Regional Sensitivity to Motor D Stalling

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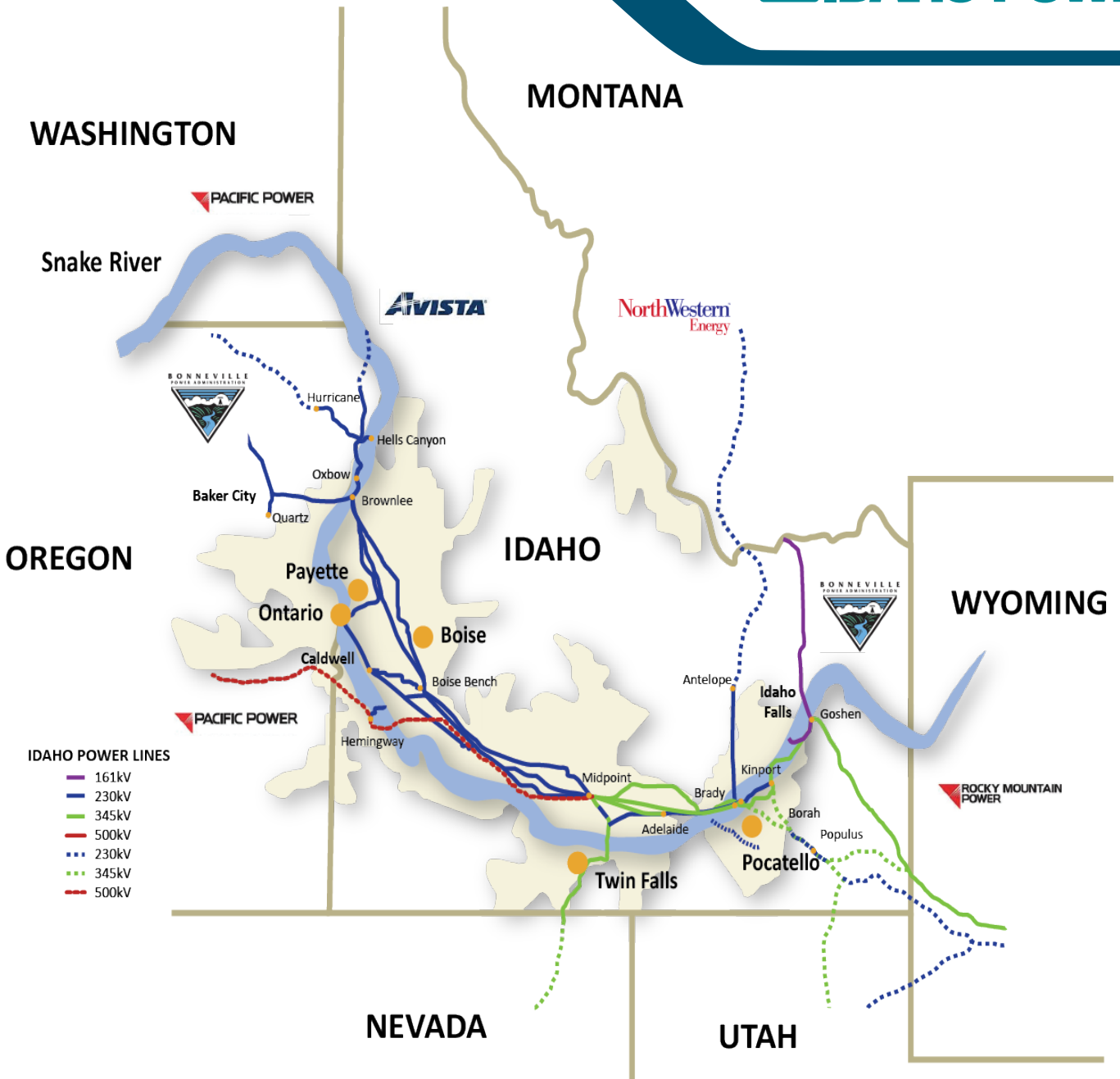
Transmission System

