SOUTHWEST POWER POOL, INC.

MODEL DEVELOPMENT ADVISORY GROUP MEETING

May 18, 2023

Conference Call

9:00 a.m. - 12:00 p.m. (CST)

AGENDA

1. Administrative Items ..... John Turner (10 mins)
    a. Call to Order
    b. Antitrust Statement
    c. Attendance
    d. Proxies
    e. Agenda Review (***Approval Item****)
        i. Acknowledgment for the posting of meeting materials
        ii. Agenda items may be taken out of order and could conclude earlier or later than estimated time.
    f. Previous ~~March~~ April Meeting Minutes (***Approval Item****)
2. Review of Past Action Items ..... Lottie Jones (10 mins)
3. MDAG Manual Language(***Approval Item****) ..... Brandon Hentschel (15 mins)
4. Rate 3 Update ..... Lottie Jones (20 mins)
5. FERC 881 Update ..... John Turner (5 mins)
6. Focus Group Updates ..... Eric Sullivan (10 mins)
7. DLTF Update ..... Marc Moore (10 mins)
8. Break ..... All (10 mins)
9. 2023 series MDAG Model Build/Application Updates
    a. Dynamics ..... Zach Sabey/Theo Brown (10 mins)
10. EDST Updates ..... Kristie Brown (10 mins)
11. CPPTF Common Model Update ..... Brandon Hentschel (15 mins)
12. Model selection discussion ..... SPS (10 mins)
    a. Model selection – member discussion on model usage
13. Discussion of Future Meetings ..... John Turner (5 mins)

All meeting times are represented in the central time zone. Please register for all meetings via spp.org

a. MDAG: June 14-15, 2023 (IN PERSON)

i. June 14, 2023 9:00AM - 4:00PM
June 15, 2023 8:30AM - 12:00PM

ii. In person registration closes *June 1, 2023*

iii. SPP Vistor Guide - https://www.spp.org/about-us/visitor-guide/

b. MDAG FG: May 23, 2023 (1:00 PM – 3:00 PM)

c. Ambient Adjustment Ratings Implementation Task Force: June 05, 2023 (9:00AM - 11:00AM)

MDAG encourages you to check out the spp.org calendar for additional information on technical topics discussed in other working groups. SPP also offers stakeholder trainings found here

14. Summary of Action Items ..... Lottie Jones (5 mins)

a. Agenda Review – additional comments request

15. Adjourn ..... All

***** The approval items denoted with "*" shall be jointly developed by PC, TP, and MDAG

Attendance worksheet

1. Input your group's name in A1

2. Enter your representative information

A. Enter the names of your rostered representatives in column A, beginning with your name (staff secretary) in row 7

B. Enter the company name for each of the rostered representatives in column B, beginning with "SPP" in row 7

2. Enter your meeting details

A. Enter your meeting dates begininng in column C, row 1 and continue across the worksheet until all meeting dates are entered

B. Enter the actual duration for each meeting beginning in column c, row 2. Round to the nearest .5 hours.

C. Enter the actual number of votes taken per meeting beginning in column c, row 3. **Do not count** administrative votes such as votes to approve the agenda or adjourn the meeting. When counting consent votes, count one vote for each item under the consent topic. Do not count a consent vote as 1 if it includes multiple items.

D. Enter the total number of attendees for each meeting beginning in column c, row 4

E. Enter the meeting format for each meeting beginning in column c, row 5

3. Track attendance at each meeting per representative

A. For yourself and each member note how the individual attended the meeting using the drop down for the cell. Options are webex, in-person, proxy, absent or non-member. Non-member is to be used for those who were members for only part of the assessment period. If you have a member that joined or left the group during the assessment period, utilize the non-member option for all meetings in which they were not considered a rostered member of the group.

Org Report Survey worksheet

1. Enter member demographic data

A. Indicate Yes if the member is current and No if they are no longer a part of the group

B. Enter the type of member for each representative in column D

C. Enter the sector type for each representative in column E

D. If a reprsentative leaves mid assessment period add a red asterick in front of their name

2. Enter Yes or No to indicate the status of your scope review in L8

3. Enter Assessment Period in A2

Model Development Advisory Group

Meeting Date(s)	########	########	########		5/18/2023
Meeting Length (hrs)	2.5	3	2		3
Number of Votes Taken	2	5	3		3
Overall Attendance	61	68	69		68
Meeting Format	WebEx	WebEx	WebEx	WebEx	

Member Name	Company	Current Member				
Alex Mucha	Oklahoma Municipa	Yes	WebEx	WebEx	WebEx	WebEx
Brianna Haug (Vice Chair)	Western Area Powe	Yes	WebEx	WebEx	WebEx	WebEx
Dustin Betz	Nebraska Public Po	Yes	WebEx	WebEx	WebEx	Proxy
Jason Shook	GDS Associates	Yes	WebEx	WebEx	WebEx	WebEx
Jerry Bradshaw	City Utilities of Spri	Yes	WebEx	WebEx	WebEx	WebEx
Jesse Kreutzfeldt	Missouri River Ener	Yes	WebEx	WebEx	WebEx	WebEx
Joe Fultz	Grand River Dam Au	Yes	WebEx	WebEx	Absent	WebEx
John Turner (Chair)	Western Farmers Ele	Yes	WebEx	WebEx	WebEx	WebEx
John Vara	Golden Spread Elec	Yes	WebEx	WebEx	WebEx	WebEx
Liam Stringham	Sunflower Electric P	Yes	WebEx	WebEx	WebEx	WebEx
Lottie Jones (Staff Secretary)	SPP	Yes	WebEx	WebEx	WebEx	WebEx
Preston Blinsky	Basin Electric Power	Yes	WebEx	WebEx	Absent	WebEx
Reené Miranda	Southwestern Public	Yes	WebEx	WebEx	WebEx	WebEx
Ryan Baysinger	Evergy	Yes	Absent	WebEx	WebEx	WebEx
Scott Rainbolt	American Electric Po	Yes	WebEx	WebEx	WebEx	Absent
Scott Schichtl	Arkansas Electric Co	Yes	WebEx	WebEx	WebEx	Proxy
Steve Hohman	Omaha Public Powe	Yes	WebEx	WebEx	WebEx	WebEx
Tyler Baxter	Corn Belt Power Co	Yes	WebEx	WebEx	Proxy	WebEx

Guest Name	Company	Current Member				
Adam Mummert	Burns & McDonnell	No	WebEx			
Adam Nmili	Oklahoma Gas and	No	WebEx	WebEx	WebEx	WebEx
Afshin Salehian	SPP	No				
Adam Schieffer	OPPD	No		WebEx		
Ala Wadi	Liberty Utilities	No	WebEx	WebEx	WebEx	WebEx
Amine Chenaf	DNV	No				
Andrew Berg	Missouri River Ener	No	WebEx	WebEx		
Andrew Howard	Lincoln Electric Syst	No	WebEx			WebEx
Antonio Barrera	Southwestern Public	No			WebEx	WebEx
Armin Sehic	Nebraska Municipal	No	WebEx	WebEx	WebEx	WebEx
Aster Amahatsion	Nebraska Municipal	No		WebEx		
Ben Hammer	WAPA	No	WebEx			
Becca McCann	SPP	No	WebEx	WebEx	WebEx	
Ben Mitchell	SPP	No				
Blake Poole	Evergy	No				
Bobby Gray	Liberty Utilities	No	WebEx	WebEx		
Brandon Hentschel	SPP	No	WebEx	WebEx		WebEx
Brian Johnson	AEP	No		WebEx		
Brooke Keene	SPP	No				
Bruce Doll	Nebraska Municipal	No				
Calvin Coates	Kansas Power Pool	No	WebEx	WebEx	WebEx	WebEx
Casey Cathey	SPP	No				
Charles Costello	Siemens	No				
Cho Wang	American Electric Po	No				
Chris Colson	Western Area Powe	No	WebEx		WebEx	
Chris Davis	SPP	No			WebEx	
Chris Gidlen	Tri State	No				
Chris Rich	Oklahoma Gas and	No		WebEx		WebEx
Clarence Campbell	SPS	No		WebEx	WebEx	WebEx
Claire Vigesaa	Burns & McDonnell	No				
Conner Sweet	City Utilities of Spri	No	WebEx	WebEx	WebEx	
Curtis Miller	Western Farmers Ele	No				
Dale Reinhold	Hastings Utilities	No	WebEx			
Damien Burbage	AECI	No				
Danielle Borg	Sunflower Electric P	No		WebEx	WebEx	WebEx
Darian Richards	SPP	No			WebEx	WebEx
David Bromberg	Pearl Street Technol	No				
David Duhart	SPP	No	WebEx	WebEx	WebEx	WebEx
David Mendoza	Grand River Dam Au	No	WebEx	WebEx	WebEx	
David Zhong	American Electric Po	No		WebEx	WebEx	WebEx
Derek Brown	Evergy	No				
Devon Pehrson	National Grid Renev	No	WebEx			
Diego Toledo	Grand River Dam Au	No	WebEx	WebEx		WebEx
Douglas Bowman	SPP	No				
Dona Parks	Grand River Dam Au	No	WebEx	WebEx		WebEx
Donald Hargrove	Oklahoma Gas and	No				
Dustin Mooehr	Liberty Utilities	No			WebEx	
Dylan Fate	Tri State	No				
Dylan Haas	Evergy	No				WebEx
Ebrahim Rezaei	American Electric Po	No				
Eddie Watson	SPP	No	WebEx	WebEx	WebEx	WebEx
Edin Terzic	Lincoln Electric Syst	No				
Eli Nyambegera	Sunflower Electric P	No				
Elijah Salinas	LES	No	WebEx		WebEx	WebEx
Ellen Cook	SPP	No				
Eric Jones	Omaha Public Powe	No	WebEx	WebEx	WebEx	WebEx
Eric Sullivan	SPP	No	WebEx	WebEx	WebEx	WebEx
Erin Cathey	SPP	No				
Erik Voice	Salem Electric	No		WebEx		
Estevan Padilla	SPP	No	WebEx	WebEx	WebEx	
Frank Favela	Southwestern Public	No				
Garrick Nelson	Western Area Powe	No			WebEx	
Gary Boerger	Oklahoma Gas and	No				
Gavin Novotny	Evergy	No				
Glen Halley	City Utilities of Spri	No		WebEx		
Grace Bouziden	Oklahoma Gas and	No				
Hannah Mason	Light Source BP	No				
Harriet Walsh	Orsted	No				
Hugh Benfer	SPP	No	WebEx	WebEx	WebEx	
James Okenfuss	Savion Energy	No				
Jason Menke	Nebraska Public Po	No			WebEx	WebEx
Jeff Knottek	City Utilities of Spri	No				
Jeff McDiarmid	SPP	No				
Jeff Plew	NextEra	No				
Jeffrey Taylor	ITC	No	WebEx	WebEx	WebEx	WebEx
Jerad Ethridge	Oklahoma Gas and	No				
Jeremy Severson	Basin Electric Power	No	WebEx			
Jesse Kreutzfeldt	Missouri River Ener	No				
Joe Williams	Western Farmers Ele	No				
John Boshears	City Utilities of Spri	No				
John Mayhan	Omaha Public Powe	No			WebEx	
John Vara	Golden Spread Elec	No				
John Varnell	Tenaska	No				
John Wilson	Southern Current LL	No				
Jon Langford	Orsted	No				
Jonathan Aus	East River	No				
Josh Hesselbein	Arkansas Electric Co	No	WebEx		WebEx	WebEx
Joshua Pilgrim	SPP	No			WebEx	
Josie Daggett	WAPA	No			WebEx	
Juliano Freitas	SPP	No				
Justin Helt	1890 and Company	No				
Kadeem Brown	AEP	No	WebEx	WebEx	WebEx	WebEx
Kalun Kelley	WFEC	No	WebEx		WebEx	
Kelsey Allen	SPP	No				
Kim Farris	SPP	No				
Kim Grogan	Evergy	No				
Kimberly Woods	SPP	No				
Kristie Brown	SPP	No	WebEx	WebEx	WebEx	WebEx
Kristen Darden	SPP	No				
Larry Brusseau	Corn Belt Power Co	No			WebEx	
Liz Gephardt	SPP	No				
Logan Peterson MPC	Minnkota	No	WebEx		WebEx	
Mae Cruz	Southwestern Public	No		WebEx	WebEx	WebEx
Marc Moor (Evergy)	Evergy	No				WebEx
Margaret Kristian	National Grid Renev	No				
Martin Green	American Electric Po	No		WebEx		WebEx
Mason Favazza	SPP	No				
Matthew Alvardo	IUB	No				
McKady Kellam	Evergy	No				
Miah Archambault	Enel	No		WebEx		
Michael Bowman	City Utilities of Spri	No		WebEx		
Mike Swan	Omaha Public Powe	No	WebEx	WebEx	WebEx	WebEx
Moses Rotich	Gridliance	No				
Mostafa Sedighizadeh	SPP	No				
Nathan Davis	Liberty Utilities	No		WebEx	WebEx	WebEx
Nathan McNeil	Midwest Energy	No				
Nicholas Hoelzeman	Evergy	No		WebEx		
Nicole Hicks	WAPA	No		WebEx		
Nitin Kushwaha	National Grid Renev	No				
Neeya Toleman	NextEra	No			WebEx	WebEx
Nolan Fertig	SPP	No				
Pallab Datta	Evergy	No	WebEx	WebEx	WebEx	WebEx
Paul Vovk	Omaha Public Powe	No	WebEx		WebEx	WebEx
Peter Jones	Savion	No				
Phil Westby	BEPC	No	WebEx			
Prajakta Pawar	Quanta Technology	No			WebEx	
Ransome Egunjobi	Enel	No				
Richard Miner	Liberty Utilities	No				
Ryan Baysinger	Evergy	No				
Ryan Benton	Oklahoma Gas and	No	WebEx			WebEx
Scott Holland	SWPA	No				WebEx
Scott Jordan	SPP	No		WebEx		
Scott Mijin	Southwestern Powe	No	WebEx	WebEx	WebEx	WebEx
Seth Cochran	DC Energy	No	WebEx			
Shalini Gupta	Apex Clean Energy	No				
Shannon Mickens	SPP	No				WebEx
Shawna Satterwhite	Oklahoma Gas and	No				
Sherri Maxey	SPP	No			WebEx	
Steve Hardebeck	Oklahoma Gas and	No				
Steve Purdy	SPP	No				
Steven Park	Sunflower Electric P	No				
Sunny Raheem	SPP	No		WebEx	WebEx	
Taiquera Jones	SPP	No				
Tanner New	Sunflower Electric P	No	WebEx			WebEx
Thomas Burns	SPP	No				
Theo Brown	SPP	No		WebEx	WebEx	WebEx
Timothy Sell	ITS	No		WebEx		
Todd Chwialkowski	EDF	No				
Tom Belshe	Evergy	No				
Tom Mayhan	Omaha Public Powe	No				
Tony Green	SPP	No	WebEx			
Walt Shumate	Shumate & Associate	No	WebEx	WebEx	WebEx	WebEx
Xiaoyu Wang	Enel	No				WebEx
Yasmin Sakalla	Enel	No				
Ying Yang	Duke Energty	No		WebEx	WebEx	
Zach Andera	Burns & McDonnell	No				
Zach Sabey	SPP	No	WebEx	WebEx	WebEx	WebEx

Model Development Advisory Group

August 2021 - July 2022

Name	Company	Is Current Member?
Alex Mucha	Oklahoma Municipal Power Authority	Yes
#REF!	#REF!	#REF!
Brianna Haug (Vice Chair)	Western Area Power Administration	Yes
Dustin Betz	Nebraska Public Power District	Yes
#REF!	#REF!	#REF!
Jason Shook	GDS Associates	Yes
#REF!	#REF!	#REF!
#REF!	#REF!	#REF!
Jerry Bradshaw	City Utilities of Springfield	Yes
Joe Fultz	Grand River Dam Authority	Yes
#REF!	#REF!	#REF!
Liam Stringham	Sunflower Electric Power Corporation	Yes
Preston Blinsky	Basin Electric Power Cooperative	Yes
Reené Miranda	Southwestern Public Service	Yes
#REF!	#REF!	#REF!
Scott Rainbolt	American Electric Power	Yes
Scott Schichtl	Arkansas Electric Cooperative Corporation	Yes
Steve Hohman	Omaha Public Power District	Yes
#REF!	#REF!	#REF!
Tyler Baxter	Corn Belt Power Cooperative	Yes
Amine Chenaf	DNV	No
Andrew Howard	Lincoln Electric System	No
Antonio Barrera	Southwestern Public Service	No
Armin Sehic	Nebraska Municipal Power Pool	No
Becca McCann	SPP	No
Brandon Hentschel	SPP	No
Brooke Keene	SPP	No
John Turner (Chair)	Western Farmers Electric Power	Yes
Bruce Doll	Nebraska Municipal Power Pool	No
Casey Cathey	SPP	No
Chris Colson	Western Area Power Administration	No
Conner Sweet	City Utilities of Springfield	No
David Duhart	SPP	No
David Zhong	American Electric Power	No

Diego Toledo	Grand River Dam Authority	No
Edin Terzic	Lincoln Electric System	No
Eli Nyambegera	Sunflower Electric Power Corporation	No
Ellen Cook	SPP	No
Frank Favela	Southwestern Public Service	No
Garrick Nelson	Western Area Power Administration	No
Grace Bouziden	Oklahoma Gas and Electric Company	No
James Okenfuss	Savion Energy	No
Jason Menke	Nebraska Public Power District	No
Jeff Plew	NextEra	No
Jeremy Severson	Basin Electric Power Cooperative	No
Jesse Kreutzfeldt	Missouri River Energy Services	Yes
Joe Williams	Western Farmers Electric Power	No
John Mayhan	Omaha Public Power District	No
John Vara	Golden Spread Electric	Yes
Kim Farris	SPP	No
Kimberly Woods	SPP	No
Mae Cruz	Southwestern Public Service	No
Marc Moor (Evergy)	Evergy	No
McKady Kellam	Evergy	No
Mike Swan	Omaha Public Power District	No
Moses Rotich	Gridliance	No
Nolan Fertig	SPP	No
Peter Jones	Savion	No

Member Type	Sector	Present	Proxy	Absent	Percent Present
Staff	RTO	16	0	2	89%
Staff	RTO	#REF!	#REF!	#REF!	N/A
TO	Investor Owned Utility	18	0	0	100%
TU	Cooperative	16	2	0	100%
TU	Cooperative	#REF!	#REF!	#REF!	N/A
TO	Cooperative	15	0	3	83%
TU	Municipal	#REF!	#REF!	#REF!	N/A
TO	State	#REF!	#REF!	#REF!	N/A
TO	Cooperative	16	1	1	94%
TO	State	15	1	2	89%
TO	Investor Owned Utility	#REF!	#REF!	#REF!	N/A
TO	Federal	17	1	0	100%
TO	State	14	2	2	89%
TU	Investor Owned Utility	13	5	0	100%
TU	Municipal	#REF!	#REF!	#REF!	N/A
TU	Investor Owned Utility	15	2	1	94%
TU	Investor Owned Utility	15	3	0	100%
TU	Cooperative	17	1	0	100%
TO	Cooperative	#REF!	#REF!	#REF!	N/A
TO	Cooperative	14	2	2	89%

Annual Assessment Totals	
Average Length of Meetings (hrs)	3
Number of Votes Taken	74
Average Overall Attendance	60
Total Meetings this Assessment	21
Live	1
Teleconference	20
Scope Reviewed	No
Transmission Owner(s)	7
Transmission User(s)	5
Director(s)	0
Investor Owned Utility	4
Cooperative	5
Municipal	0
State	2
Federal	1
Independent Power Producer / Marketer	0
Independent Transmission Company	0
Large Retail	0
Alt Power / Public Interest	0
Small Retail	0

MDAG MINUTES
May 18, 2023

SOUTHWEST POWER POOL
MODEL DEVELOPMENT ADVISORY GROUP MEETING

May 18, 2023 9:00 am – 12:00 pm (CST)

Conference Call

SUMMARY OF MOTIONS AND ACTION ITEMS

Action Items:

- **Action Item:** A survey will be provided to MDAG membership once it is approved internally by SPP.
- **Action Item:** Set up a meeting with Joe to determine the origin of the missing short circuit information in the 2023 MDAG models.
- **Action Item:** Poll to be sent to MDAG membership to determine the willingness of the group to create these additional models and added too MDAG Face-to-Face agenda

Motions:

- **Motion: Alex Mucha motioned to approve the presented agenda as modified. Steve Hohman seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.**
- **Motion: John Vara motioned to approve April 20, 2023, meeting minutes as presented. Jesse Kreutzfeldt seconded the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.**
- **Motion: Jason Shook motioned to approve the updated manual language as presented. Joe Fultz seconded the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.**

MDAG MINUTES
May 18, 2023

Southwest Power Pool
MODEL DEVELOPMENT ADVISORY GROUP MEETING

May 18, 2023 9:00 am – 12:00 pm (CST)

Conference Call

MINUTES

AGENDA ITEM 1 – ADMINISTRATIVE ITEMS

AGENDA ITEM 1A & 1B – CALL TO ORDER AND ANTITRUST STATEMENT

SPP MDAG Chair, John Turner, called the meeting to order at 9:03 a.m. (CST) with Quorum. SPP Staff Secretary, Lottie Jones, read the anti-trust statement to the group.

