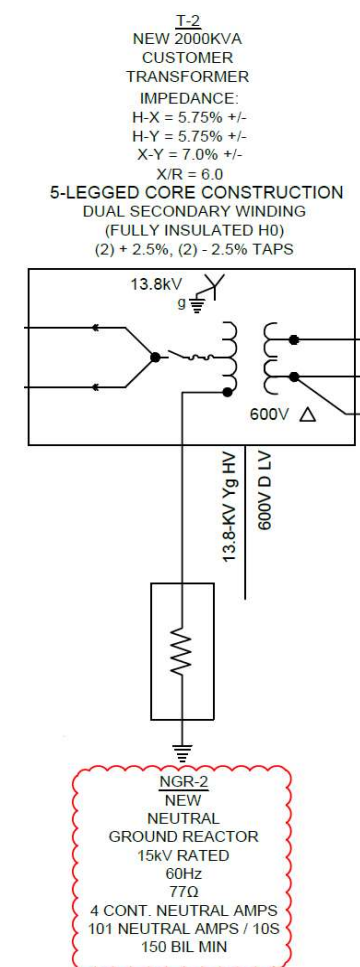
Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - Project total size (kW-AC and kWh if applicable)

SYSTEM SIZE = 11,062.48 kW DC
4,999.00 kW AC NOM.
4,999.00 kW AC MAX.
3,740 kW / 11,220 kWh DC-COUPLED BESS

Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - GSU information
 - Rated kVA
 - Impedance %Z
 - X/R Ratio
 - Rated winding voltages
 - Taps (typical is +/-2 steps, each at 2.5%)
 - Winding configuration (ie. YNd1)
 - Grounding (ie. NGR: 77 ohm, X/R=4)



Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - Inverter information (make, model, version, quantity, rated kW & kVA)

PV INVERTER 1

Inverter Make, Model, & Version

1200-kW NOM
1200-kVA MAX
(FACTORY DERATED TO
999.8 kW MAX)

Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - Inverter trip settings for frequency and voltage

<u>Inverter Protective Settings ISO-NE SRD Tables I & II</u>				
INTERNAL PROTECTIVE FUNCTIONS	TRIP OUTPUT	VOLTAGE SETTING PU	SETTING	CLEARING TIME (sec)
27-1 - UNDERVOLTAGE	X	0.50	300 V	1.1
27-2 - UNDERVOLTAGE	X	0.88	528 V	2
59-1 - OVERVOLTAGE	X	1.10	660 V	2
59-2 - OVERVOLTAGE	X	1.20	720 V	0.16
81U-1 - UNDERFREQUENCY	X		56.5 Hz	0.16
81U-2 - UNDERFREQUENCY	X		58.5 Hz	300
81O-1 - OVERFREQUENCY	X		61.2 Hz	300
81O-2 - OVERFREQUENCY	X		62 Hz	0.16
PRIMARY VOLTAGE (L-L)	0.6	kV	600	V

Example Data Package – Level 0 & 3 ASO

- One Line Diagram/Design
 - A stamped one-line diagram including:
 - Inverter ride-through settings for frequency and voltage

Inverter Voltage Ride-Through Settings ISO-NE SRD Table III

OPERATING MODE / RESPONSE	VOLTAGE SETTING PU RANGE	SETTING (MIN.)	SETTING (MAX.)	MIN. RIDE-THROUGH TIME (sec)	MAX. RESPONSE TIME (sec)
CEASE TO ENERGIZE	$V > 1.2$	N/A	720.1 V	N/A	0.16
PERMISSIVE OPERATION	$1.175 < V \leq 1.20$	705 V	720 V	0.2	N/A
PERMISSIVE OPERATION	$1.15 < V \leq 1.175$	690 V	705 V	0.5	N/A
PERMISSIVE OPERATION	$1.10 < V \leq 1.15$	660 V	690 V	1	N/A
CONTINUOUS OPERATION	$0.88 \leq V \leq 1.10$	528 V	660 V	INFINITE	N/A
MANDATORY OPERATION	$0.65 \leq V < 0.88$	390 V	528 V	Linear slope of 8.7 s/ 1p.u. voltage starting at 3 s @ 0.65 p.u.: $T_{vrt} = 3 \text{ s} + 8.7 \text{ s/1 p.u. (V-0.65 p.u.)}$	N/A
PERMISSIVE OPERATION *a,b	$0.45 \leq V < 0.65$	270 V	390 V	0.32	N/A
PERMISSIVE OPERATION *b	$0.30 \leq V < 0.45$	180 V	270 V	0.16	N/A
CEASE TO ENERGIZE	$V < 0.3$	179.9 V	N/A	N/A	0.16
Footnote a	In the Permissive Operation region above 0.5 p.u., inverters shall ride-through in Mandatory Operation mode				
Footnote b	In the Permissive Operation region below 0.5 p.u., inverters shall ride-through in Mandatory Cessation mode with a maximum response time of 0.083 seconds.				