Idaho Power

~3,800 MW Summer Peak

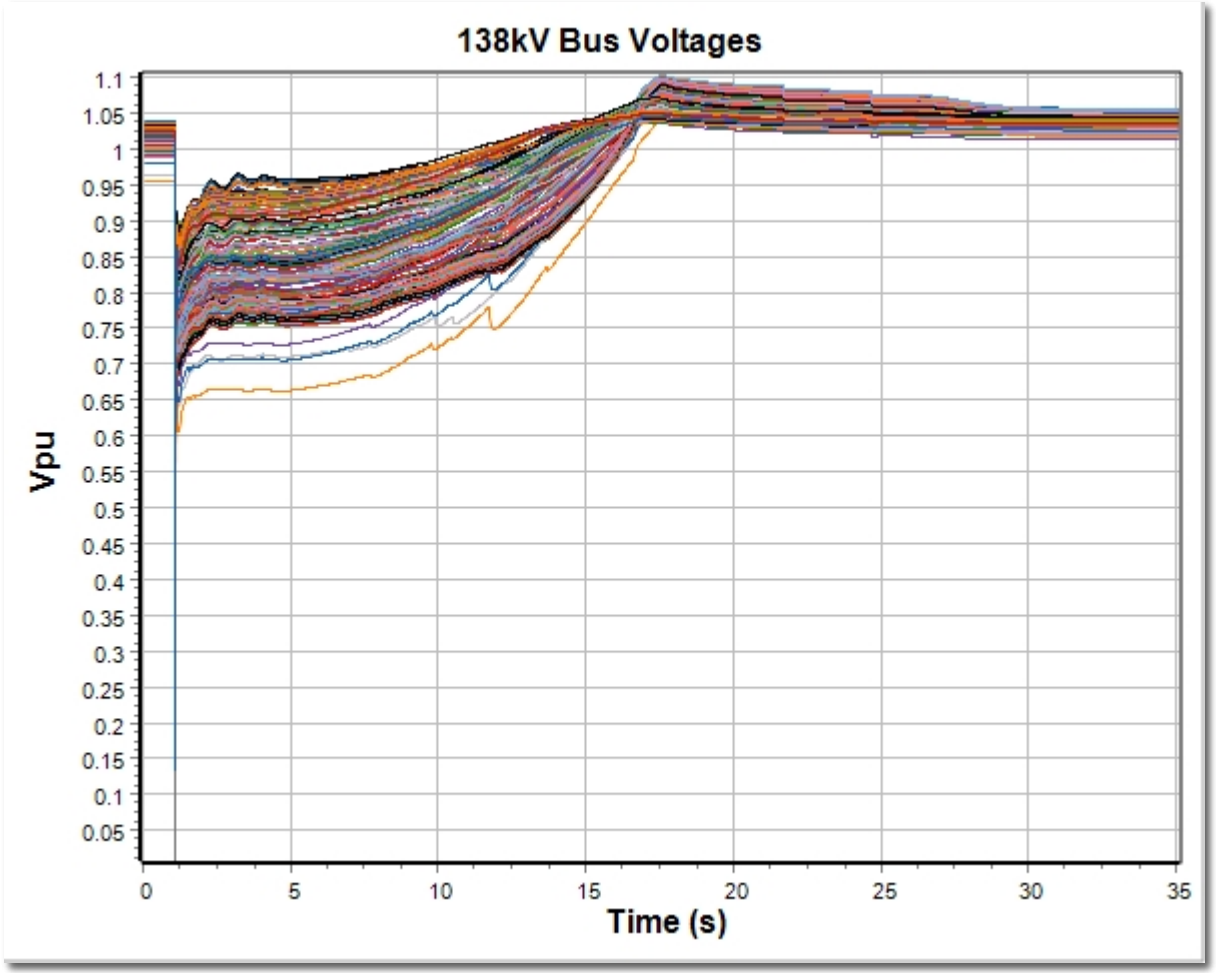
Area 60

~4,200 MW Summer Peak

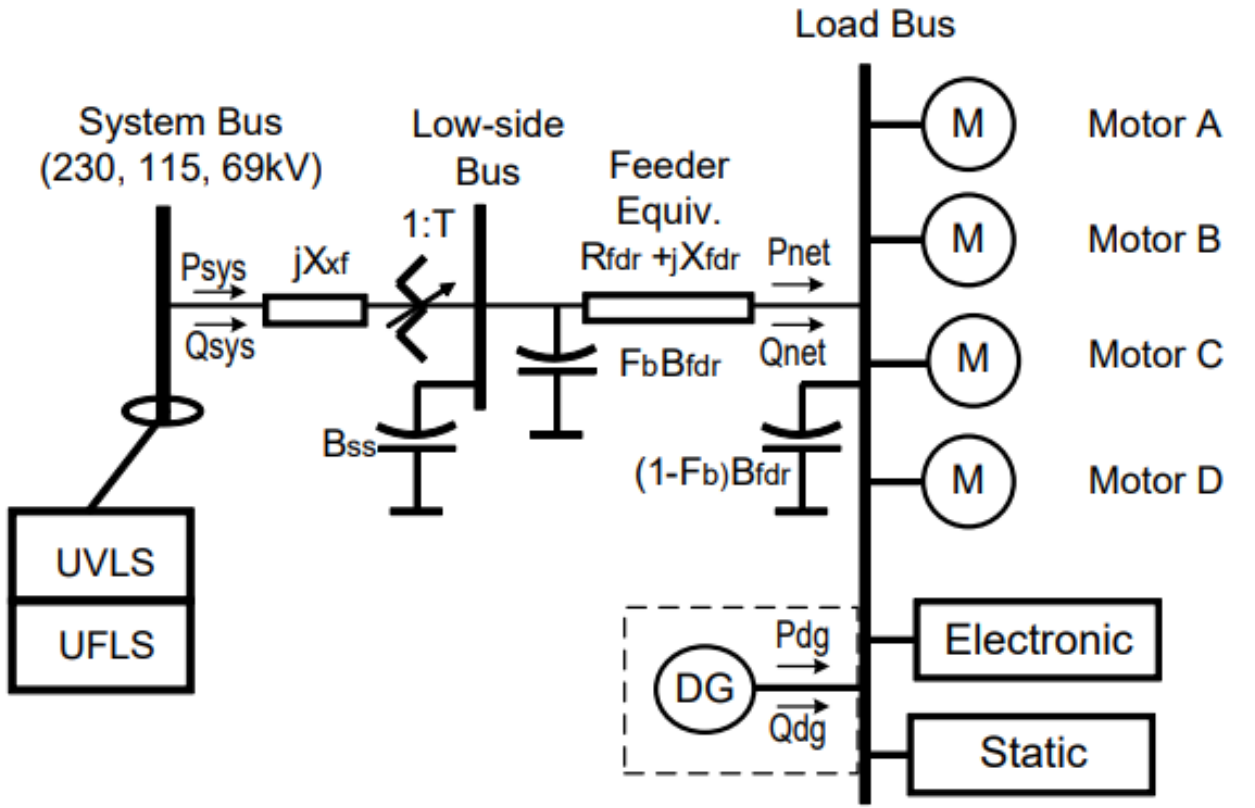


FIDVR

- 3Ø 3-cycle fault on MPSN-HMWY 500kV
- Several Violations seen
- 1,092 MW of load tripped offline by Composite Load Model
- Isolated to Area 60