MDAG MINUTES
May 18, 2023

AGENDA ITEM 1C & 1D – ATTENDANCE AND PROXIES

The following members attended or were represented by proxy:

MDAG Member	Present	Proxy	Present	Company
Tyler Baxter	Yes			Corn Belt Power Cooperative
Jerry Bradshaw	Yes			City Utilities of Springfield
Dustin Betz	No	Jason Menke	Yes	Nebraska Public Power District
Preston Blinsky	Yes			Basin Electric Power Cooperative
Joe Fultz	Yes			Grand River Dam Authority
Brianna Haug	Yes			Western Area Power Administration, MDAG Vice-Chair
Steve Hohman	Yes			Omaha Public Power District
Reené Miranda	Yes			Southwestern Public Service
Alex Mucha	Yes			Oklahoma Municipal Power Authority
Scott Rainbolt	No			American Electric Power
Scott Schichtl	No	Josh Hesselbein		Arkansas Electric Cooperative Corporation
Jason Shook	Yes			GDS Associates
Liam Stringham	Yes			Sunflower Electric Power Corporation
John Turner	Yes			Western Farmers Electric Power, MDAG Chair
Lottie Jones	Yes			Southwest Power Pool, Inc., MDAG Secretary
John Vara	Yes			Golden Spread Electric
Ryan Baysinger	Yes			Evergy
Jesse Kreutzfeldt	Yes			Missouri River Energy Services

Material: MAY18_Attach2 - 1c. MDAG Conference Call Attendance-05-18-2023

MDAG MINUTES
May 18, 2023

AGENDA ITEM 1E – AGENDA REVIEW **(APPROVAL ITEM)**

John Turner asked the group if they had a chance to review the agenda and if the group had any modifications to the agenda.

John Vara mentioned a correction to the previous meeting minute topic.

Motion: Alex Mucha motioned to approve the presented agenda as modified. Steve Hohman seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.

Material: MAY18_Attach1- 1e. MDAG Meeting Agenda

AGENDA ITEM 1F – PREVIOUS APRIL 20, 2023 MEETING MINUTES **(APPROVAL ITEM)**

Lottie Jones asked the group if they had any proposed changes for the previous April 20, 2023, meeting minutes.

Motion: John Vara motioned to approve April 20, 2023, meeting minutes as presented. Jesse Kreutzfeldt seconded the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.

Material: MAY18_Attach3- 1f. April 20, 2023, Meeting Minutes.docx

MDAG MINUTES
May 18, 2023

AGENDA ITEM 2 – REVIEW OF PAST ACTION ITEMS

Lottie Jones discussed outstanding issues highlighted in red font, including the action items added from the last meeting. Lottie walked the group through updates on action items collected at the previous session and updates for existing in-progress action items.

- Action Item 164 – In-Progress – SPP staff presented to MVTF and is currently benchmarking. Please follow MDAG FG for more on this topic (May FG meeting).
    - This will be discussed further in the May MDAG FG meeting
- Action Item 205 – In-Progress – Included in EDST enhancements for future release.

AGENDA ITEM 3 – MDAG MANUAL LANGUAGE

SPP staff, Brandon Hentschel, updated the group on the recent manual changes including an update on how the MDAG models are requested through RMS as well as allowing the MOD Matrix to be editable as a word table instead of an image.

Membership asked for some further clarification regarding the grey shaded language in the manual (page 18 for example).

Membership mentioned that the grey shading was put in there for a reason possibly to point back to an appendix.

Membership mentioned that the table of contents indentions have some items that do not line up with the rest.

Motion: Jason Shook motioned to approve the updated manual language as presented. Joe Fultz seconded the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.

AGENDA ITEM 4 – RATE 3 UPDATE

SPP staff, Lottie Jones, provided the group with an update on the Rate 3 discussion including our current approach and some options to meet the request.

MDAG membership mentioned that this could be moved to the TWG for further discussion and conclusion.

Membership addressed concerns as well with solely relying on this data without the background information. There was a range in preference with the presented options; MDAG requested an action of sending out a poll to membership for discussion in June.

Action Item: A survey will be provided to MDAG membership once it is approved internally by SPP.

AGENDA ITEM 5 – FERC 881 UPDATE

John Turner updated the group on FERC Order 881 and mentioned that it includes the operations realm and does not include the planning realm. There was additionally discussion (including NERC update that is included in posting materials), concluding that this topic will be discussed at future MDAG meetings.

REFERENCE MATERIAL INCLUDED

AGENDA ITEM 6 – FOCUS GROUP UPDATES

SPP staff, Eric Sullivan, provided the group with an update on the April MDAG FG meeting as well as topics for the future May MDAG FG meeting.

AGENDA ITEM 7 – DLTF UPDATE

Marc Moore with Evergy provided an update regarding the last DLTF discussion.

DLTF is currently working on a draft document to bring to MDAG for review and approval.

This document would cover guidance for inclusion of the composite load model into the dynamics model build (dynamics and stability studies).

The MDAG manual would likely be updated in the future as well to incorporate all loads and not just the large industrial loads.

REFERENCE MATERIAL INCLUDED

AGENDA ITEM 8 – BREAK (10 MINUTES)

AGENDA ITEM 9 – 2023 SERIES MDAG MODEL BUILD/APPLICATION UPDATES

AGENDA ITEM 9A – DYNAMICS

SPP staff, Zach Sabey, updated the group on the 2023 series Dynamics model build.

Membership asked if there is a process if the wind does not initialize appropriately or fails.

SPP responded, “The goal in the future would be to reach out to GOs for them to update their models; however, these were handled by dyre files during the last model build.”

MDAG MINUTES
May 18, 2023

AGENDA ITEM 10 – EDST UPDATES

SPP staff, Kristie Brown, provided the group with information regarding the latest EDST updates including defects and key reminders.

Membership asked if SPP is aware that some of the tie data was missing as well as some of the sequence data was missing in the short circuit models.

Action Item: Set up a meeting with Joe to determine the origin of the missing short circuit information in the 2023 MDAG models.

AGENDA ITEM 11 – CPPTF COMMON MODEL UPDATE

SPP staff, Brandon Hentschel, provided an update on the common model timeline and manual changes.

AGENDA ITEM 12 – MODEL SELECTION DISCUSSION

AGENDA ITEM 12A – MODEL SELECTION – MEMBER DISCUSSION ON MODEL USAGE

SPS is requesting the addition/removal of some models to the current MDAG model list (gap year models: Y4, Y6, and Y7 Summer/Winter Models). SPS stated there is value in adding these additional models from the perspective of SPS in order to better understand future projects. The proposal is to include these additional models and remove the Fall/Shoulder models to compensate for the additional work.

During discussion of this proposal, the group decided it was best to poll the members for additional feedback.

Action Item: Would it be possible to send out a poll to MDAG membership to determine the willingness of the group to create these additional models and carry it over to the MDAG Face-to-Face as well?

REFERENCE MATERIAL INCLUDED

AGENDA ITEM 13 – DISCUSSION OF FUTURE MEETINGS

MDAG Chair, John Turner, updated the group on upcoming meetings.

a. MDAG: June 14-15, 2023 (IN PERSON)
    i. June 14, 2023 (9:00 AM – 4:00 PM)
    ii. June 15, 2023 (8:30 AM – 12:00 PM)

b. MDAG FG: May 23, 2023 (1:00 PM – 3:00 PM)

AGENDA ITEM 14 – SUMMARY OF ACTION ITEMS

Lottie discussed the action items from this meeting:

- **Action Item:** A survey will be provided to MDAG membership once it is approved internally by SPP.
- **Action Item:** Set up a meeting with Joe to determine the origin of the missing short circuit information in the 2023 MDAG models.
- **Action Item:** Would it be possible to send out a poll to MDAG membership to determine the willingness of the group to create these additional models and carry it over to the MDAG Face-to-Face as well?

AGENDA ITEM 15 – ADJOURN

John Turner adjourned the meeting at 12:02 p.m. (CST)

Respectfully Submitted,

Lottie Jones
Secretary

Eric Sullivan
Secretary Assistant

MDAG MINUTES
May 18, 2023

Attachments

MAY18_Attach1- 1e. MDAG Meeting Agenda.docx

MAY18_Attach2 - 1c. MDAG Conference Call Attendance-05-18-2023

MAY18_Attach3- 1f. April 20, 2023, Meeting Minutes.docx

MDAG MINUTES
April 20, 2023

SOUTHWEST POWER POOL
MODEL DEVELOPMENT ADVISORY GROUP MEETING

April 20, 2023 9:00 am – 12:00 pm (CST)

Conference Call

SUMMARY OF MOTIONS AND ACTION ITEMS

Action Items:

- **Action Item:** MDAG to discuss a path forward via email for future discussions on the Rate 3 topic.
- **Action Item:** Review how the current MDAG dispatch workbook is being populated and look for areas of improvement.

Motions:

- **Motion: Steve Hohman motioned to approve the presented agenda as modified. Brianna Haug seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.**
- **Motion: John Vara motioned to approve March 20, 2023, meeting minutes as presented. Steve Hohman seconded the motion. Reene Miranda abstained from the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.**
- **Motion: Jason Shook motioned to approve the date, time, and location for the MDAG in-person workshop meeting June 14-15 at SPP Campus. John Vara seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.**

MDAG MINUTES
April 20, 2023

Southwest Power Pool
MODEL DEVELOPMENT ADVISORY GROUP MEETING

April 20, 2023 9:00 am – 12:00 pm (CST)

Conference Call

MINUTES

AGENDA ITEM 1 – ADMINISTRATIVE ITEMS

AGENDA ITEM 1A & 1B – CALL TO ORDER AND ANTITRUST STATEMENT

SPP MDAG Chair, John Turner, called the meeting to order at 9:02 a.m. (CST) with Quorum. SPP Staff Secretary, Lottie Jones, read the anti-trust statement to the group.

MDAG MINUTES
April 20, 2023

AGENDA ITEM 1C & 1D – ATTENDANCE AND PROXIES

The following members attended or were represented by proxy:

MDAG Member	Present	Proxy	Present	Company
Tyler Baxter	No	Larry Brusseau	Yes	Corn Belt Power Cooperative
Jerry Bradshaw	Yes			City Utilities of Springfield
Dustin Betz	Yes			Nebraska Public Power District
Preston Blinsky	No			Basin Electric Power Cooperative
Joe Fultz	No			Grand River Dam Authority
Brianna Haug	Yes			Western Area Power Administration, MDAG Vice-Chair
Steve Hohman	Yes			Omaha Public Power District
Reené Miranda	Yes			Southwestern Public Service
Alex Mucha	Yes			Oklahoma Municipal Power Authority
Scott Rainbolt	Yes			American Electric Power
Scott Schichtl	Yes			Arkansas Electric Cooperative Corporation
Jason Shook	Yes			GDS Associates
Liam Stringham	Yes			Sunflower Electric Power Corporation
John Turner	Yes			Western Farmers Electric Power, MDAG Chair
Lottie Jones	Yes			Southwest Power Pool, Inc., MDAG Secretary
John Vara	Yes			Golden Spread Electric
Ryan Baysinger	Yes			Evergy
Jesse Kreutzfeldt	Yes			Missouri River Energy Services

Material: APR20_Attach2 - 1c. MDAG Conference Call Attendance-04-20-2023

MDAG MINUTES
April 20, 2023

AGENDA ITEM 1E – AGENDA REVIEW **(APPROVAL ITEM)**

John Turner asked the group if they had a chance to review the agenda and if the group had any modifications to the agenda.

Motion: Steve Hohman motioned to approve the presented agenda as modified. Brianna Haug seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.

Material: APR20_Attach1- 1e. MDAG Meeting Agenda

AGENDA ITEM 1F – PREVIOUS MARCH 20, 2023 MEETING MINUTES **(APPROVAL ITEM)**

Lottie Jones asked the group if they had any proposed changes for the previous March 20, 2023, meeting minutes.

Lottie mentioned one correction to the previous minutes including removing Michael Swan as Steve Hohman's proxy.

Motion: John Vara motioned to approve March 20, 2023, meeting minutes as presented. Steve Hohman seconded the motion. Reene Miranda abstained from the motion. The group did not voice any additional concerns during the discussion of the motion. The motion passed.

Material: APR20_Attach3- 1f. March 20, 2023, Meeting Minutes.docx

MDAG MINUTES
April 20, 2023

AGENDA ITEM 2 – REVIEW OF PAST ACTION ITEMS

Lottie Jones discussed outstanding issues highlighted in red font, including the action items added from the last meeting. Lottie walked the group through updates on action items collected at the previous session and updates for existing in-progress action items.

- Action Item 164 – In-Progress – SPP staff presented to MVTF and is currently benchmarking requesting input from MDAG members as well.
- Action Item 200 – Complete – Training to be performed during the MDAG in-person workshop.
- Action Item 202 – In-Progress – To be marked complete after discussion during this meeting.

AGENDA ITEM 3 – MDAG IN-PERSON MEETING (APPROVAL ITEM)

AGENDA ITEM 3A – JUNE 14-15, 2023 – SPP – WORKSHOP

SPP staff, Lottie Jones, requested a motion to approve the meeting date for the June MDAG in-person workshop at SPP on June 14-15.

John Vara asked for clarification that the location is still set for SPP offices.

Motion: Jason Shook motioned to approve the date, time, and location for the MDAG in-person workshop meeting June 14th-15th at SPP Campus. John Vara seconded the motion. The group did not voice concerns during the discussion of the motion. The motion passed unanimously.

AGENDA ITEM 4 – RATE 3

AGENDA ITEM 4A – DPP PROCESS

SPP staff, Chris Davis, updated the group on the Rate 3 discussion and how conductor data is utilized in the DPP process for transmission planning.

SPP Member Company requested that there is a check to see if the data request has been sent out to members as they have not found the request from SPP.

SPP Member Company asked the group if the data is already submitted during the project stage of the DPP window if they are terminally limited. This is a competitive process so the expectation is that these would be submitted as projects. Does submitting this data throw them out of the competitive process? This data would probably not result in a competitive project. A

competitive upgrade determination is considered final after legal review. Facility rating determinations are not considered competitive as the equipment is already existing and are part of the model development process. If a rating impact is shown in year 8 would that be considered competitive? Ratings are not considered in the competitive process. When SPP receives DPP this data is utilized for automation but does not make it competitive. Do DPP submitters submit these projects to do terminal upgrades? Yes, but not always and SPP staff is creating solutions for these uprate solutions as well.

SPP Member Company asked SPP if this data request be tied to as standard such as FAC-008 or MOD-032? This data could be tied to a standard if it is applicable but this would be a good add as it is not currently in the data request. SPP Member Company mentioned that it might be more relevant to tie this request to MOD-032 and not to FAC-008.

SPP Member Company asked how FAC-008-5 R8 relates to the request for ratings during the DPP process? This data point in FAC-008 is limited to operations planning and not the DPP process. SPP Member Company would caution any correlation between the annual data request and the FAC-008-5 R8 standard. SPP Member Company also suggested a rewrite of the annual data request as SPP Member Company has not provided additional data since 2020 as the conductor information has not changed since that period. There is currently a seven day period for responses and this should be sufficient for the data request. Ask the host TO for any updated data required during the DPP process. A middle ground would be to include a question during the request as to whether the conductor is terminally limited or conductor limited. Solutions cannot be concluded from this as we need the rating data as well.

Staff mentioned that the annual data request is put into place to allow TOs to have a look for the entire year to plan for future data requirements.

SPP Member Company asked if the rating data is designed to provide higher quality data when it could be something like a jumper that needs to be replaced rather than a conductor limit rating. What is the result if we are upgrading everything beyond the conductor rating? There could be some alternatives as well. The conductor rating allows SPP the immediate solution to upgrade everything up to the conductor rating.

SPP Member Company asked for clarification that SPP is asking for the rating of the transmission line minus any terminal limits? What is the rating of the line minus any equipment on either side? The lines would go in the same bucket as the substation equipment. The transmission element itself minus any switches, breakers, etc. absent the switching devices and measuring devices.

SPP Member Company commented that the currently rated conductors do not typically change over time. SPP Member Company experience is that the rating value is entered and locked in for a long period. Has staff seen an instance where the conductor limit needs to be changed after

the initial value entry? This is an SPP assumption so it is fine if the data does not change over time.

SPP Member Company added a few comments to the discussion based upon her experience providing the planning level cost estimates. When talking about the conductor limit is it SAG limited and how many structures do you have to replace to raise the conductor. In most cases, there is a bright line between the line conductor limit and terminally limited conductors as far as the cost. There is currently seven days or less to provide this data and it is currently a challenge to come up with a somewhat accurate planning level cost estimate. This is an additional burden for the modelers to submit this information. Also, individuals who are not the planner or TO are not going to have this Rate 3 data to provide to SPP. They could run with a false assumption and not ask for confirmation from the TO.

Staff mentioned that this type of estimation needs to be done during the cost estimate process so that they can determine if there is anything that needs to be upgraded around the conductor. Upgrading to the conductor limit would address any terminally limited issues.

Staff mentioned that we need to put some focus into the suggestion from SPP Member Company so that we may be able to use this as a price suggestion. The current data submittals is creating a mixed bag of the data that we currently receive from members if the data and conductor ratings has not been updated. What we are doing today may not hold water in the future if we do not receive conductor ratings from TOs.

SPP Member Company mentioned that a check box for the data may not be enough and you may have to dig into the terminal equipment as well. You may have to upgrade more than you are touching with this checkbox and the DPP window is used to figure out what is needed for a good project.

SPP Member Company mentioned that though this request does not seem like it would take a lot of effort; from a model building perspective, there are several items that would cause this request to add to the modeling effort for WAPA and others.

AGENDA ITEM 5 – RATE 3 STRAW POLL

SPP staff, Lottie Jones, asked the group how they would like to proceed with the straw poll after this last discussion.

John suggested that we skip the straw poll and SPP staff and MDAG members work through an appropriate path moving forward through email communication.

Action Item: MDAG to discuss a path forward via email for future discussions on the Rate 3 topic.

MDAG MINUTES
April 20, 2023

AGENDA ITEM 6 – CPPTF COMMON MODEL UPDATE

SPP staff, Brandon Hentschel, updated the group on the CPPTF common model discussion.

SPP Member Company asked what the asterisks represent in the proposed schedule. These coincide with the 90/10 load option discussion.

SPP Member Company proposed building additional models for 28S/W and 30S/W and would like to discuss it during the MDAG workshop topics discussion.