Inverter Frequency Ride-Through Settings ISO-NE SRD Table IV

OPERATING MODE / RESPONSE	FREQUENCY RANGE (Hz)	MIN. RIDE-THROUGH TIME (sec)
N/A	$f > 62.0$	N/A
MANDATORY OPERATION	$61.2 < f \leq 61.8$	299
CONTINUOUS OPERATION	$58.8 \leq f \leq 61.2$	Infinite
MANDATORY OPERATION	$57.0 \leq f < 58.8$	299
N/A	$f < 57.0$	N/A

Example Data Package – Level 0 & 3 ASO

- Additional_Attach
 - ESS_Questionnaire.xlsx if applicable

Energy Storage System Project Design Information Requirement		
Application ID #		
Customer Name		
ESS Location	Street Address	
	City/Town	
	Zip Code	
1 Design Documentation		
Please provide both a one-line diagram and a site plan as a separate attachment to this questionnaire		
2 System Configuration		
Is the ESS design Behind-the-Meter or Independent Power Producer?		
	For Behind-the-Meter, will the site export or be non-export?	
Is the ESS electrically connected with DG or other generation?		
	DG Type (select from dropdown list)	
	AC or DC coupled?	
Will the site be limiting export? If so, identify relay information:		

Example Data Package – Level 0 & 3 ASO

- Additional_Attach
 - PSCAD model supplier checklist

Appendix E: PSCAD Model Checklist

This document is a model requirements checklist which must be completed by the supplier of the model and submitted alongside each PSCAD model. Model suppliers must review every item in the checklist and indicate compliance for each item. If the supplied model does not meet any of the requirements an explanation of the deficiency must be provided in the comments column.

Model Submission Summary (to be completed by model supplier)	
Submission date:	
Project Name:	
Primary contact information for model related questions:	
Secondary contact information for model related questions:	
Manufacturer:	
Equipment type: (eg. PV or BESS)	
Equipment version:	
Documentation file(s):	
Model Files supplied:	

Example Data Package – Level 0 & 3 ASO

- Inverter Specification
 - Sample manufacturer datasheet(s) for inverter(s)










Inverter Make, Model, & Version Bidirectional Energy Storage & Microgrid PCS



MODEL					
AC	AC configuration max. cables per phase (1)				
	3-wire (3P3W) 6 x 600 kcmil or 6 x 300 mm ²				
	Nominal AC voltage (+/- 10%) (2)	480 VRMS	600 VRMS	630 VRMS	660 VRMS
	Nominal AC current (export/import)	1255 ARMS			
	AC export/import capacity @ 40°C (3)	1043 kW	1304 kW	1369 kW	1435 kW
	Export power overload capacity @ 40°C, starting from 66% full load.	120 % for 3 sec and 116 % for 5 min			
	Reactive power capacity (4), (5)	Power Factor 0.8...1 leading/lagging			
	Allowed grid short ckt. current ratios	Current mode: >4 Voltage mode: all			
	Max. fault current allowed from AC source	100 kA (AC RMS) throatied version 180 kA (AC RMS) non-throatied version			
	Nominal frequency range	50 / 60 Hz (configurable)			
DC	Harmonic distortion	UL1741 / IEEE 1547, <2% TDDi at rated power per IEEE 519 <3% according to VDE-AR-N 4110/4120			
	Efficiency (@ 690 VAC): Peak CEC Euro	98.8% 98.4% 98.5%			
	DC voltage range, maximum (6)	720 - 1500 VDC	900 - 1500 VDC	945 - 1500 VDC	990 - 1500 VDC
	DC voltage range, at nominal power (6)	761 - 1200 VDC	951 - 1500 VDC	999 - 1500 VDC	1046 - 1500 VDC
Recommended minimum battery voltage		1.65 x nominal AC voltage			