SPP Member Company commented that the comparison between MDAG and ITP is worthwhile from a modeling perspective.

Staff mentioned that it would be worthwhile to ask TWG if it would be possible to use the EIA data for the ITP BR models. Jason Shook did not voice any concerns with SPP presenting this discussion and bringing it to TWG.

SPP Member Company mentioned that he does not think the user interface for MDAG would carry over well to ITP. There are some challenges with the current spreadsheet. SPP Member Company mentioned that he would be supportive of a change to the current process.

Staff mentioned that an EDST survey will be coming soon and asked MDAG membership to participate in this survey.

AGENDA ITEM 7 – BREAK (5 MINUTES)

AGENDA ITEM 8 – 2023 SERIES MDAG MODEL BUILD/APPLICATION UPDATES

AGENDA ITEM 8A – DYNAMICS

SPP staff, Zach Sabey, updated the group on the 2023 series Dynamics model build.

AGENDA ITEM 8B – MOD-033 EVENT SELECTION

SPP staff, Eric Sullivan, updated the group on the next MOD-033-2 East event selection.

AGENDA ITEM 9 – FOCUS GROUP UPDATES

SPP staff, Eric Sullivan, provided the group with the upcoming MDAG Focus Group topics and requested any additional topics.

AGENDA ITEM 10 – RAD TF

SPP staff, David Duhart, updated the group on the RAD Task Force goal and participation.

MDAG MINUTES
April 20, 2023

The primary goal of the group is to streamline the 5 year average process.

SPP would like to ask for participation from the MDAG members as well.

AGENDA ITEM 11 – MDAG WORKSHOP TOPICS

SPP staff, Lottie Jones, updated the group on proposed MDAG workshop topics.

Staff will be sending out a Google Form Survey as well as a PDF version so that members may add some additional topics that they would be interested in covering during the workshop.

Mae Cruz requested a topic discussion covering additional models that SPS would like to see in the next model build. This can be covered by SPP and would likely be an approval item as well.

AGENDA ITEM 12 – DISCUSSION OF FUTURE MEETINGS

MDAG Chair, John Turner, updated the group on upcoming meetings.

a. MDAG: May 18, 2023 (9:00 AM – 12:00 PM)

b. MDAG FG: April 25, 2023 (1:00 PM – 3:00 PM)

AGENDA ITEM 12 – SUMMARY OF ACTION ITEMS

Lottie discussed the action items from this meeting:

- **Action Item:** MDAG to discuss a path forward via email for future discussions on the Rate 3 topic.
- **Action Item:** Review how the current MDAG dispatch workbook is being populated and look for areas of improvement.

AGENDA ITEM 13 – ADJOURN

John Turner adjourned the meeting at 11:18 a.m. (CST)

MDAG MINUTES
April 20, 2023

Respectfully Submitted,

Lottie Jones
Secretary

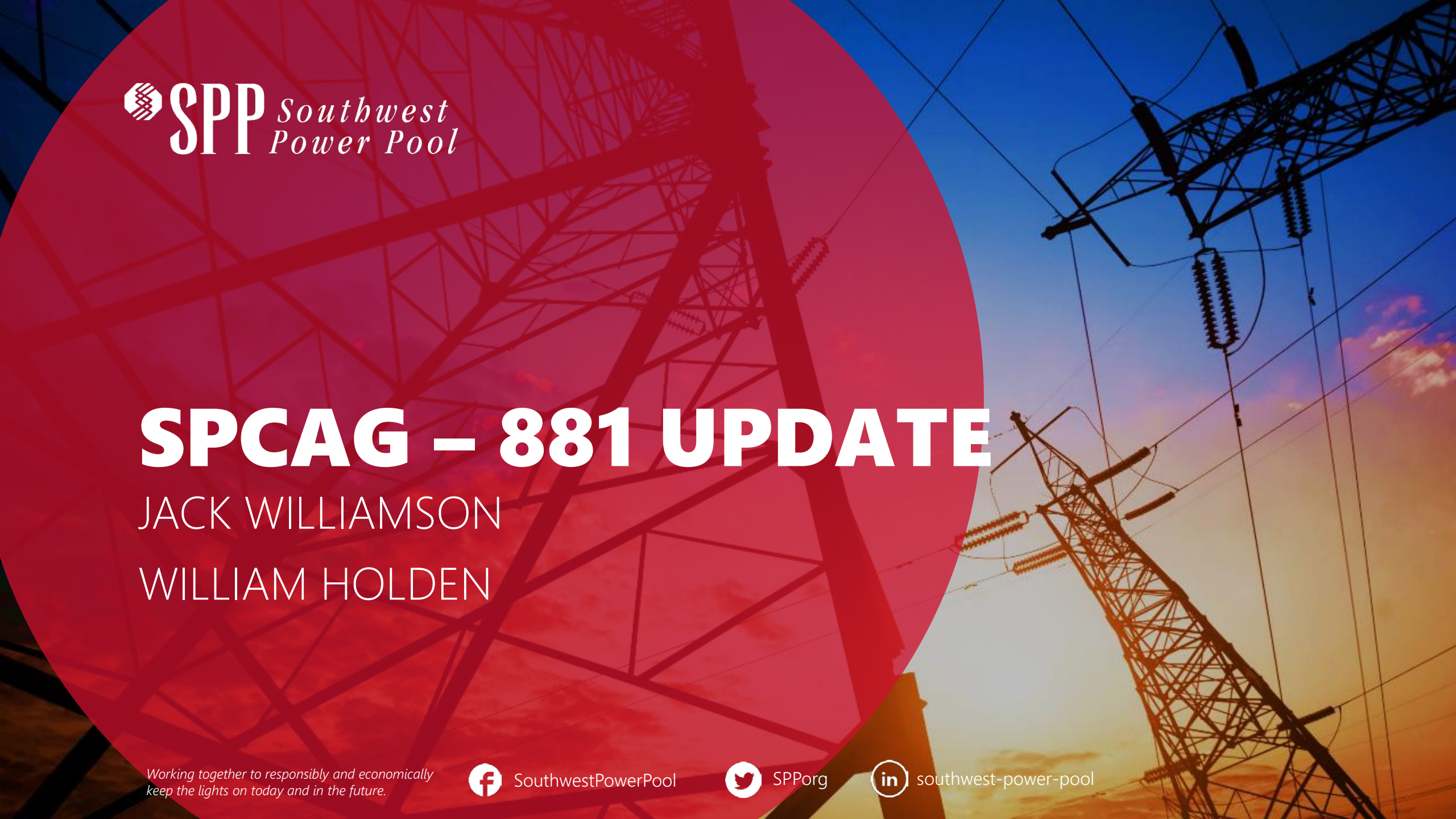
Eric Sullivan
Secretary Assistant

Attachments

APR20_Attach1- 1e. MDAG Meeting Agenda.docx

APR20_Attach2 - 1c. MDAG Conference Call Attendance-04-20-2023

APR20_Attach3- 1f. Mar 20, 2023, Meeting Minutes.docx



SPCAG – 881 UPDATE

JACK WILLIAMSON

WILLIAM HOLDEN

Working together to responsibly and economically keep the lights on today and in the future.

SouthwestPowerPool SPPorg southwest-power-pool

TODAY'S TOPICS

- Overview of FERC Order 881
- Walkthrough of Timeline
- Vendor Selection Info
- Impacting System Protection
  - Exceeding Relay Settings
  - SPCAG/Planning Questions

FERC ORDER 881 DETAILS

FERC ORDER 881 REQUIREMENTS

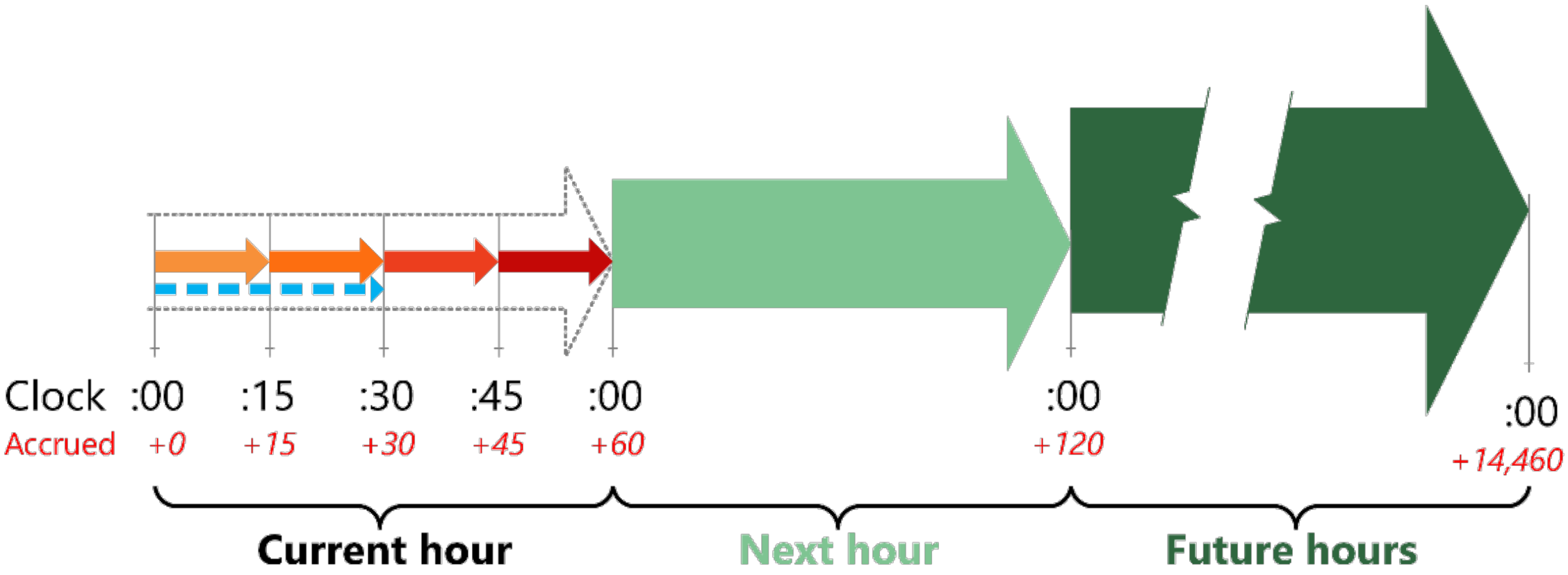
- Transmission Owner (TO) provide their ratings methodology
- At least four distinct TO determined Seasonal Line Ratings
  - Some facilities exempt, identified by methodology and owner
- Hourly TO Ambient Adjusted Ratings (AAR) for 10 day forecast
- TO ratings provided hourly to Transmission Provider (SPP)
- Ratings used by SPP, Transmission Operators, and adjacent RCs
  - Exceptions as needed for reliability (i.e. maintenance)
  - Exceptions determined by the TO, and submitted to the Transmission Provider (SPP)
- Ratings and methodology published by SPP

AMBIENT ADJUSTED RATING (AAR)

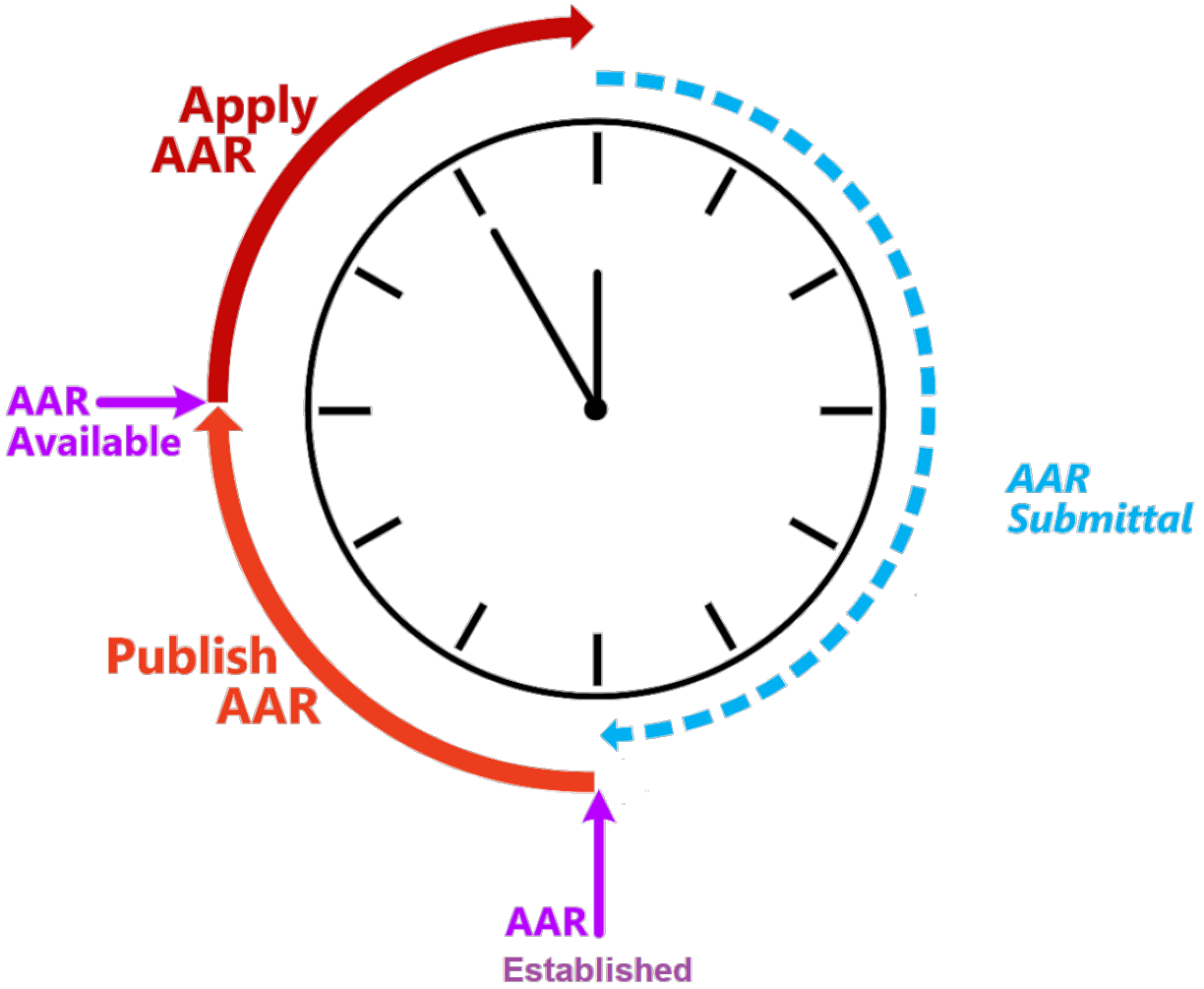
- Hourly variable circuit ratings
  - Normal
  - Emergency
  - Most limiting equipment in transmission circuit
- 10-day temperature forecast
  - Weather vendor provided temperature
  - 5 degree F or smaller increment
  - Ratings must include security margin (forecast error)
  - Inclusion/exclusion of solar heating (day/night)
  - Seasonal ratings used for evaluations beyond 10 days

AAR TIMELINE

- 10 Days (240 Hours)



AAR HOURLY UPDATE CYCLE

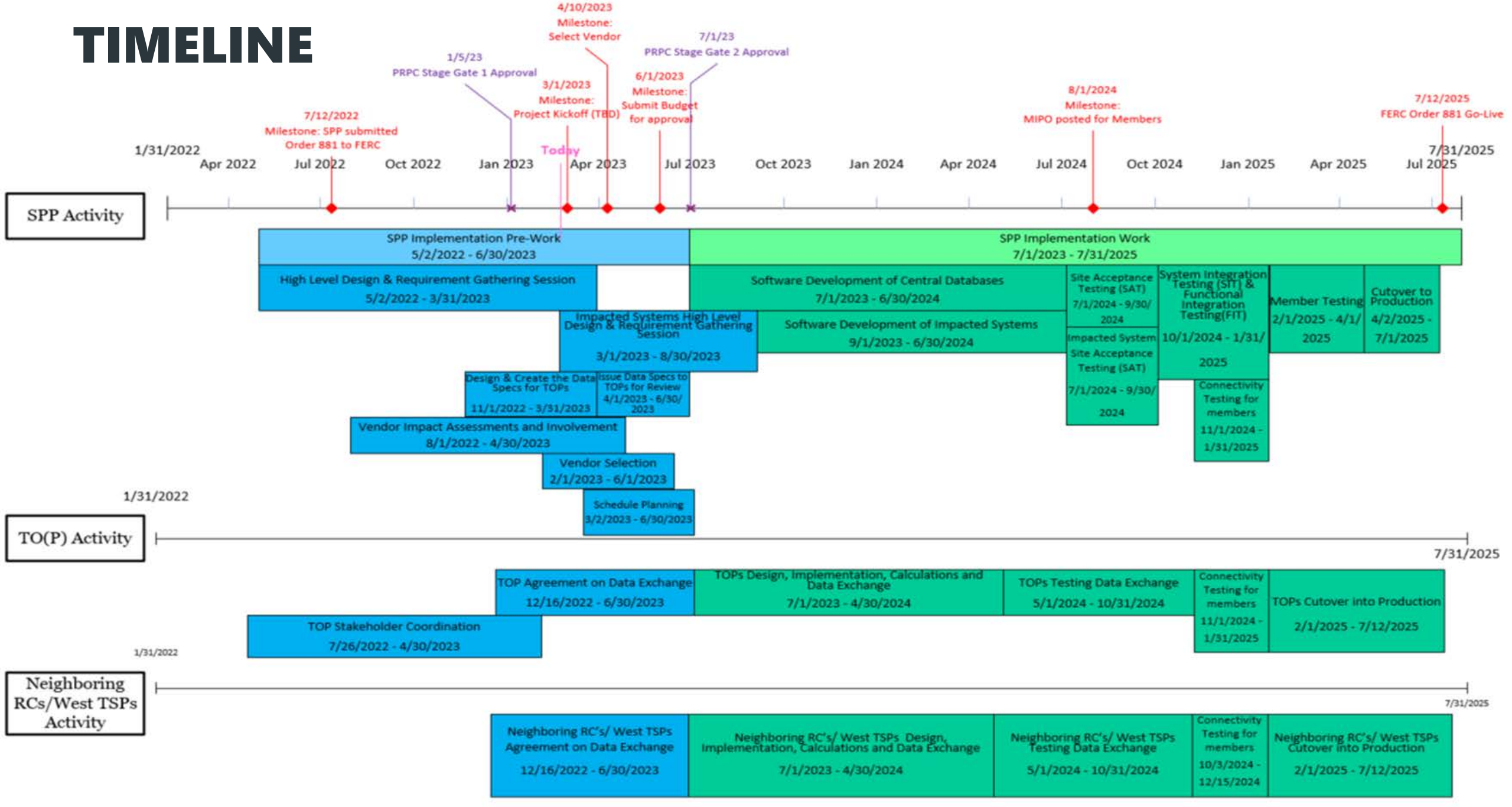


AAR CALCULATION CONSIDERATIONS

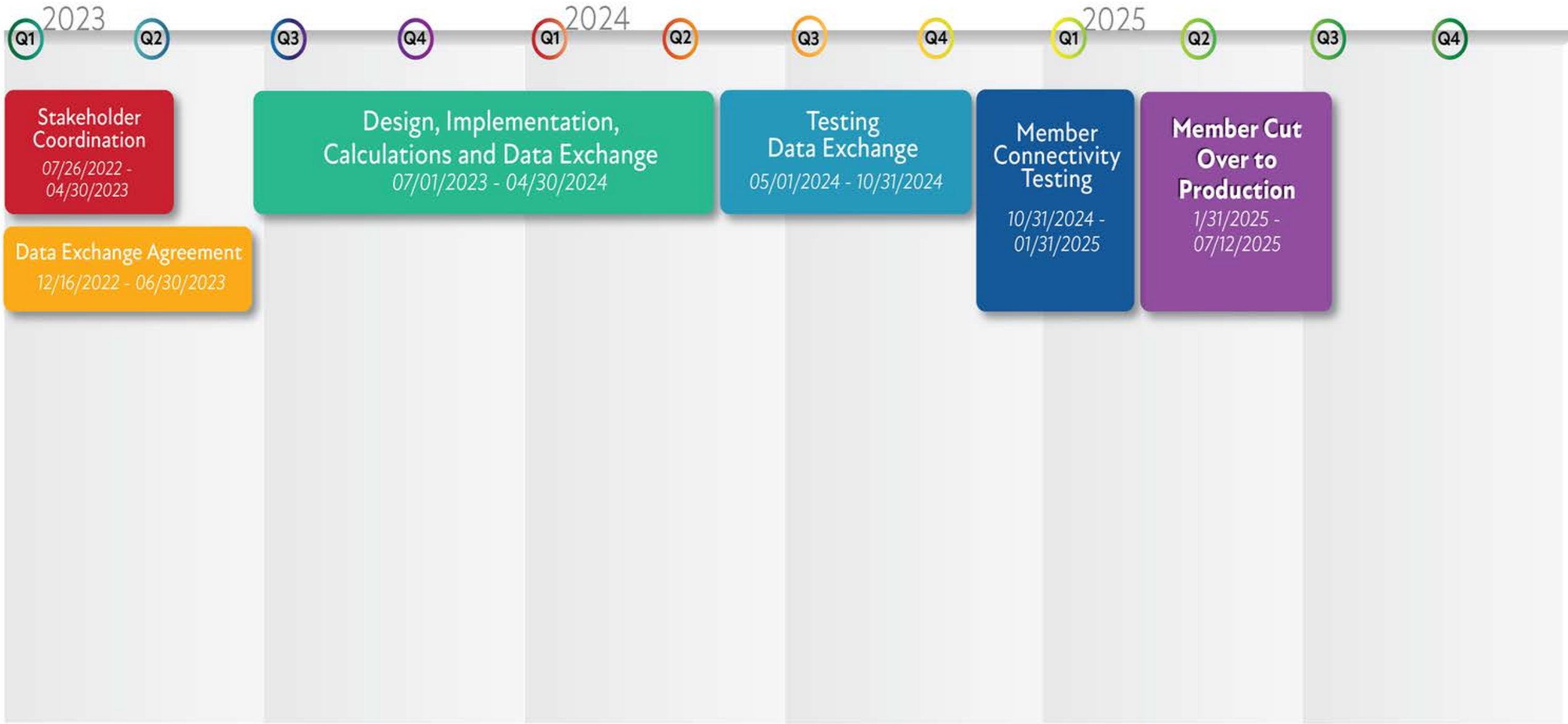
- Temperature Range
  - Ratings for each 5 degree increment
  - Ratings determined for entire historical extremes
    - AARITF requested initial range based on entire SPP footprint
    - Extended by 10 degree F margin
    - Process to adjust when new records are set
- Solar heating
  - Included in daylight hours
  - Excluded in nighttime hours
  - Daylight hours adjusted at least monthly
  - AARITF requested daylight hours based on entire SPP footprint

TIMELINES

TIMELINE


4/10/2023
Milestone:
Select Vendor
7/1/23
PRPC Stage Gate 2 Approval
1/5/23
PRPC Stage Gate 1 Approval
6/1/2023
Milestone:
Submit Budget
for approval
3/1/2023
Milestone:
Project Kickoff (TBD)
8/1/2024
Milestone:
MIPO posted for Members
7/12/2025
FERC Order 881 Go-Live
7/12/2022
Milestone: SPP submitted
Order 881 to FERC
Today
1/31/2022
Apr 2022
Jul 2022
Oct 2022
Jan 2023
Apr 2023
Jul 2023
Oct 2023
Jan 2024
Apr 2024
Jul 2024
Oct 2024
Jan 2025
Apr 2025
Jul 2025
7/31/2025
SPP Activity
SPP Implementation Pre-Work
5/2/2022 - 6/30/2023
SPP Implementation Work
7/1/2023 - 7/31/2025
High Level Design & Requirement Gathering Session
5/2/2022 - 3/31/2023
Software Development of Central Databases
7/1/2023 - 6/30/2024
Site Acceptance Testing (SAT)
7/1/2024 - 9/30/2024
System Integration Testing (SIT) & Functional Integration Testing(FIT)
10/1/2024 - 1/31/2025
Member Testing
2/1/2025 - 4/1/2025
Cutover to Production
4/2/2025 - 7/1/2025
Impacted Systems High Level Design & Requirement Gathering Session
3/1/2023 - 8/30/2023
Software Development of Impacted Systems
9/1/2023 - 6/30/2024
Impacted System Site Acceptance Testing (SAT)
7/1/2024 - 9/30/2024
Connectivity Testing for members
11/1/2024 - 1/31/2025
Design & Create the Data Specs for TOPs
11/1/2022 - 3/31/2023
Issue Data Specs to TOPs for Review
4/1/2023 - 6/30/2023
Vendor Impact Assessments and Involvement
8/1/2022 - 4/30/2023
Vendor Selection
2/1/2023 - 6/1/2023
Schedule Planning
3/2/2023 - 6/30/2023
1/31/2022
TO(P) Activity
7/31/2025
TOP Agreement on Data Exchange
12/16/2022 - 6/30/2023
TOPs Design, Implementation, Calculations and Data Exchange
7/1/2023 - 4/30/2024
TOPs Testing Data Exchange
5/1/2024 - 10/31/2024
Connectivity Testing for members
11/1/2024 - 1/31/2025
TOPs Cutover into Production
2/1/2025 - 7/12/2025
TOP Stakeholder Coordination
7/26/2022 - 4/30/2023
1/31/2022
Neighboring RCs/West TSPs Activity
7/31/2025
Neighboring RC's/ West TSPs Agreement on Data Exchange
12/16/2022 - 6/30/2023
Neighboring RC's/ West TSPs Design, Implementation, Calculations and Data Exchange
7/1/2023 - 4/30/2024
Neighboring RC's/ West TSPs Testing Data Exchange
5/1/2024 - 10/31/2024
Connectivity Testing for members
10/3/2024 - 12/15/2024
Neighboring RC's/ West TSPs Cutover into Production
2/1/2025 - 7/12/2025

CURRENT MEMBER PLANNING TIMELINE



VENDOR SELECTION INFO

VENDOR UPDATE – LATENT SYSTEMS

- Vendor selection discussion specifically refers to development of the API
- Latent systems that need to be upgraded to incorporate the use of AARs
  - Systems updated will use their current vendor

VENDOR UPDATE

- SPP is currently in negotiations with vendors
  - SPP cannot name any vendor preferences until selection has been made
- Vendors does not have a finished product, and in fact has not begun development of said product
  - See timeline for expected development time (~1 year)
- Vendors are taking feedback from the industry, and is likely to have a standard package for all
  - Additional costs for "customized" needs from different companies
- Vendors likely to include solutions for both TO AAR calculations, and data exchange needs

IMPACTING SYSTEM PROTECTION

POTENTIALLY EXCEEDING STANDARD RELAY SETTINGS

- At times, ambient air temperatures may be well below the assumptions that go into seasonal ratings
  - There may be ratings that exceed the standard relay settings in these scenarios
- I.E. Winter seasonal rating may assume an average 50F with
  - If air temperature drops to below 0F, it may fall outside the exceedance currently allowed.

PLANNING STAFF PREPARATION

- Are members of SPCAG working with their planning staff to:
  - Determine relay settings?
  - How relay settings might limit AARs?
  - How to factor these decisions into their methodology?

APPENDIX

Range of Local Historical Temperatures

	All-Time Maximum Temperature† [deg F]	All-Time Minimum Temperature† [deg F]	AAR Valid Range - Max Temperature [deg F]	AAR Valid Range - Min Temperature [deg F]
Arkansas	120	-29	130	-39
Iowa	118	-47	128	-57
Kansas	121	-40	131	-50
Louisiana	114	-16	124	-26
Minnesota	115	-60	125	-70
Missouri	118	-40	128	-50
Montana	117	-70	127	-80
Nebraska	118	-47	128	-57
New Mexico	122	-50	132	-60
North Dakota	121	-60	131	-70
Oklahoma	120	-31	130	-41
South Dakota	120	-58	130	-68
Texas	120	-23	130	-33
Wyoming	115	-66	125	-76

† *Source: National Oceanic and Atmospheric Administration (NOAA) - National Centers for Environmental Information, State Climate Extremes Committee Records, available at www.ncei.noaa.gov/access/monitoring/scec/records.*

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

FERC Order 881 Managing Transmission Line Ratings Impact to PRC-023?

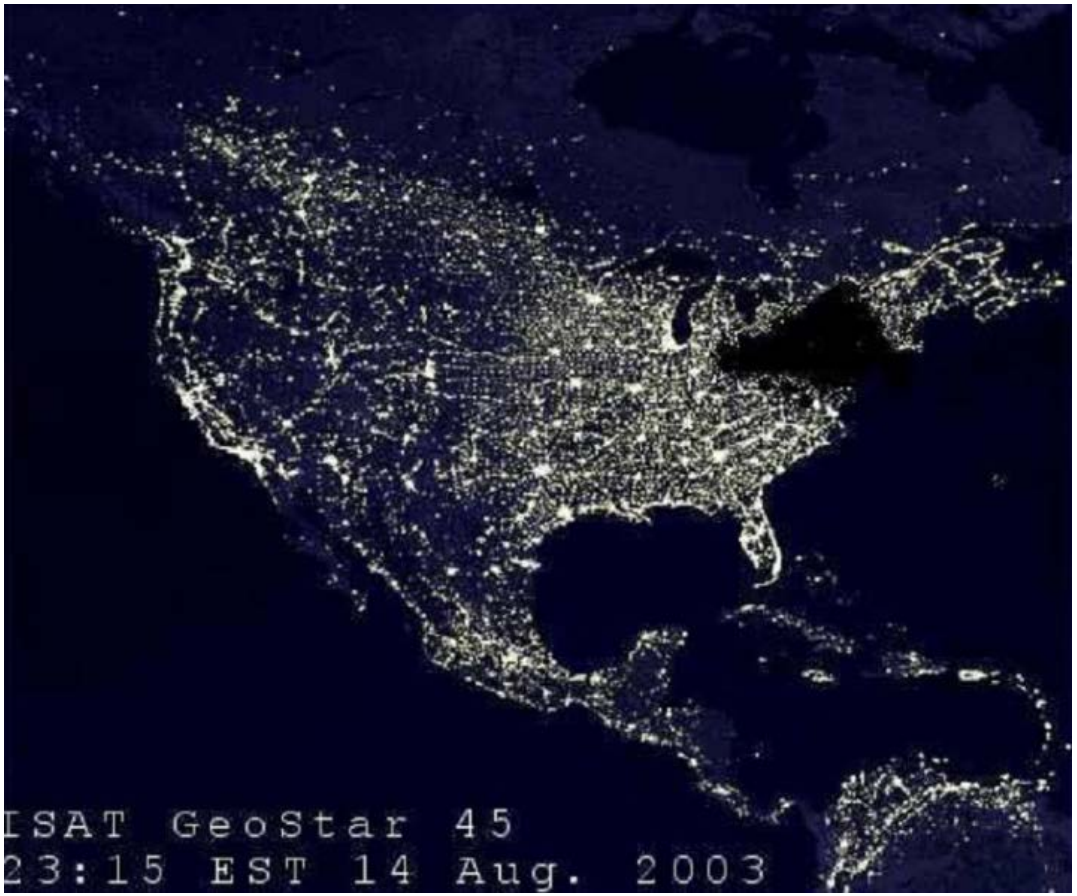
Rich Bauer
NERC
SPP
4/25/2023

RELIABILITY | ACCOUNTABILITY




Background

- **August 14th 2003**



Background

- **2003 Blackout Report**
  - **Recommendation 8. Improve System Protection to Slow or Limit the Spread of Future Cascading Outages**
    - **Beginning with the Sammis-Star line trip, most of the remaining line trips during the cascade phase were the result of the operation of a zone 3 relay for a perceived overload**

Background

- **PRC-023 Transmission Relay Loadability**
  - **Criteria 1 – 150% of the highest seasonal 4 hour Rating**
  - **Criteria 2 – 115% of the highest seasonal 15 minute Rating**

Background

- **PRC-023 Transmission Relay Loadability**
  - **Criteria 1 – 150% of the *highest seasonal* 4 hour Rating**
  - **Criteria 2 – 115% of the *highest seasonal* 15 minute Rating**
- **From the 2005 SPCTF Working Paper on Relay Loadability**
  - **That rating will typically be the *winter* short-term rating of the line and series elements.**

FERC Order 881

- **December 16, 2021 FERC issued Order 881**
- **May 19, 2022 FERC issued Order 881A (Rehearing and Clarification)**

177 FERC ¶ 61,179
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

18 CFR Part 35

Docket No. RM20-16-000; Order No. 881

Managing Transmission Line Ratings

(Issued December 16, 2021)

AGENCY: Federal Energy Regulatory Commission.

ACTION: Final rule.

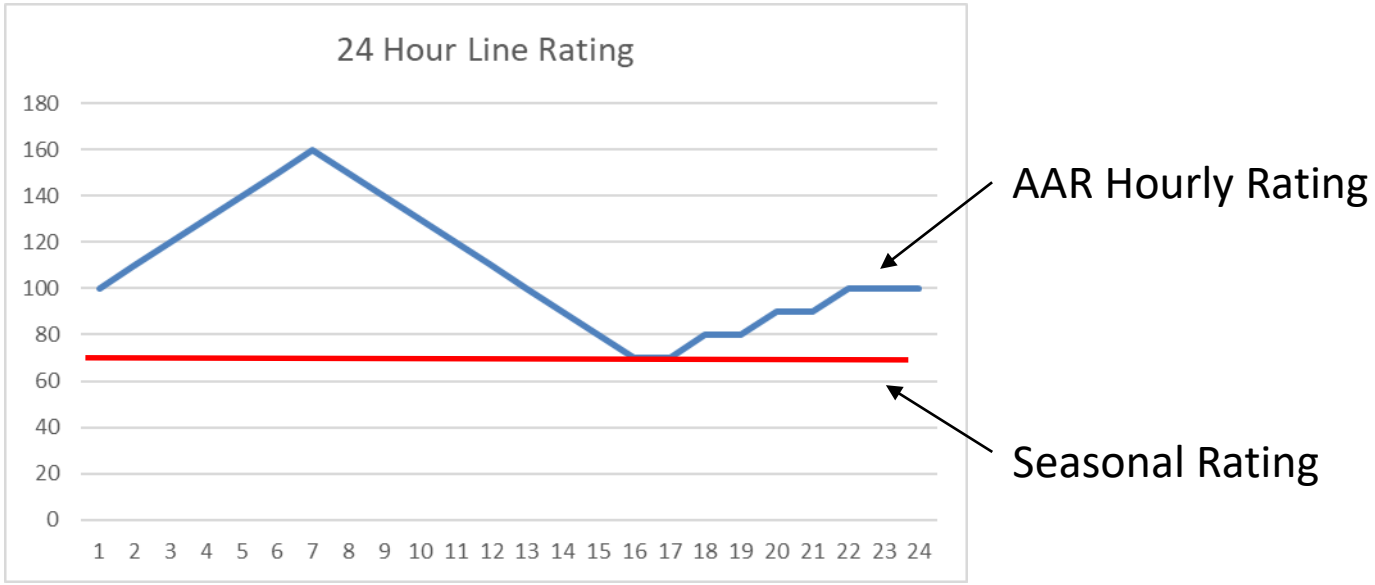
SUMMARY: The Federal Energy Regulatory Commission (Commission) is revising both the *pro forma* Open Access Transmission Tariff and the Commission's regulations under the Federal Power Act to improve the accuracy and transparency of electric transmission line ratings. Specifically, the Commission is requiring: public utility transmission providers to implement ambient-adjusted ratings on the transmission lines over which they provide transmission service; regional transmission organizations (RTO) and independent system operators (ISO) to establish and implement the systems and procedures necessary to allow transmission owners to electronically update transmission line ratings at least hourly; public utility transmission providers to use uniquely determined emergency ratings; public utility transmission owners to share transmission line ratings and transmission line rating methodologies with their respective transmission provider(s) and with market monitors in RTOs/ISOs; and public utility transmission

FERC Order 881

- **The order revised the pro forma OATT to require:**
- ***Ambient-Adjusted transmission line Ratings (AARs)*** **determined at least hourly**
- **Seasonal Line Ratings**
- **Emergency Ratings**

FERC Order 881

- ***Ambient-Adjusted transmission line Ratings (AARs)***
  - **determined at least hourly**
  - **Used for near-term transmission service (10 days to real time)**
  - **Reflects forecasted ambient temperature**
  - **Reflects the absence of solar heating during nighttime**



FERC Order 881

- **Seasonal Line Ratings**
  - **At least four seasons**
  - **Reasonably reflect portions of the year where expected high temperatures are relatively consistent**
  - **Calculated at least Annually**
  - **Use up-to-date temperature forecast**

FERC Order 881

- **Emergency Ratings**
  - **Must use Emergency Ratings for contingency analysis in the operations horizon and in post-contingency simulations**
  - **Emergency Ratings must also include AAR calculations**

Impact to PRC-023

Criteria:

1. Set transmission line relays so they do not operate at or below 150% of the highest seasonal Facility Rating of a circuit, for the available defined loading duration nearest 4 hours.

2. Set transmission line relays so they do not operate at or below 115% of the highest seasonal 15-minute Facility Rating[1] of a circuit.

- **What is highest seasonal Facility Rating?**
- **Is that the highest anticipated hourly AAR?**

Impact to PRC-023

Criteria:

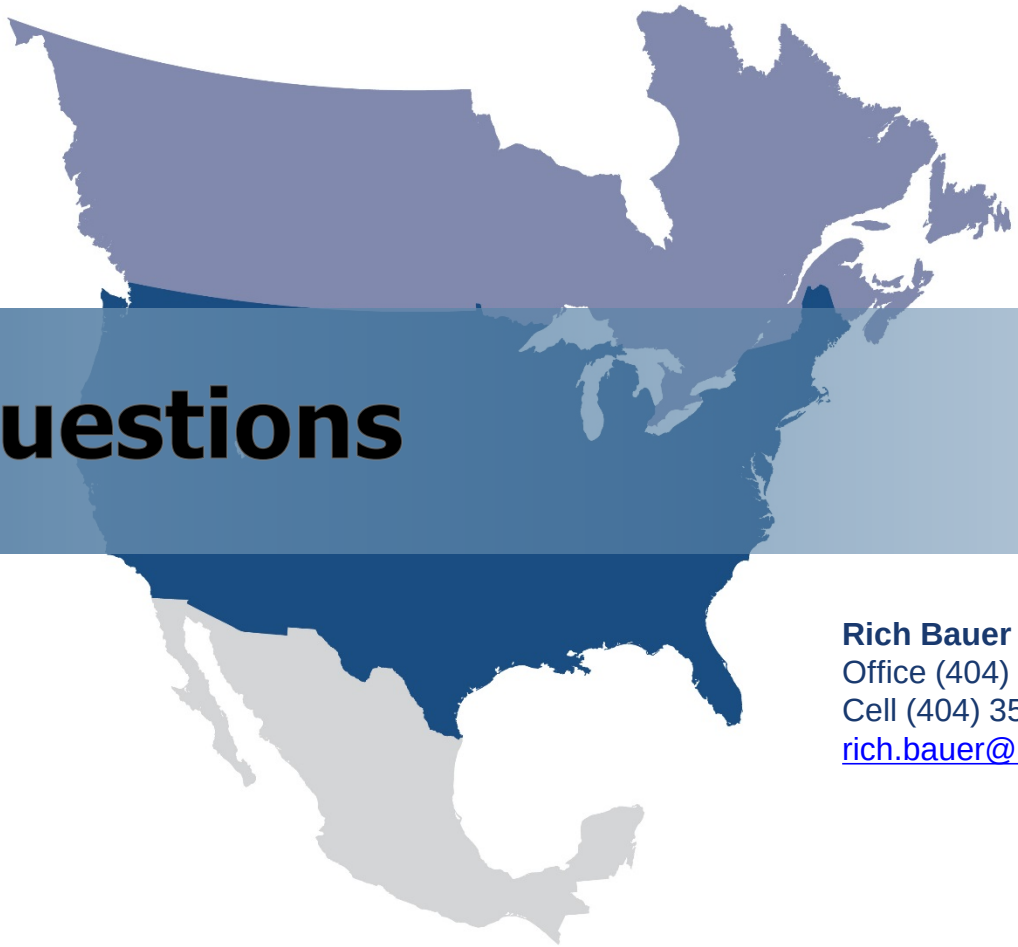
1. Set transmission line relays so they do not operate at or below 150% of the highest seasonal Facility Rating of a circuit, for the available defined loading duration nearest 4 hours.