Example Data Package – Level 0 & 3 ASO

- PSCAD_Model
 - A ZIP file of site-specific PSCAD model & documentation
 - Model documentation (.pdf) – **REQUIRED!**
 - Site-specific PSCAD case (.pscx) – **REQUIRED!**
 - Additional PSCAD model files (e.g. .pslx, .pswx, .obj, .lib, .dll) – as applicable
 - OEM inverter configuration files (e.g. .txt, .pmvs, etc.) – as applicable

 InvControlUnit.obj	3D Object
 libInvControl.obj	3D Object
 PSCAD Model Documentation.pdf	Adobe Acrobat D...
 libInvControl-i686.lib	Object File Library
 Inverter Settings File.pmvs	PMVS File
 PSCAD Library.pslx	PSCAD File
 PSCAD Site-Specific Test Case.pscx	PSCAD File
 PSCAD Workspace.pswx	PSCAD File
 PSCAD Library.psmx	PSMX File

Example Data Package – Level 3 ASO < 5MW

Same as level 0 with following additions:

- Cond_Type_Details
 - Conductor type and distances in mile between inverters/GSUs (collection system)
 - Conductor type and length of dedicated feeder to POI in miles (generator tie-line)

MEDIUM VOLTAGE CABLE SCHEDULE

TAG	COUNT & SIZE	NEUTRAL	INSULATION	CONDUIT	LENGTH +/- 10'
(A)	(3) 155.4 AAAC	155.4 AAAC	N/A	FREE AIR	40'
(B)	(3) 250kcmil AL	1/3 CONC.	15kV 100% MV-105	4"	50'
(C)	(3) 3/0 AL	1/3 CONC.	15kV 100% MV-105	4"	835'
(D)	(3) 1/0 AL	1/3 CONC.	15kV 100% MV-105	4"	595'

- GSU_Details
 - Saturation data

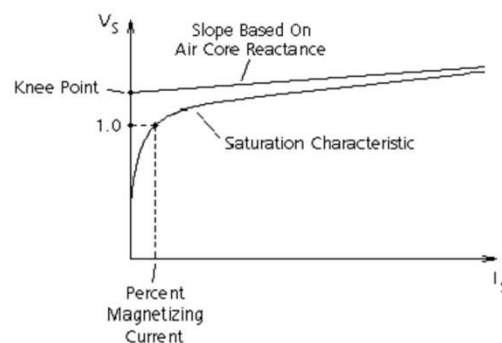


Figure 6-8 -- Typical Classic Core Saturation Characteristic

Example Data Package – Level 3 ASO \geq 5MW

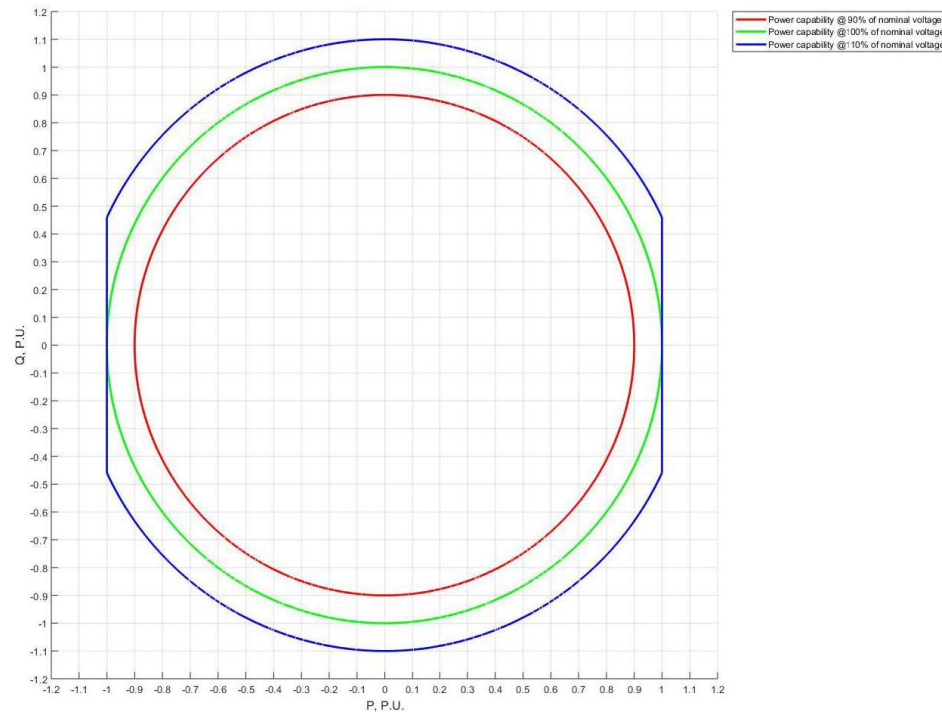
Same as level 3 < 5MW with following additions:

- Data_Sheet
 - Reactive capability curve or equivalent data
- Stability_Model_List
 - Stability model in PSS/E standard library model format (.idv/.raw/.sav & .dyr) ISO-NE does not accept user- written models
 - The following PSSE v34 standard library renewable energy system models shall be used to represent the transient stability of inverter-based DER's:
 - Renewable Energy Generator/Converter Model: REGC_B
 - Renewable Energy Electrical Model: REEC_D
 - Plant Controller Model:
 - REPC_A for standalone PV, BESS and DC coupled BESS
 - PLNTBU1 + REAX4BU1 for AC coupled BESS and hybrid-projects which include multiple technologies controlled by a single plant controller

Example Data Package – Level 3 ASO $\geq 5\text{MW}$

Same as level 3 $< 5\text{MW}$ with following additions:

- Data_Sheet
 - Reactive capability curve or equivalent data



Example Data Package – Level 3 ASO $\geq 5\text{MW}$

Same as level 3 $< 5\text{MW}$ with following additions:

- Stability_Model_List
 - .idv or .raw or .sav file:

```

RATING,12, RATING,12, RATING SET 12
0 / END OF SYSTEM-WIDE DATA, BEGIN BUS DATA
@! I, 'NAME', BASKV, IDE, AREA, ZONE, OWNER, VM, VA, NVHI, NVLO, EVHI, EVLO
70100, 'BUS_POI', 115.0000, 1, 1, 1, 1.00360, 5.7216, 1.10000, 0.90000, 1.10000, 0.90000
70101, 'BUS_SUB', 115.0000, 1, 1, 1, 1.00422, 6.1851, 1.10000, 0.90000, 1.10000, 0.90000
70102, 'BUS_COL', 34.5000, 1, 99, 999, 1.1.00122, 11.0458, 1.10000, 0.90000, 1.10000, 0.90000
70103, 'TM840_TER', 4.1600, 1, 99, 999, 1.1.00182, 8.6118, 1.10000, 0.90000, 1.10000, 0.90000
70104, 'BUS_XFR', 34.5000, 1, 99, 999, 1.1.00172, 11.1031, 1.10000, 0.90000, 1.10000, 0.90000
70105, 'BUS_GEN', 0.8000, 2, 99, 999, 1.1.00201, 12.7407, 1.10000, 0.90000, 1.10000, 0.90000
97000, 'BUS_INF', 115.0000, 3, 1, 1, 1.1.00000, 0.0000, 1.10000, 0.90000, 1.10000, 0.90000
0 / END OF BUS DATA, BEGIN LOAD DATA
@! I, 'ID', STAT, AREA, ZONE, PL, QL, IP, IQ, YP, YQ, OWNER, SCALE, INTRPT,
70102, '1', 1, 99, 999, 0.004, 0.000, 0.000, 0.000, 0.000, 0.000, 1, 1, 0,
0 / END OF LOAD DATA, BEGIN FIXED SHUNT DATA
@! I, 'ID', STATUS, GL, BL
0 / END OF FIXED SHUNT DATA, BEGIN GENERATOR DATA
@! I, 'ID', PG, QG, QT, QB, VS, IREG, MBASE, ZR, ZX,
70105, '1', 100.300, 0.450, 0.450, -0.450, 1.01000, 70100, 120.175, 0.00000E+0, 9.99900E+3, 0.000

```

- .dyr file:

```

70105 'REGCA1' 1
@! / Lvplsw
0
@! / Tg Rrpwr Brkpt Zerox Lvpl1
0.0200 0.8000 0.9000 0.8800 1.0000
@! / Volim Lvpnt1 Lvpnt0 Iolim Tfltr
1.0000 0.0010 0.0000 -1.0000 0.0000
@! / Khv Iqrmax Iqrmin Accel
0.0000 20.000 -20.000 0.7000/

```