2. Set transmission line relays so they do not operate at or below 115% of the highest seasonal 15-minute Facility Rating[1] of a circuit.

- **What is highest seasonal Facility Rating?**
- **Is that the highest anticipated hourly AAR?**

Order 881A

- **“we clarify that, if, as a result of favorable ambient conditions, a transmission provider establishes a higher transfer capability than the currently determined maximum facility ratings, the transmission provider must evaluate its applicable protection systems for that facility in order to comply with Reliability Standard PRC-023-4 and prevent protection settings from limiting transmission loadability.”**



Questions

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Composite Load Model Guidance

Introduction

This document provides guidance to Southwest Power Pool (SPP) members in regard to utilizing and submitting dynamic load information for the composite load model (CMLD).

Intended Audience

This document is intended primarily for SPP Members~~engineers~~ involved with the development of dynamic stability cases created by SPP's Model Development Advisory Group (MDAG).

History of The Composite Load Model

In 2015, the North American Electric Reliability Corporation (NERC) Reliability Standard TPL-001-4 became enforceable. A key difference between TPL-001-4 and the preceding versions of the Standard (and its cohort) was the addition of language specifying the need to "*… include a Load model which represents the expected dynamic behavior of Loads that could impact the study area, considering the behavior of induction motor Loads.*"[1] Until this time, Transmission Planners (TPs) and Planning Coordinators (PCs) generally used the constant impedance, constant current, constant power~~,~~ (or ZIP)~~,~~ model to represent load in stability studies, especially for studies related to interconnection-wide planning. The ZIP model, however, is not an appropriate method to represent loads with high concentrations of three-phase or single-phase motors; induction motors; or power electronics (e.g., computer power supplies, battery chargers, variable-frequency drives (VFDs), variable-speed drives (VSDs), etc.) Therefore, the adoption of this requirement drove the implementation of a load model suitable for phasor-based dynamic stability simulations (e.g., dynamic simulation using PSSE) that incorporated the necessary motor, electronic, and equipment characteristics to ~~more accurately represent a loads' dynamic response~~represent a loads' dynamic response more accurately to transmission-level stimuli. Enter, the composite load model (CMLD).

~~Description~~ Explanation of the Composite Load Model

The CMLD is the state-of-the-art dynamic model used to represent the dynamic nature of electrical loads in transient stability studies. It is intended for use in transmission studies to better represent the dynamic response of electrical load **as seen from the transmission-to-distribution interface**. It is a dynamic model that can be assigned to one or more loads within a bus, area, owner, or zone that applies multiple dynamic characteristics for transient stability simulations. ~~Most~~ The most widely-used ~~major~~ power simulation software platforms have implemented the CMLD including, Siemens PTI's

[1] NERC Reliability Standard TPL-001-4, Requirement R2, Part 2.4.1

Power System Simulator for Engineering (PSS®E), GE's Power System Load Flow (PSLF), PowerWorld, and PowerTech Labs' TSAT.

The CMLD is composed of over 130 parameters that are used to create an approximation of a distribution system and the aggregate behavior of electrical loads. While many parameters make up this model, each parameter is a sub-component of one of a handful of sub-sections of the overall model:

1. Distribution feeder model
2. Load allocation percentages
    a. The user specifies what percent of a load's MVA is allocated to each sub-component of the load
3. Electronic load model
4. Static load model
5. Motor A model and protection settings
6. Motor B model and protection settings
7. Motor C model and protection settings
8. Motor D model and protection settings
9. Distributed energy resource (DER) model

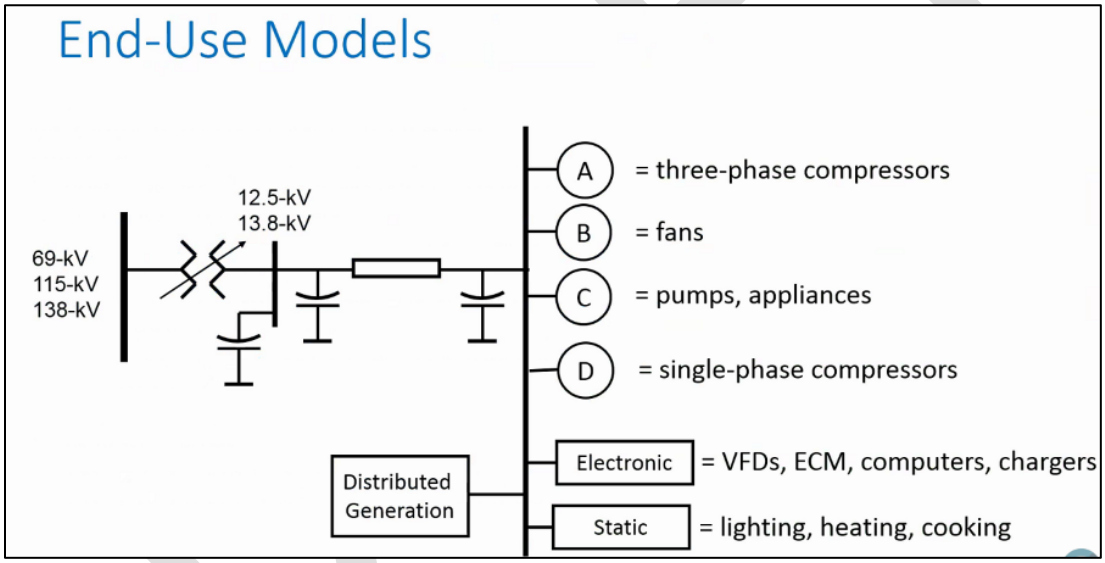


Figure 1: Overview of What a CMLD Represents (Diagram Credit: Dmitry Kosterev, Bonneville Power Administration)

Generally speaking, the ~~component~~ impedance and protection ~~models~~ values (CONS J+24 through J+132) have been developed to represent a generalized aggregate response of electrical load where it meets the transmission system~~are based on parameters intended to represent a wide variety of common load components~~. Therefore, unless specific ~~load model~~ details are known of individual transmission-to-distribution interfaces, the user does not typically need to modify the impedance~~model~~ and protection parameters from their default values. ~~These typically unmodified parameters make the majority of the CMLD's total parameters.~~

~~In most instances,~~When using default impedance and protection values, the ~~user~~ engineer only needs to modify the load allocation percentages (CONS J+18 through J+23). These percentages may be modified manually, but the following sections will provide guidance on how the user may utilize the default

~~"phone book~~Dataset~~"~~ developed by the DLTF and SPP staff to map these percentages based on physical location and the ~~general~~ aggregate ~~type of~~ load type as seen from the transmission-to-distribution interface.

~~General~~ Default End-Use Load Types

Since the vast majority of loads in transmission system models are rarely representative of a single piece of equipment, NERC, the Western Electricity Coordinating Council (WECC), and Electric Power Research Institute (EPRI) collaborated to create~~d~~ a set of general classifications for transmission loads to which users can refer (show in Table 1[2]).

Name	Abbreviation	Description and Usage
Residential	RES	"Suburban Residential" – many homes, schools and day care, retail, grocery, restaurants, small offices, etc.
Commercial	COM	"Commercial Downtown" – high-rise commercial buildings, hotels, shopping malls, restaurants, etc.
Mixed	MIX	Combination of RES and COM types (e.g., suburban area with many homes but also medium-size office buildings, hospitals, etc.)

Table 1: General End-Use Load Types to which the CMLD can be Associated

~~General~~ Default Large Industrial Customer End-Use Load Types

In addition to the ~~general~~ default load types described in the previous section, ~~defined~~ default load types are available for large industrial customer~~s~~ ~~types~~ as well. These definitions are intended for individual loads that represent electrical service to a single, large industrial consumer (normally represented as a non-scalable load).

Name
Agricultural Loads (including irrigation)
Agricultural Loads (irrigation only)
Aluminum Smelter
Industrial - other
Large Pumping Station (LNG & petroleum pipeline)
Mining Operation
Paper Mill - Kraft Process
Paper Mill - Thermo-mechanical process
Petrochemical Plant
Power Plant Auxiliary Load
Semiconductor Plant
Server Farm
Steel Mill
Oil Extraction
Shale Gas Extraction
Liquified Natural Gas Extraction

[2] Based on MRO designations as presented to the NERC LMTF in May of 2019

Lumber Mill
Vehicle Manufacturing
Cement Manufacturing
Railroad

Table 2: Large Industrial Customer Load Types to which the CMLD can be Associated

Collecting End-Use Load Composition Data

In order for dynamic simulations to reasonably represent motor dynamics and, potentially, capture the effects of Fault Induced Delayed Voltage Recovery (FIDVR), it is important to assign load composition data that reasonably reflects the types of equipment (and their associated saturation) at a given transmission-to-distribution interface.

However, depending on a utility's role as an energy provider, knowledge of and access to end-use data may be limited. This section seeks to provide guidance on how different entities may embark on gathering or estimating end-use load composition given their role as an energy provider.

Wholesale Provider Perspective

Wholesale providers may need to rely on less-exact methods of categorizing load composition. While it is important for load composition to be as accurate as possible, it may not be practical for wholesale providers to obtain the exact details of load composition.

For wholesale providers, it is advisable to utilize the area, owner, and/or zone CMLD designations. This allows the provider to assign a general CMLD type (e.g., Residential) to a large number of loads. If individual load compositions are known (e.g., for large, industrial customers or large urban areas), individual bus-level CMLD records can be assigned to specific loads to better represent those subsets of the system where the engineer has greater detail.

For example, consider a transmission-owning electric cooperative (G&T Coop) that spans an entire state and provides wholesale power to multiple distribution cooperatives. The G&T Coop serves two larger urban areas as well as three large, industrial customers. In this example, the G&T Coop may be best served to supply an area wide CMLD (CMLDARU2) that uses the default residential parameters. This action applies a residential CMLD to all buses in the area. More specific load types can be specified using the bus-level CMLD (CMLDBLU2). These bus-level load specifications take precedents over the area-wide model and allow the specific load models to be applied where needed/known.

Vertically Integrated or Distribution Provider Perspective

For a utility that is vertically integrated and/or is a distribution provider, the collection of end-use data may be different than that of a wholesale provider. Before proceeding, several principals may help guide engineers to appropriately classify/define load composition:

1. Number of customers does not equal CMLD load percentages:
    a. Example: one load is composed of 95 residential class customers using a total of 1MW and 5 commercial class users using a total of 9MW (10MW total)
    b. From a customer class perspective, this load is 90% residential and 10% commercial

c. From a CMLD perspective, this load is 10% residential and 90% commercial
d. From a CMLD perspective, this load should be classified as commercial (COM)

2. The CMLD seeks to quantify electrical response in dynamic simulations, not customer billing class
   a. Customer billing class, especially commercial, does not necessarily map to the default COM load classifications used by the CMLD
      i. Commercial billing class is typically assigned to businesses
      ii. How many commercial customers (from a billing perspective) meet the description of the COM type of CMLD: "'Commercial Downtown' – high-rise commercial buildings, hotels, shopping malls, restaurants, etc."
      iii. It is possible that a large number of customers assigned to the commercial billing class do not belong in the COM classification used by the CMLD
      iv. The engineer must focus on the anticipated electrical response at the transmission-to-distribution interface and assign a CMLD load composition that best represents the types of electrical end-use loads served from the transmission-to-distribution interface
   b. For example
      i. One SPP member utility has the following billing classifications for commercial customers:
         1. Small General Service
         2. Medium General Service
         3. Large General Service
         4. Large Power Service (Industrial/Commercial)
      ii. Based on the utility's requirements for these billing classes, it was pertinent to assign customer billing classifications to CMLD load types as shown in Table 3
3. Load composition varies by season; the load compositions specified in the Default Composite Load Dataset for non-industrial load percentages are intended for **summer on-peak only**
4. In most instances, future load composition cannot be perfectly predicted; therefore, using generic parameters for load composition may be appropriate for both near-term and long-term cases

Customer Billing Classification	Corresponding CMLD Classification
Small General Service	RES
Medium General Service	RES
Large General Service	COM
Large Power Service	Industrial

Table 3: Customer Billing Class to CMLD Load Classification

Associating End-Use Customer Detail from Load Surveys into CMLD Classifications

The engineer may have enough detail to associate customer billing classes with CMLD load types at the transmission-to-distribution interface. The recommended practice to do this is:

1. Develop rules of association between customer billing class and CMLD load type (e.g., Small General Service = RES)
2. Determine what model season is to be represented (e.g., summer on-peak, fall peak, winter on-peak, etc.)

3. Determine what individual load records in the power flow model represent, for example
    a. One load represents the aggregate of all transmission-to-distribution interfaces within a substation (i.e., one power flow load record per substation)
    b. One load represents a single transmission-to-distribution transformer within a substation (i.e., multiple power flow load records may exist per substation)
4. For each power flow load record, collect the billing class and kW load profile for each customer served by the load represented in the power flow model
5. For the appropriate model season, determine the MW percentage of load associated with each CMLD load classification (e.g., 1MW of customer billing classes qualify as RES while 9MW of customer billing classes qualify as COM)
6. Based on the percentage of CMLD load classifications, determine the overall CMLD classification to be used for studies (e.g., if 90% is of the MW load is commercial, it should be represented as COM for dynamic simulation purposes)

This guidance document focuses on summer on-peak. For non-industrial loads, the load composition values contained in the SPP Default Composite Load Dataset are intended specifically for summer on-peak. This is due to the general nature of load composition during hotter times of year (i.e., the greater presence of single-phase air conditioner motors which are a significant contributor to FIDVR).

If the engineer wishes to utilize non-industrial loads for other seasons (e.g., winter on-peak) the fractions of motor load must be adjusted appropriately for the climate zone where the load is located (see Additional Resources #2) and the specific time of year being studied.

Field Measurements

It is also possible to establish load composition parameters through field measurements. If the utility is able to obtain high-speed measurements at the transmission-to-distribution interface where an individual load record is located in the transmission model, CMLD parameters can be tuned to match actual system response. This typically requires one or more system disturbances to be captured at or near the point of measurement.

General Classifications

Depending on availability of data and other resources, it may be most prudent for the engineer to assign a standard load type on an area, owner, or zonal basis and define more detailed load models for certain individual loads. This general classification methodology is similar to that a wholesale energy provider may take (see the Wholesale Provider Perspective discussion).

Using the SPP Default Composite Load ~~Phone Book~~Dataset

The SPP Default Composite Load ~~Phone Book~~Dataset and accompanying flowchart ~~can~~ is intended to enable SPP members to create CMLD data records at specific buses, zones, owners, or areas~~be used to assign all 130+ parameters to a given CMLD dynamic model. The Phone Book is specifically designed to assist SPP members in creation of CMLDs that can be added directly to a *.DYR file~~. These data records may be submitted to the SPP MDAG model build or they may be used for a members' internal study purposes.

Before applying CMLD records, SPP members should consider the seasonality of load composition of non-industrial end-use loads. For non-industrial load types (residential, commercial, and mixed), **the SPP Default Composite Load Dataset is primarily intended for use in summer on-peak or shoulder cases**. End-use loads consisting exclusively of an industrial customer are intended for use in most planning cases, as the load composition of large, industrial customers typically does not vary substantially by season.

For non-industrial load types, load composition also varies by regional climate (e.g., generally a lower penetration of air conditioner load in northern states as opposed to southern states). The U.S. government has done extensive research on climate zones, and Members can easily classify non-industrial load types by the state in which they reside.

~~-~~The high-level process of using the Dataset is~~To utilize the Phone Book, the user can~~:

1. Review the list of available load classifications
2. Based on the available options, determine the appropriate End-Use Load Type
3. In the "DLTF Default CMLD ~~Phonebook~~Dataset" Excel workbook, navigate to the "DLTF Default CMLD Parameters" tab
4. Locate the column containing ~~that contains~~ the parameters for the chosen End-Use Load Type
5. In Row 4 of the corresponding column, replace "######" with the appropriate PSSE bus number, PSSE area number, PSSE owner number, or PSSE zone number
6. In Row 6 of the corresponding column, replace "User Input" with the appropriate PSSE load ID
    a. If applying a dynamic load model to an area, zone, or owner, use an asterisk (*)
7. In Row 7 of the corresponding column, replace xx within the word "CMLDxxU2" with the appropriate model type identifier, as follows:
    a. "BL" to indicate an individual bus load
    b. "OW" to indicate any load assigned to the specific owner
    c. "ZN" to indicate any load assigned to the specified zone
    d. "AR" to indicate any load assigned to the specific area
    e. "AL" to indicate all loads
8. In Row 9 of the corresponding column, replace "1" with the appropriate model type identifier, as follows:
    a. "1" to indicate an individual bus load
    b. "2" to indicate any load assigned to the specific owner
    c. "3" to indicate any load assigned to the specified zone
    d. "4" to indicate any load assigned to the specific area
    e. "5" to indicate all loads

9. Once all information is added to Rows 4, 6, 7, and 9, the user may scroll to rows 153 through 162
    a. These rows can be copied from the applicable column directly into a PSSE-compatible *.DYR file
10. When finished, close the workbook **without** saving

Completing the CMLD Workbooks For the Annual MDAG Process

In addition to the ~~Phone Book~~Dataset, SPP members can select the composite load models en masse directly into the dynamic cases created during the annual MDAG dynamic case build. This method is similar to using the Composite Load ~~Phone Book~~Dataset; however, the user is asked to assign a type to each load record contained in the power flow case (see Figure 2 for an example of the workbook). Once members complete and return these workbooks, SPP is able to run automation to assign the correct CMLD values to the given loads based on user selection in the workbook.

Before applying CMLD records en masse, SPP members should consider the seasonality of load composition of non-industrial end-use loads. For non-industrial load types (residential, commercial, and mixed), **the load composition details are only valid for summer on-peak or shoulder cases**. End-use loads consisting exclusively of an industrial customer are intended for use in most planning cases, as the load composition of large, industrial customers typically does not vary substantially by season.

One workbook is provided for each dynamic case being built. Therefore, the Member may choose to apply CMLDs appropriately by season.

The process to complete these workbooks is as follows:

1. O~~User o~~pen~~s the~~ the next available CMLD workboo~~k k associated with a power flow case~~
2. Filter the workbook to~~The user selects~~ the appropriate area/zone/owner/bus number filters
3. Sort the data by Pload (MW) from largest to smallest (descending order)~~The user selects all loads >= 10MVA~~
4. Starting in Row 7, step through each row and assign a CMLD (if applicable)
    a. If the load MW value is ≥ 5MW, proceed, otherwise save the spreadsheet, and close
    b. If the load type is a large industrial customer (generally denoted as a non-scalable load), place an "x" in the appropriate column Q through AC
    c. If the load type is a non-industrial customer, place an "x" in the appropriate column AD through AW (selecting the appropriate state in which the load resides)
    ~~3.~~d. If none of the available load types meet the Members' needs, custom load compositions may be created using columns AX through BB
4.~~5.~~ Repeat Steps 1-4 until all workbooks have been completed~~For each load in the resulting list, the user should classify the load appropriate to the applicable classification of customer use type~~
    ~~a. If the user is selecting Residential (RES), Commercial (COM), or Mixed (MIX) type load, the appropriate U.S. state should be chosen that corresponds to the physical location of the applicable load~~

Bus Number	Bus Name	Id	Code	Area Num	Area Name	Zone Num	Zone Name	Owner Num	Owner Name	In Service	Scalable	Interruptible	Pload (MW)	Qload (Mvar)	Value Description	Petro Che	Paper Mill - Kraft Proce
															FmA – Motor A Fraction (3-phase com	0.15	0.1
															FmB – Motor B Fraction (3-phase fans	0.25	0.25
															FmC – Motor C Fraction (3-phase pum	0.4	0.4
															FmD – Motor D Fraction (1-phase A/C)	0	0
															Fel – Electronic Load Fraction4 (elect	0.15	0.2
300214	2CHILCT	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	12.653	-3.674			
300238	2TRENC	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	10.816	-3.674			
300652	2LAMRC	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	6.139	1.698			
300690	2BUTLEF	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	5.51	-1.225			
300807	2ELDRC	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	7.143	-1.633			
301076	5WANSV	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	7.959	0			
301080	2COPELI	M	1	506	MJMEUC	1586	MOPEP_	506	MJMEUC	1	1	0	6	1.5			

Figure 2: Sample CMLD Workbook Associated with the MDAG Model Build

Inclusion of Distributed Energy Resources with the CMLD

If Distributed Energy Resources (DER) are located within a transmission-to-distribution interface represented by a power flow load record, the engineer may utilize a version of the CMLD that includes additional parameters to represent the general, aggregate response of DERs.

Modeling DER as part of a CMLD record has two pre-requisites:

1. The DER must be modeled as generation within the power flow record
2. The DER version of the CMLD must be used (CMLDxxDGU2)

To properly represent the aggregate effect of DER, it is important for the engineer to understand the type(s) of generators that are represented. The CMLD is only capable of representing the aggregate behavior of DER, but the types of individual machines or inverters plays a significant role in how the aggregate model within the CMLD should behave.

Even if all DER is of a certain type (i.e., a RES load that has a significant penetration of solar PV; no other types of DER present), the vintage of DER can be important. Most prominent with residential solar and battery installations, vintage plays a significant role in how the DER will respond. Specifically, inverters build to the following versions IEEE Standard 1547 will respond differently:

- IEEE Std. 1547-2003
- IEEE Std. 1547a-2014
- IEEE Std. 1547-2018

These variations are discussed in detail in the Reliability Guideline created by the NERC System Planning Impacts from DER Working Group (SPIDERWG). Default parameters for the CMLD for these various vintages are presented and explained in Chapter 2 of the Reliability Guideline (see Additional Resources #5).

Further and more detailed reading is available in Additional Resources #4 and #5.

Additional Resources

Reference #	Resource	Link
	~~NERC Load Model Working Group (LMWG)~~	~~Link~~
1	NERC LMWG Composite Load Model Technical Reference Document	Link
2	USA Climate Zone map developed by the US Department of Energy, downloadable as Google Earth-compatible KMZ file	Link
3	WECC Model Validation Working Group; contains several papers and guidelines regarding the CMLD	Link
4	NERC Reliability Guideline for Including DER in Transmission-Level Studies	Link
5	CAISO Presentation on modeling DER with CMLD	Link

Document Version

Revision Number	Published Date	Author	Changes
0	X	Dynamic Load Task Force	Document created.

SPP

Purpose:
Target:
Use as defaults:
Background:
CMLD Representation (from NERC Technical Reference Document "Dynamic Load Modeling", December 2016):

How to use this table?

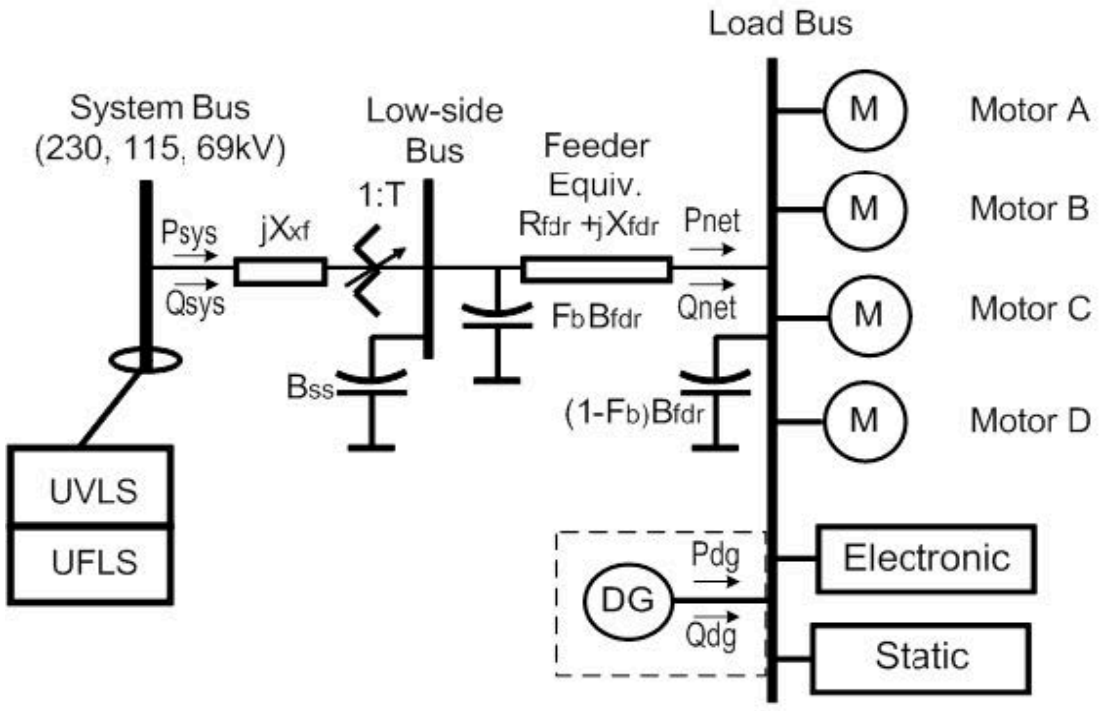
DLTF Recommendations for Default CMLD parameters

This workbook contains suggested parameters for the CMLDxxU2 model.

The DLTF has developed these recommendations based upon NERC guidance, member simulation experience, and engineering judgement. These suggested parameters are intended as guidance only and ultimately the

It is uncommon for Model Data Submitters to have access to detailed real-world dynamic response data for dynamic loads. The DLTF recommends the use of these parameters as defaults for the dynamic simulation when load data is unavailable or unconfirmed. The DLTF intends these defaults to exhibit consistency across all dynamic loads simulated within the SPP footprint. It is emphasized: **SPP members may submit appropriate non-default CMLD parameters according to normal modeling data and reporting requirements, in lieu of using these default parameters.**

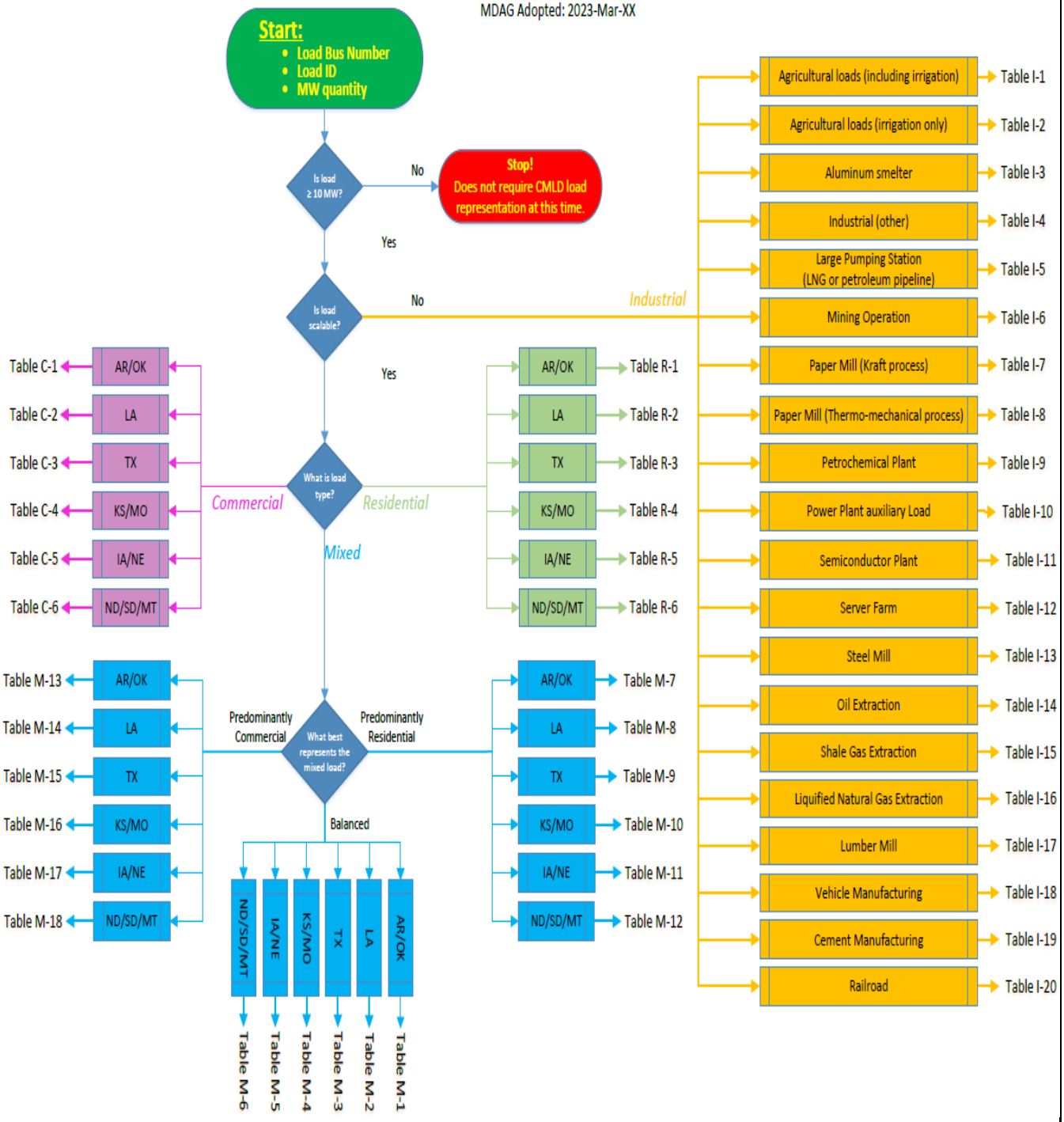
The composite load model (CMLD) is a dynamic load representation that simulates the combination of three phase and single-phase induction motors, power electronic load, static load, distributed generation, and the distribution equivalent network. Additionally, the CMLD model allows for the modeling of protection system action resulting in component load dropping and restarting, similar to what would be experienced under faulted or voltage sag conditions, as well as system restoration.



DLTF Recommended CMLD default parameters

Version 1

MDAG Adopted: 2023-Mar-XX



YELLOW cell indicates significant and unique load characteristic	Table ------>
	Geographic Location ----->
Data Record Reference	Parameter Reference / Description ------>
I	Bus Number
Data record placeholder	n/a
LID	Load ID
Data record placeholder	n/a
Data record placeholder	n/a
IT (1 = Bus Number)	How model is applied, e.g. buswise, areawise, etc.
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
Data record placeholder	Data record affixed
J	Load MVA base
J+1	Substation shunt B (pu on Load MVA base)
J+2	Rfdr - Feeder R (pu on Load MVA base)

J+3	Xfdr - Feeder X (pu on Load MVA base)
J+4	Fb - Fraction of Feeder Compensation at substation end
J+5	Xxf - Transformer Reactance - pu on load MVA base
J+6	Tfixhs - High side fixed transformer tap
J+7	Tfixls - Low side fixed transformer tap
J+8	LTC - LTC flag (1 active, 0 inactive)
J+9	Tmin - LTC min tap (on low side)
J+10	Tmax - LTC max tap (on low side)
J+11	Step - LTC Tstep (on low side)
J+12	Vmin - LTC Vmin tap (low side pu)
J+13	Vmax - LTC Vmax tap (low side pu)
J+14	TD - LTC Control time delay (sec)
J+15	TC - LT C Tap adjustment time delay (sec)
J+16	Rcmp - LTC Rcomp (pu on load MVA base)
J+17	Xcmp - LTC Xcomp (pu on load MVA base)
J+18	FmA - Motor A Fraction
J+19	FmB - Motor B Fraction
J+20	FmC - Motor C Fraction
J+21	FmD - Motor D Fraction
J+22	Fel - Electronic Load Fraction4
J+23	PFel - PF of Electronic Loads
J+24	Vd1 - Voltage at which elect. loads start to drop
J+25	Vd2 - Voltage at which all elect.load have dropped

J+26	PFs - Static Load Power Factor
J+27	P1e - P1 exponent
J+28	P1c - P1 coefficient
J+29	P2e - P2 exponent
J+30	P2c - P2 coefficient
J+31	Pfrq - Frequency sensitivity
J+32	Q1e - Q1 exponent
J+33	Q1c - Q1 coefficient
J+34	Q2e - Q2 exponent
J+35	Q2c - Q2 coefficient
J+36	Qfrq - Frequency sensitivity
J+37	MtypA - Motor type6
J+38	LFmA - Loading factor (MW/MVA rating)
J+39	RaA - Stator resistance
J+40	LsA - Synchronous reactance
J+41	LpA - Transient reactance
J+42	LppA - Sub-transient reactance
J+43	TpoA - Transient open circuit time constant
J+44	TppoA - Sub-transient open circuit time constant
J+45	HA - Inertia constant
J+46	etrqA - Torque speed exponent
J+47	Vtr1A - U/V Trip1 V (pu)
J+48	Ttr1A - U/V Trip1 Time (sec)

J+49	Ftr1A - U/V Trip1 fraction
J+50	Vrc1A - U/V Trip1 reclose V (pu)
J+51	Trc1A - U/V Trip1 reclose Time (sec)
J+52	Vtr2A - U/V Trip2 V (pu)
J+53	Ttr2A - U/V Trip2 Time (sec)
J+54	Ftr2A - U/V Trip2 fraction
J+55	Vrc2A - U/V Trip2 reclose V (pu)
J+56	Trc2A - U/V Trip2 reclose Time (sec)
J+57	MtypB - Motor type
J+58	LFmB - Loading factor (MW/MVArating)
J+59	RaB - Stator resistance
J+60	LsB - Synchronous reactance
J+61	LpB - Transient reactance
J+62	LppB - Sub-transient reactance
J+63	TpoB - Transient open circuit time constant
J+64	TppoB - Sub-transient open circuit time constant
J+65	HB - Inertia constant
J+66	etrqB - Torque speed exponent
J+67	Vtr1B - U/V Trip1 V (pu)
J+68	Ttr1B - U/V Trip1 Time (sec)
J+69	Ftr1B - U/V Trip1 fraction
J+70	Vrc1B - U/V Trip1 reclose V (pu)
J+71	Trc1B - U/V Trip1 reclose Time (sec)

J+72	Vtr2B - U/V Trip2 V (pu)
J+73	Ttr2B - U/V Trip2 Time (sec)
J+74	Ftr2B - U/V Trip2 fraction
J+75	Vrc2B - U/V Trip2 reclose V (pu)
J+76	Trc2B - U/V Trip2 reclose Time (sec)
J+77	MtypC - Motor type
J+78	LFmC - Loading factor (MW/MVA rating)
J+79	RaC - Stator resistance
J+80	LsC - Synchronous reactance
J+81	LpC - Transient reactance
J+82	LppC - Sub-transient reactance
J+83	TpoC - Transient open circuit time constant
J+84	TppoC - Sub-transient open circuit time constant
J+85	HC - Inertia constant
J+86	etrqC - Torque speed exponent
J+87	Vtr1C - U/V Trip1 V (pu)
J+88	Ttr1C - U/V Trip1 Time (sec)
J+89	Ftr1C - U/V Trip1 fraction
J+90	Vrc1C - U/V Trip1 reclose V (pu)
J+91	Trc1C - U/V Trip1 reclose Time (sec)
J+92	Vtr2C - U/V Trip2 V (pu)
J+93	Ttr2C - U/V Trip2 Time (sec)
J+94	Ftr2C - U/V Trip2 fraction

J+95	Vrc2C - U/V Trip2 reclose V (pu)
J+96	Trc2C - U/V Trip2 reclose Time (sec)
J+97	Tstall - stall delay (sec)
J+98	Trestart - restart delay (sec)
J+99	Tv - voltage input time constant(sec)
J+100	Tf - frequency input time constant(sec)
J+101	CompLF - compressor load factor, p.u. of rated power
J+102	CompPF - compressor power factor at 1.0 p.u. voltage
J+103	Vstall - compressor stall voltage at base condition (p.u.)
J+104	Rstall - compressor motor restart ith 1.0 p.u. current
J+105	Xstall - compressor motor stall reactance - unsat.
J+106	LFadj - Load factor adjustment to the stall voltage
J+107	Kp1 - real power constant for running state 1
J+108	Np1 - real power exponent for running state 1
J+109	Kq1 - reactive power constant for running state 1
J+110	Nq1 - reactive power exponent for running state 1
J+111	Kp2 - real pow er constant for running state 2
J+112	Np2 - real power exponent for running state 2
J+113	Kq2 - reactive power constant for running state 2
J+114	Nq2 - reactive power exponent for running state 2
J+115	Vbrk - compressor motor "break- down" voltage (p.u.)
J+116	Frst - fraction of motors capable of restart
J+117	Vrst - voltage at which motors can restart (p.u.)

J+118	CmpKpf - real power constant for freq dependency
J+119	CmpKqf - reactive power constnt for freq dependency
J+120	Vc1off - Vo tage 1 at which contactors start dropping out (p.u.)
J+121	Vc2off - Voltage 2 at whic h all contactors drop out (p.u.)
J+122	Vc1on - Voltage 1 at which all contactors reclose (p.u.)
J+123	Vc2on - Voltage 2 at which contactors start reclosing (p.u.)
J+124	Tth - compressor motor heating time constant(sec)
J+125	Th1t - temp at which comp. motor begin tripping
J+126	Th2t - temp at which comp. all motors are tripped
J+127	Fuvr - fraction of comp. motors with U/V relays
J+128	UVtr1 - 1st voltage pick-up (p.u.)
J+129	Ttr1 - 1st definite time voltage pick- up (sec)
J+130	UVtr2 - 2nd voltage pick-up (p.u.)
J+131	Ttr2 - 2nd definite time voltage pick- up (sec)
J+132	Fraction of eletronic load that can restart

PSSE String Data

Bus/Model Detail
Distribution Feeder Model
Load Allocation Percentages
Electronc Load Model
Static Load Model
Motor A Model and Protection Settings
Motor B Model and Protection Settings
Motor C Model and Protection Settings
Motor D Model and Protection Settings
Electronic Load Restart Fraction

I-1	I-2	I-3
All	All	All
Agricultural loads (including irrigation)	Agricultural loads (irrigation only)	Aluminum Smelter
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.2	0	0.1
0.25	0	0
0.45	1	0
0	0	0
0.1	0	0
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.2 0.25 0.45 0 0.1 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Agricultural loads (includ

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0 0 1 0 0 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Agricultural loads (irrigat

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.1 0 0 0 0 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Aluminum Smelter

I-4	I-5	I-6
All	All	All
Industrial - other	Large Pumping Station (LNG & petroleum pipeline)	Mining Operation
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.2	0	0.2
0.25	0	0.35
0.3	1	0.35
0	0	0
0.2	0	0.05
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.2 0.25 0.3 0 0.2 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Industrial - other

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0 0 1 0 0 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Large Pumping Station (L

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.2 0.35 0.35 0 0.05 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Mining Operation

I-7	I-8	I-9
All	All	All
Paper Mill - Kraft Process	Paper Mill - Thermo-mechnical process	Petro-chemical Plant
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.1	0.05	0.15
0.25	0.55	0.25
0.4	0.25	0.4
0	0	0
0.2	0.12	0.15
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.1 0.25 0.4 0 0.2 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Paper Mill - Kraft Proces

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.05 0.55 0.25 0 0.12 0.9
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Paper Mill - Thermo-mec

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.15 0.25 0.4 0 0.15 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Petro-chemical Plant

I-10	I-11	I-12
All	All	All
Power Plant Auxillary Load	Semiconductor Plant	Server Farm
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.1	0.1	0.25
0.5	0.35	0.1
0.25	0.1	0.05
0	0	0
0.15	0.4	0.6
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.001 0.001 1 0.02 1 1.
0 0.1 0.5 0.25 0 0.15 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Power Plant Auxillary Loa

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.1 0.35 0.1 0 0.4 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.3
3 0.75 0.03 1.8 0.19 0.14 0.3
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Semiconductor Plant

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.25 0.1 0.05 0 0.6 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Server Farm

I-13	I-14	I-15
All	All	All
Steel Mill	Oil Extraction	Shale Gas Extraction
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.2	0.3	0
0.25	0	0.2
0.3	0.4	0.4
0	0	0
0.2	0.3	0.4
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.2 0.25 0.3 0 0.2 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Steel Mill

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.3 0 0.4 0 0.3 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Oil Extraction

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0 0.2 0.4 0 0.4 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Shale Gas Extraction

I-16	I-17	I-18
All	All	All
Liquified Natural Gas Extraction	Lumber Mill	Vehicle Manufacturing
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.001

0.001	0.001	0.001
1	1	1
0.02	0.02	0.02
1	1	1
1.05	1.05	1.05
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0	0.4	0.15
0.3	0.2	0
0.2	0.3	0.3
0	0	0
0.5	0	0.3
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0 0.3 0.2 0 0.5 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Liquified Natural Gas Ext

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.4 0.2 0.3 0 0 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Lumber Mill

'USRLOD' User Input
-1 0 0.001 0.001 1 0.02 1 1
0 0.15 0 0.3 0 0.3 0.98
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5
3 0.75 0.04 1.8 0.12 0.104 (
3 0.75 0.03 1.8 0.19 0.14 0.
3 0.75 0.03 1.8 0.19 0.14 0.
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Vehicle Manufacturing

I-19	I-20	R-1
All	All	AR/OK
Cement Manufacturing	Railroad	Residential
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.001	0.001	0.01

0.001	0.001	0.005
1	1	1
0.02	0.02	0.08
1	1	1
1.05	1.05	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.1	0	0
0.1	0	0.1
0.1	0.05	0.036
0	0	0.53
0.6	0.95	0.099
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input ###### 'USRLOD' User Input ###### 'USRLOD' User Input (
-1 0 0.001 0.001 1 0.02 1 1 -1 0 0.001 0.001 1 0.02 1 1 -1 0 0.01 0.005 1 0.08 1 1.0
0 0.1 0.1 0.1 0 0.6 0.98 0 0 0 0.05 0 0.95 0.98 0 0 0.1 0.036 0.53 0.099 0.9
0.65 0.5 0.65 0.5 0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 0.98 2 0.3 1 0.7 0.1 2 -0.5 0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 (3 0.75 0.04 1.8 0.12 0.104 (3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.3 0.75 0.03 1.8 0.19 0.14 0.3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.3 0.75 0.03 1.8 0.19 0.14 0.3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Cement Manufacturing 1 /* Railroad 1 /* Residential

R-2	R-3	R-4
LA	TX	KS/MO
Residential	Residential	Residential
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0	0	0
0.106	0.121	0.105
0.033	0.022	0.028
0.584	0.646	0.566
0.088	0.081	0.092
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0 0.106 0.033 0.584 0.088
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Residential

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0 0.121 0.022 0.646 0.081
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Residential

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0 0.105 0.028 0.566 0.092
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Residential

R-5	R-6	C-1
IA/NE	ND/SD/MT	AR/OK
Residential	Residential	Commercial
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0	0	0.498
0.087	0.087	0.099
0.034	0.034	0.039
0.5	0.5	0
0.11	0.11	0.227
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0 0.087 0.034 0.5 0.11 0.9
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Residential

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0 0.087 0.034 0.5 0.11 0.9
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Residential

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.498 0.099 0.039 0 0.227
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

C-2	C-3	C-4
LA	TX	KS/MO
Commercial	Commercial	Commercial
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.467	0.522	0.375
0.112	0.099	0.15
0.052	0.048	0.039
0	0	0
0.241	0.223	0.308
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.467 0.112 0.052 0 0.241 0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.522 0.099 0.048 0 0.223 0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.375 0.15 0.039 0 0.308 (
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

C-5	C-5	M-1
IA/NE	ND/SD/MT	AR/OK
Commercial	Commercial	Balanced (50/50)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.417	0.417	0.249
0.125	0.125	0.1
0.038	0.038	0.038
0	0	0.265
0.278	0.278	0.163
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.417 0.125 0.038 0 0.278 0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.417 0.125 0.038 0 0.278 0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Commercial

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.249 0.1 0.038 0.265 0.16
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

M-2	M-3	M-4
LA	TX	KS/MO
Balanced (50/50)	Balanced (50/50)	Balanced (50/50)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.233	0.261	0.188
0.109	0.11	0.128
0.042	0.035	0.034
0.292	0.323	0.283
0.165	0.152	0.2
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.233 0.109 0.042 0.292 0.
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.261 0.11 0.035 0.323 0.1
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.188 0.128 0.034 0.283 0.
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

M-5	M-6	M-7
IA/NE	ND/SD/MT	AR/OK
Balanced (50/50)	Balanced (50/50)	Predominantly Residential (75R/25C)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.188	0.188	0.125
0.125	0.125	0.1
0.038	0.038	0.037
0.25	0.25	0.397
0.194	0.194	0.131
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.188 0.125 0.038 0.25 0.1
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.188 0.125 0.038 0.25 0.1
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Balanced (50/50)

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.125 0.1 0.037 0.397 0.13
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Residentia

M-8	M-9	M-10
LA	TX	KS/MO
Predominantly Residential (75R/25C)	Predominantly Residential (75R/25C)	Predominantly Residential (75R/25C)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.117	0.131	0.094
0.108	0.115	0.116
0.038	0.029	0.031
0.438	0.484	0.425
0.126	0.116	0.146
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (###### 'USRLOD' User Input (###### 'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0 -1 0 0.01 0.005 1 0.08 1 1.0 -1 0 0.01 0.005 1 0.08 1 1.0
0 0.117 0.108 0.038 0.438 0.0 0.131 0.115 0.029 0.484 0.0 0.094 0.116 0.031 0.425 0.
0.65 0.5 0.65 0.5 0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1 0.98 2 0.3 1 0.7 0.1 2 -0.5 1 0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0 3 0.75 0.04 1.8 0.12 0.104 0 3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Residentia 1 /* Predominantly Residentia 1 /* Predominantly Residentia

M-11	M-12	M-13
IA/NE	ND/SD/MT	AR/OK
Predominantly Residential (75R/25C)	Predominantly Residential (75R/25C)	Predominantly Commercial (75R/25C)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.104	0.104	0.374
0.096	0.096	0.099
0.035	0.035	0.038
0.375	0.375	0.132
0.152	0.152	0.195
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.104 0.096 0.035 0.375 0.0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Residentia

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.104 0.096 0.035 0.375 0.0
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Residentia

'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0
0 0.374 0.099 0.038 0.132 0.
0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Commerci

M-14	M-15	M-16
LA	TX	KS/MO
Predominantly Commercial (75R/25C)	Predominantly Commercial (75R/25C)	Predominantly Commercial (75R/25C)
######	######	######
'USRLOD'	'USRLOD'	'USRLOD'
User Input	User Input	User Input
CMLDxxU2	CMLDxxU2	CMLDxxU2
12	12	12
1	1	1
2	2	2
133	133	133
27	27	27
146	146	146
48	48	48
0	0	0
0	0	0
-1	-1	-1
0	0	0
0.01	0.01	0.01

0.005	0.005	0.005
1	1	1
0.08	0.08	0.08
1	1	1
1.02	1.02	1.02
0	0	0
0.9	0.9	0.9
1.1	1.1	1.1
0.00625	0.00625	0.00625
0.98	0.98	0.98
1.02	1.02	1.02
30	30	30
5	5	5
0	0	0
0	0	0
0.35	0.392	0.281
0.111	0.104	0.139
0.047	0.042	0.036
0.146	0.161	0.142
0.203	0.187	0.254
0.98	0.98	0.98
0.65	0.65	0.65
0.5	0.5	0.5

0.98	0.98	0.98
2	2	2
0.3	0.3	0.3
1	1	1
0.7	0.7	0.7
0.1	0.1	0.1
2	2	2
-0.5	-0.5	-0.5
1	1	1
1.5	1.5	1.5
-0.75	-0.75	-0.75
3	3	3
0.75	0.75	0.75
0.04	0.04	0.04
1.8	1.8	1.8
0.12	0.12	0.12
0.104	0.104	0.104
0.095	0.095	0.095
0.0021	0.0021	0.0021
0.1	0.1	0.1
0	0	0
0.65	0.65	0.65
0.1	0.1	0.1

0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.5	0.5	0.5
0.02	0.02	0.02
0.8	0.8	0.8
0.65	0.65	0.65
0.1	0.1	0.1
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.5	0.5	0.5
2	2	2
0.55	0.55	0.55
0.02	0.02	0.02
0.3	0.3	0.3
0.65	0.65	0.65
0.05	0.05	0.05

0.5	0.5	0.5
0.025	0.025	0.025
0.3	0.3	0.3
0.6	0.6	0.6
0.05	0.05	0.05
3	3	3
0.75	0.75	0.75
0.03	0.03	0.03
1.8	1.8	1.8
0.19	0.19	0.19
0.14	0.14	0.14
0.2	0.2	0.2
0.0026	0.0026	0.0026
0.2	0.2	0.2
2	2	2
0.6	0.6	0.6
0.03	0.03	0.03
0.2	0.2	0.2
0.1	0.1	0.1
9999	9999	9999
0.53	0.53	0.53
0.03	0.03	0.03
0.3	0.3	0.3

0.62	0.62	0.62
0.05	0.05	0.05
9999	9999	9999
0.3	0.3	0.3
0.025	0.025	0.025
0.1	0.1	0.1
1	1	1
0.98	0.98	0.98
0.5	0.5	0.5
0.1	0.1	0.1
0.1	0.1	0.1
0	0	0
0	0	0
1	1	1
6	6	6
2	2	2
12	12	12
3.2	3.2	3.2
11	11	11
2.5	2.5	2.5
0.86	0.86	0.86
0.2	0.2	0.2
0.95	0.95	0.95

1	1	1
-3.3	-3.3	-3.3
0.5	0.5	0.5
0.4	0.4	0.4
0.65	0.65	0.65
0.55	0.55	0.55
15	15	15
0.7	0.7	0.7
1.9	1.9	1.9
0.025	0.025	0.025
0.5	0.5	0.5
0.02	0.02	0.02
0.1	0.1	0.1
9999	9999	9999
1	1	1

'USRLOD' User Input (###### 'USRLOD' User Input (###### 'USRLOD' User Input (
-1 0 0.01 0.005 1 0.08 1 1.0 -1 0 0.01 0.005 1 0.08 1 1.0 -1 0 0.01 0.005 1 0.08 1 1.0
0 0.35 0.111 0.047 0.146 0.2 0 0.392 0.104 0.042 0.161 0. 0 0.281 0.139 0.036 0.142 0.
0.65 0.5 0.65 0.5 0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 1 0.98 2 0.3 1 0.7 0.1 2 -0.5 1 0.98 2 0.3 1 0.7 0.1 2 -0.5 1
3 0.75 0.04 1.8 0.12 0.104 0 3 0.75 0.04 1.8 0.12 0.104 0 3 0.75 0.04 1.8 0.12 0.104 0
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2
0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1
1 /* Predominantly Commerci 1 /* Predominantly Commerci 1 /* Predominantly Commerci

M-17	M-18
IA/NE	ND/SD/MT
Predominantly Commercial (75R/25C)	Predominantly Commercial (75R/25C)
######	######
'USRLOD'	'USRLOD'
User Input	User Input
CMLDxxU2	CMLDxxU2
12	12
1	1
2	2
133	133
27	27
146	146
48	48
0	0
0	0
-1	-1
0	0
0.01	0.01

0.005	0.005
1	1
0.08	0.08
1	1
1.02	1.02
0	0
0.9	0.9
1.1	1.1
0.00625	0.00625
0.98	0.98
1.02	1.02
30	30
5	5
0	0
0	0
0.313	0.313
0.115	0.115
0.037	0.037
0.125	0.125
0.236	0.236
0.98	0.98
0.65	0.65
0.5	0.5

0.98	0.98
2	2
0.3	0.3
1	1
0.7	0.7
0.1	0.1
2	2
-0.5	-0.5
1	1
1.5	1.5
-0.75	-0.75
3	3
0.75	0.75
0.04	0.04
1.8	1.8
0.12	0.12
0.104	0.104
0.095	0.095
0.0021	0.0021
0.1	0.1
0	0
0.65	0.65
0.1	0.1

0.2	0.2
0.1	0.1
9999	9999
0.5	0.5
0.02	0.02
0.8	0.8
0.65	0.65
0.1	0.1
3	3
0.75	0.75
0.03	0.03
1.8	1.8
0.19	0.19
0.14	0.14
0.2	0.2
0.0026	0.0026
0.5	0.5
2	2
0.55	0.55
0.02	0.02
0.3	0.3
0.65	0.65
0.05	0.05

0.5	0.5
0.025	0.025
0.3	0.3
0.6	0.6
0.05	0.05
3	3
0.75	0.75
0.03	0.03
1.8	1.8
0.19	0.19
0.14	0.14
0.2	0.2
0.0026	0.0026
0.2	0.2
2	2
0.6	0.6
0.03	0.03
0.2	0.2
0.1	0.1
9999	9999
0.53	0.53
0.03	0.03
0.3	0.3

0.62	0.62
0.05	0.05
9999	9999
0.3	0.3
0.025	0.025
0.1	0.1
1	1
0.98	0.98
0.5	0.5
0.1	0.1
0.1	0.1
0	0
0	0
1	1
6	6
2	2
12	12
3.2	3.2
11	11
2.5	2.5
0.86	0.86
0.2	0.2
0.95	0.95

1	1
-3.3	-3.3
0.5	0.5
0.4	0.4
0.65	0.65
0.55	0.55
15	15
0.7	0.7
1.9	1.9
0.025	0.025
0.5	0.5
0.02	0.02
0.1	0.1
9999	9999
1	1

'USRLOD' User Input (###### 'USRLOD' User Input CMLDxxU2 12 1 2 133 27 146 48
-1 0 0.01 0.005 1 0.08 1 1.0 -1 0 0.01 0.005 1 0.08 1 1.02 0 0.9 1.1 0.00625 0.98 1.02 30
0 0.313 0.115 0.037 0.125 0.0 0.313 0.115 0.037 0.125 0.236 0.98
0.65 0.5 0.65 0.5
0.98 2 0.3 1 0.7 0.1 2 -0.5 10.98 2 0.3 1 0.7 0.1 2 -0.5 1 1.5 -0.75
3 0.75 0.04 1.8 0.12 0.104 0 3 0.75 0.04 1.8 0.12 0.104 0.095 0.0021 0.1 0 0.65 0.1 0.2 0.1
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 0.0026 0.5 2 0.55 0.02 0.3 0.65
3 0.75 0.03 1.8 0.19 0.14 0.2 3 0.75 0.03 1.8 0.19 0.14 0.2 0.0026 0.2 2 0.6 0.03 0.2 0.1 99
0.025 0.1 1 0.98 0.5 0.1 0.1 0.025 0.1 1 0.98 0.5 0.1 0.1 0 0 1 6 2 12 3.2 11 2.5 0.86 0.2
1 /* Predominantly Commerci 1 /* Predominantly Commercial (75R/25C)

0 0
5 0 0

1 9999 0.5 0.02 0.8 0.65 0.1
0.05 0.5 0.025 0.3 0.6 0.05
)99 0.53 0.03 0.3 0.62 0.05
0.95 1 -3.3 0.5 0.4 0.65 0.55 15 0.7 1.9 0.025 0.5 0.02 0.1 9999

	CMLDxxxU2	
J	Load MVA base	J
J+1	Substation shunt B (pu on Load MVA base)	J+1
J+2	Rfdr - Feeder R (pu on Load MVA base)	J+2
J+3	Xfdr - Feeder X (pu on Load MVA base)	J+3
J+4	Fb - Fraction of Feeder Compensation at substation end	
J+5	Xxf - Transformer Reactance - pu on load MVA base	J+4
J+6	Tfixhs - High side fixed transformer tap	J+5
J+7	Tfixls - Low side fixed transformer tap	J+6
J+8	LTC - LTC flag (1 active, 0 inactive)	J+7
J+9	Tmin - LTC min tap (on low side)	J+8
J+10	Tmax - LTC max tap (on low side)	J+9
J+11	Step - LTC Tstep (on low side)	J+10
J+12	Vmin - LTC Vmin tap (low side pu)	J+11
J+13	Vmax - LTC Vmax tap (low side pu)	J+12
J+14	TD - LTC Control time delay (sec)	J+13
J+15	TC - LT C Tap adjustment time delay (sec)	J+14
J+16	Rcmp - LTC Rcomp (pu on load MVA base)	J+15
J+17	Xcmp - LTC Xcomp (pu on load MVA base)	J+16
J+18	FmA - Motor A Fraction	J+17
J+19	FmB - Motor B Fraction	J+18
J+20	FmC - Motor C Fraction	J+19
J+21	FmD - Motor D Fraction	J+20
J+22	Fel - Electronic Load Fraction4	J+21
J+23	PFel - PF of Electronic Loads	J+22
J+24	Vd1 - Voltage at which elect. loads start to drop	J+23
J+25	Vd2 - Voltage at which all elect.load have dropped	J+24
		J+25
J+26	PFs - Static Load Power Factor	J+26
J+27	P1e - P1 exponent	J+27
J+28	P1c - P1 coefficient	J+28
J+29	P2e - P2 exponent	J+29
J+30	P2c - P2 coefficient	J+30
J+31	Pfrq - Frequency sensitivity	J+31
J+32	Q1e - Q1 exponent	J+32
J+33	Q1c - Q1 coefficient	J+33
J+34	Q2e - Q2 exponent	J+34
J+35	Q2c - Q2 coefficient	J+35
J+36	Qfrq - Frequency sensitivity	J+36
J+37	MtypA - Motor type6	
J+38	LFmA - Loading factor (MW/MVA rating)	J+37
J+39	RaA - Stator resistance	J+38
		J+39
J+40	LsA - Synchronous reactance	J+40
J+41	LpA - Transient reactance	J+41
J+42	LppA - Sub-transient reactance	J+42
J+43	TpoA - Transient open circuit time constant	J+43

J+44	TppoA - Sub-transient open circuit time constant	J+44
J+45	HA - Inertia constant	J+45
J+46	etrqA - Torque speed exponent	J+46
J+47	Vtr1A - U/V Trip1 V (pu)	J+47
J+48	Ttr1A - U/V Trip1 Time (sec)	J+48
J+49	Ftr1A - U/V Trip1 fraction	J+49
J+50	Vrc1A - U/V Trip1 reclose V (pu)	J+50
J+51	Trc1A - U/V Trip1 reclose Time (sec)	J+51
J+52	Vtr2A - U/V Trip2 V (pu)	J+52
J+53	Ttr2A - U/V Trip2 Time (sec)	J+53
J+54	Ftr2A - U/V Trip2 fraction	J+54
J+55	Vrc2A - U/V Trip2 reclose V (pu)	J+55
J+56	Trc2A - U/V Trip2 reclose Time (sec)	J+56
J+57	MtypB - Motor type	
J+58	LFmB - Loading factor (MW/MVArating)	J+57
J+59	RaB - Stator resistance	J+58
		J+59
J+60	LsB - Synchronous reactance	J+60
J+61	LpB - Transient reactance	J+61
J+62	LppB - Sub-transient reactance	J+62
J+63	TpoB - Transient open circuit time constant	J+63
J+64	TppoB - Sub-transient open circuit time constant	J+64
J+65	HB - Inertia constant	J+65
J+66	etrqB - Torque speed exponent	J+66
J+67	Vtr1B - U/V Trip1 V (pu)	J+67
J+68	Ttr1B - U/V Trip1 Time (sec)	J+68
J+69	Ftr1B - U/V Trip1 fraction	J+69
J+70	Vrc1B - U/V Trip1 reclose V (pu)	J+70
J+71	Trc1B - U/V Trip1 reclose Time (sec)	J+71
J+72	Vtr2B - U/V Trip2 V (pu)	J+72
J+73	Ttr2B - U/V Trip2 Time (sec)	J+73
J+74	Ftr2B - U/V Trip2 fraction	J+74
J+75	Vrc2B - U/V Trip2 reclose V (pu)	J+75
J+76	Trc2B - U/V Trip2 reclose Time (sec)	J+76
J+77	MtypC - Motor type	
J+78	LFmC - Loading factor (MW/MVA rating)	J+77
J+79	RaC - Stator resistance	J+78
		J+79
J+80	LsC - Synchronous reactance	J+80
J+81	LpC - Transient reactance	J+81
J+82	LppC - Sub-transient reactance	J+82
J+83	TpoC - Transient open circuit time constant	J+83
J+84	TppoC - Sub-transient open circuit time constant	J+84
J+85	HC - Inertia constant	J+85
J+86	etrqC - Torque speed exponent	J+86
J+87	Vtr1C - U/V Trip1 V (pu)	J+87
J+88	Ttr1C - U/V Trip1 Time (sec)	J+88

J+89	Ftr1C - U/V Trip1 fraction	J+89
J+90	Vrc1C - U/V Trip1 reclose V (pu)	J+90
J+91	Trc1C - U/V Trip1 reclose Time (sec)	J+91
J+92	Vtr2C - U/V Trip2 V (pu)	J+92
J+93	Ttr2C - U/V Trip2 Time (sec)	J+93
J+94	Ftr2C - U/V Trip2 fraction	J+94
J+95	Vrc2C - U/V Trip2 reclose V (pu)	J+95
J+96	Trc2C - U/V Trip2 reclose Time (sec)	J+96
J+97	Tstall - stall delay (sec)	J+97
J+98	Trestart - restart delay (sec)	J+98
J+99	Tv - voltage input time constant(sec)	J+99
J+100	Tf - frequency input time constant(sec)	J+100
J+101	CompLF - compressor load factor, p.u. of rated power	J+101
J+102	CompPF - compressor power factor at 1.0 p.u. voltage	J+102
J+103	Vstall - compressor stall voltage at base condition (p.u.)	J+103
J+104	Rstall - compressor motor restart ith 1.0 p.u. current	J+104
J+105	Xstall - compressor motor stall reactance - unsat.	J+105
J+106	LFadj - Load factor adjustment to the stall voltage	J+106
J+107	Kp1 - real power constant for running state 1	J+107
J+108	Np1 - real power exponent for running state 1	J+108
J+109	Kq1 - reactive power constant for running state 1	J+109
J+110	Nq1 - reactive power exponent for running state 1	J+110
J+111	Kp2 - real pow er constant for running state 2	J+111
J+112	Np2 - real power exponent for running state 2	J+112
J+113	Kq2 - reactive power constant for running state 2	J+113
J+114	Nq2 - reactive power exponent for running state 2	J+114
J+115	Vbrk - compressor motor "break- down" voltage (p.u.)	J+115
J+116	Frst - fraction of motors capable of restart	J+116
J+117	Vrst - voltage at which motors can restart (p.u.)	J+117
J+118	CmpKpf - real power constant for freq dependency	J+118
J+119	CmpKqf - reactive power constnt for freq dependency	J+119
J+120	Vc1off - Vo tage 1 at which contactors start dropping out (p.u.)	J+120
J+121	Vc2off - Voltage 2 at whic h all contactors drop out (p.u.)	J+121
J+122	Vc1on - Voltage 1 at which all contactors reclose (p.u.)	J+122
J+123	Vc2on - Voltage 2 at which contactors start reclosing (p.u.)	J+123
J+124	Tth - compressor motor heating time constant(sec)	J+124
J+125	Th1t - temp at which comp. motor begin tripping	J+125
J+126	Th2t - temp at which comp. all motors are tripped	J+126
J+127	Fuvr - fraction of comp. motors with U/V relays	J+127
J+128	UVtr1 - 1st voltage pick-up (p.u.)	J+128
J+129	Ttr1 - 1st definite time voltage pick- up (sec)	J+129
J+130	UVtr2 - 2nd voltage pick-up (p.u.)	J+130
J+131	Ttr2 - 2nd definite time voltage pick- up (sec)	J+131
J+132	Fraction of eletronic load that can restart	
		J+132
		J+133
		J+134

		J+135
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		J+173
		J+174

CMLDxxxDGU2
Load MVA basea
Substation shunt B (pu on Load MVA base)
Rfdr, Feeder R (pu on Load MVA base)
Xfdr, Feeder X (pu on Load MVA base)b
Xxf, Transformer Reactance - pu on load MVA basec
Tfixhs, High side fixed transformer tap
Tfixls, Low side fixed transformer tap
LTC flag (1: active during simulation, 0: inactive, -1: active during initialization, but inactive during simulation)
Tmin, LTC min tap (on low side)
Tmax, LTC max tap (on low side)
Tstep, LTC Tstep (on low side)
Vmin (pu), LTC Vmin tap (low side)
Vmax (pu), LTC Vmax tap (low side)
TD (s), LTC Control time delay
TC (s), LTC Tap adJustment time delay
Rcmp, LTC Rcomp (pu on load MVA base)
Xcmp, LTC Xcomp (pu on load MVA base)
FmA, Motor A Fraction
FmB, Motor B Fraction
FmC, Motor C Fraction
FmD, Motor D Fraction
Fel, Electronic Load Fractiond
PFel, PF of Electronic Loads
Vd1 (pu), Voltage at which electronic loads start to drop
Vd2 (pu), Voltage at which all electronic loads have dropped
frecel, fraction of electronic load that can restart
PFs, Power factor of static load
P1e, P1 exponente
P1c, P1 coefficient
P2e, P2 exponent
P2c, P2 coefficient
Pfrq, Frequency sensitivity coefficient for real part of static load
Q1e, Q1 exponent
Q1c, Q1 coefficient
Q2e, Q2 exponent
Q2c, Q2 coefficient
Qfrq, Frequency sensitivity coefficient for reactive part of static loady
LFmA, Motor A Loading factor (MW/MVA rating)
RaA (pu), Motor A Stator resistance
LA (pu), Motor A leakage reactance
LsA (pu) - Motor A Synchronous reactance
LpA (pu), Motor A Transient reactance
LppA (pu), Motor A Sub-transient reactance
TpoA (s), Motor A Transient open circuit time constant

TppoA (s), Motor A Sub-transient open circuit time constant
HA (s), Motor A Inertia constant
etrqA, Motor A Load Torque exponent for speed
Vtr1A (pu), Motor A first undervoltage trip voltage
Ttr1A (s), Motor A first undervoltage trip delay
Ftr1A, Motor A first undervoltage trip fraction
Vrc1A (pu), Motor A first undervoltage reclose voltage
Trc1A (s), Motor A first undervoltage reclose delay
Vtr2A (pu), Motor A second undervoltage trip voltage
Ttr2A (s), Motor A second undervoltage trip delay
Ftr2A, Motor A second undervoltage trip fraction
Vrc2A (pu), Motor A second undervoltage reclose voltage
Trc2A (s), Motor A second undervoltage reclose delay
LFmB, Motor B Loading factor (MW/MVA rating)
RaB (pu), Motor B Stator resistance
LB (pu), Motor B leakage reactance
LsB (pu), Motor B Synchronous reactance
LpB (pu), Motor B Transient reactance
LppB (pu), Motor B Sub-transient reactance
TpoB (s), Motor B Transient open circuit time constant
TppoB (s), Motor B Sub-transient open circuit time constant
HB (s), Motor B Inertia constant
etrqB, Motor B Load Torque exponent for speed
Vtr1B (pu), Motor B first undervoltage trip voltage
Ttr1B (s), Motor B first undervoltage trip delay
Ftr1B, Motor B first undervoltage trip fraction
Vrc1B (pu), Motor B first undervoltage reclose voltage
Trc1B (s), Motor B first undervoltage reclose delay
Vtr2B (pu), Motor B second undervoltage trip voltage
Ttr2B (s) Motor B second undervoltage trip delay
Ftr2B, Motor B second undervoltage trip fraction
Vrc2B (pu), Motor B second undervoltage reclose voltage
Trc2B (s), Motor B second undervoltage reclose delay
LFmC, Motor C Loading factor (MW/MVA rating)
RaC (pu), Motor C Stator resistance
LC (pu), Motor C leakage reactance
LsC (pu) Motor C Synchronous reactance
LpC (pu) Motor C Transient reactance
LppC (pu), Motor C Sub-transient reactance
TpoC (s), Motor C Transient open circuit time constant
TppoC (s), Motor C Sub-transient open circuit time constant
HC (s), Motor C Inertia constant
etrqC, Motor C Load Torque exponent for speed
Vtr1C (pu), Motor C first undervoltage trip voltage
Ttr1C (s), Motor C first undervoltage trip delay

Ftr1C, Motor C first undervoltage trip fraction
Vrc1C (pu), Motor C first undervoltage reclose voltage
Trc1C (s), Motor C first undervoltage reclose delay
Vtr2C (pu), Motor C second undervoltage trip voltage
Ttr2C (s), Motor C second undervoltage trip delay
Ftr2C, Motor C second undervoltage trip fraction
Vrc2C (pu), Motor C second undervoltage reclose voltage
Trc2C (s), Motor C second undervoltage reclose delay
Tstall (s), Motr D (compressor motor) stall delay
Trestart (s), Motor D restart (after stall) delay
Tv (s), Motor D voltage measurement time constant
Tf (s), Motor D frequency measurement time constant
LFmD, Motor D load factor, pu of rated powerf
PFmD, Motor D power factor
Vstall (pu), Motor D stall voltage at base condition
Rstall (pu), Motor D stall resistanceg
Xstall (pu), Motor D stall reactance
LFadJ, Load factor adjustment to the stall voltageh
Kp1 (pu), Motor D real power constant for running state 1i
Np1, Motor D real power exponent for running state 1
Kq1, Motor D reactive power constant for running state 1
Nq1, Motor D reactive power exponent for running state 1
Kp2, Motor D real power constant for running state 2
Np2, Motor D real power exponent for running state 2
Kq2, Motor D reactive power constant for running state 2
Nq2, Motor D reactive power exponent for running state 2
Vbrk, Motor D "breakdown" voltage (pu)
Frst, fraction of motor D capable of restart
Vrst (pu), voltage at which motor D can restart after stall
CmpKpf, Motor D real power constant for frequency dependencyj
CmpKqf, Motor D reactive power constnt for frequency dependency
Vc1off (pu), Motor D voltage 1 at which contactors start dropping out
Vc2off (pu), Motor D voltage 2 at which all contactors drop out
Vc1on (pu), Motor D Voltage 1 at which all contactors reclose
Vc2on (pu), Voltage 2 at which contactors start reclosing
Tth (s), Motor D heating time constantk
Th1t, temperature at which Motor D begins tripping
Th2t, temperature at which all of motor D are tripped
Fuvr, fraction of Motor D with underboltage relays
UVtr1 (pu), Motor D 1st undervoltage pick-up
Ttr1 (s), Motor D 1st undervoltage trip delay
UVtr2 (pu), Motor D 2nd undervoltage pick-up
Ttr2 (s), Motor D 2nd undervoltage trip delay
Trv (s), DER voltage measurement transducer time constant
Trf (s), DER frequency measurement transducer time constant
dbd1 (pu), DER lower voltage deadband (< 0)

dbd2 (pu), DER upper voltage deadband (> 0)
Kqv (pu), DER proportional voltage control gain
Vref0 (pu), DER user specified voltage set-point (Note 2)
Tp (s), DER power measurement transducer time constant
Tiq (s), DER Q-control time constant
Ddn (pu), DER reciprocal of droop for over-frequency conditions (> 0)
Dup (pu), DER reciprocal of droop for under-frequency conditions (>0)
fdbd1 (pu), DER deadband for frequency control, lower threshold (<=0)
fdbd2 (pu), DER deadband for frequency control, upper threshold (>= 0)
femax (pu), DER frequency error upper limit
femin (pu), DER frequency error lower limit
PMAX (pu), DER Maximum power limit
PMIN (pu), DER Minimum power limit
dPmax (pu/s), DER Power reference maximum ramp rate (> 0)
dPmin (pu/s), DER Power reference minimum ramp rate (< 0)
Tpord (s), DER Power filter time constant
Kpg (pu), DER PI controller proportional gain
Kig (pu), DER PI controller integral gain
Imax (pu), DER Maximum converter current
vl0 (pu), DER voltage break-point for low voltage cut-out
vl1 (pu), DER voltage break-point for low voltage cut-out (vl1 > vl0)
vh0 (pu), DER voltage break-point for high voltage cut-out
vh1 (pu), DER voltage break-point for high voltage cut-out (vh1 < vh0)
tv10 (s), DER low voltage cut-out timer corresponding to voltage vl0
tvl1 (s), DER low voltage cut-out timer corresponding to voltage vl1
tvh0 (s), DER high voltage cut-out timer corresponding to voltage vh0
tvh1 (s), DER high voltage cut-out timer corresponding to voltage vh1
Vrfrac, DER fraction of device that recovers after voltage comes back to within vl1 < V < vh1 (0 <= Vrfrac <= 1)
fl (Hz), DER frequency break-point for low frequency cut-out
fh (Hz), DER frequency break-point for high frequency cut-out (Note 5)
tfl (s), DER low frequency cut-out timer corresponding to frequency fl
tfh (s), DER high frequency cut-out timer corresponding to frequency fh
Tg (s), DER current control time constant (to represent behavior of inner control loops) (> 0)
rrpwr (pu/s), DER ramp rate for real power increase following a fault
Tv (s), DER time constant on the output of the multiplier
Vpr (pu), DER voltage below which frequency tripping is disabled
Iqhl (pu), DER Upper limit on reactive current injection Iqinj
Iqll (pu), DER Lower limit on reactive current injection Iqinj
LfDER, DER Load factor (ratio of DER power to rating)
Xe (pu), DER output reactance

Suggested Parameters
0.0832


0.112
0.112

0.02
0.02
-1

Param	Early Vintage DER System IEEE Std. 1	70% of-20(30% of-20:	30% of-20(70% of-20:	System IEEE Std. 1547-2018 (Category II)
trv	0.02	0.02	0.02	0.02
dbd1	-99	-99	-99	-99

1
0
1
0
0.02
30
0
-0.005
0
99
-99
1
0
0
-99
0
0
10
1
0.7
0.9
1.105
1.08
2
0.1
0.2
1.5
0.2
58
62
1.5
0.2
0.02
10
0.02
0.7
0
0
1
0.3

dbd2	99	99	99	99
kqv	0	0	0	0
vrefO	0	0	0	0
tp	0.02	0.02	0.02	0.02
tiq	0.02	0.02	0.02	0.02
ddn	0	6	14	20
dup	0	0	0	0
fdbd1	-99	-0.0006	-0.0006	-0.0006
fdbd2	99	0.0006	0.0006	0.0006
femax	0	0	99	99
femin	0	0	-99	-99
pmax	1	1	1	1
pmin	0	0	0	0

Version	Author	MDAG Adoption Date
1	Dynamic Load Task Force	

Notes
Initial version of workbook and flow diagram by Chris Colson (WAPA-UGP) - 2021-Jul-15 Additional industrial load types added to workbook and flow diagram from NERC LMWG by Marcus Moor (Evergy) - 2023-Feb-03 PSSE DYR string functionality added to workbook by Marcus Moor (Evergy) - 2023-Mar-10

Below are my suggestions. Red=eliminate model, Yellow/Red Text=add model which I believe with the addition and eliminate it puts us at 20 models, which not be difficult with MOD (which is the whole reason we moved to building models with MOD).

	2024 Series MDAG / 2025 ITP Model Selection										
Year Definition	Year	Season	MDAG PF	MDAG SC	MDAG DYN	ITP BR PF	ITP MPM F1 (TBD)	ITP MPM F2 (TBD)	ITP MEM F1	ITP MEM F2	ITP BR SC
1	2025	Light Load	1		1						
1	2025	Spring	1								
1	2025	Summer	*1	1	1	1	1				
1	2025	Fall	1			1					
1	2025	Winter	*1		1	1					
2	2026	Light Load	1			1	1				
2	2026	Spring	1			1					
2	2026	Summer	1		1	1	1		1		1
2	2026	Fall				1					
2	2026	Winter	1			1					
3	2027	Light Load	1		1						
3	2027	Summer	1		1	1					
4	2028	Summer	1			1					
4	2028	Winter	1			1					
5	2029	Light Load	1		1	1	1	1			
5	2029	Summer	1	1	1	1	1	1	1	1	1
5	2029	Summer Shoulder	1								
5	2029	Winter	1		1	1					
6	2030	Summer	1			1					
6	2030	Winter	1			1					
7	2031	Summer	1			1					
7	2031	Winter	1			1					
10	2034	Light Load				1	1	1			
10	2034	Summer	1		1	1	1	1	1	1	1
10	2034	Winter	1		1	1					

2024 MDAG / 2025 ITP Models - MOD/EDST Data Submissions					
Year	Season	Load Profile	Generation Profile Review	Topology	Transactions
2025	Light Load	Yes	Yes	Yes	Yes
2025	Spring	Yes	Yes	Yes	Yes
2025	Summer	Yes	Yes	Yes	Yes
2025	Fall	Yes	Yes	Yes	Yes
2025	Winter	Yes	Yes	Yes	Yes
2026	Light Load	Yes	Yes	Yes	Yes
2026	Spring	Yes	Yes	Yes	Yes
2026	Summer	Yes	Yes	Yes	Yes
2026	Fall	Yes	Yes	Yes	Yes
2026	Winter	Yes	Yes	Yes	Yes
2027	Light Load	Yes	Yes	Yes	Yes
2027	Summer	Yes	Yes	Yes	Yes
2028	Summer	Yes	Yes	Yes	Yes
2028	Winter	Yes	Yes	Yes	Yes
2029	Light Load	Yes	Yes	Yes	Yes
2029	Summer	Yes	Yes	Yes	Yes
2029	Summer Shoulder	Yes	Yes	Yes	Yes
2029	Winter	Yes	Yes	Yes	Yes
2030	Summer	Yes	Yes	Yes	Yes
2030	Winter	Yes	Yes	Yes	Yes
2031	Summer	Yes	Yes	Yes	Yes
2031	Winter	Yes	Yes	Yes	Yes
2034	Light Load	Yes	Yes	Yes	Yes
2034	Summer	Yes	Yes	Yes	Yes
2034	Winter	Yes	Yes	Yes	Yes