- Historical Solution: Turn off Stalling



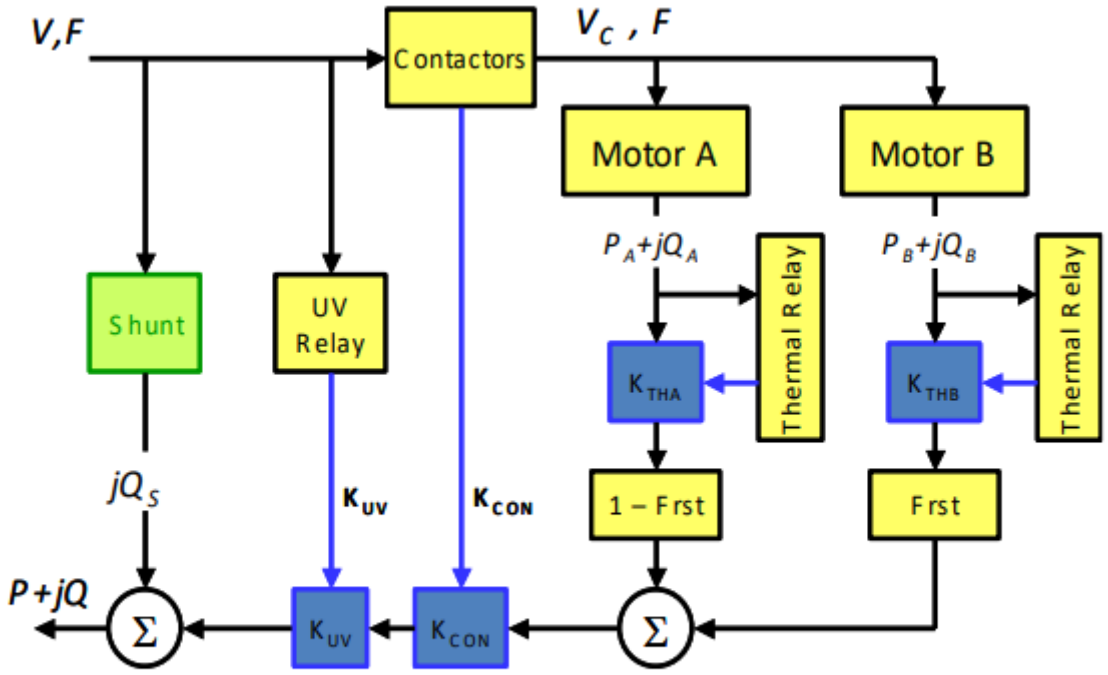
Composite Load Model



- 3Ø Low Inertia / Constant Torque
- 3Ø High Inertia / Variable Torque
- 3Ø Low Inertia / Variable Torque
- 1Ø Residential HVAC system
- AC/DC Power Electronics
- Pure Resistive Load

Motor D Component

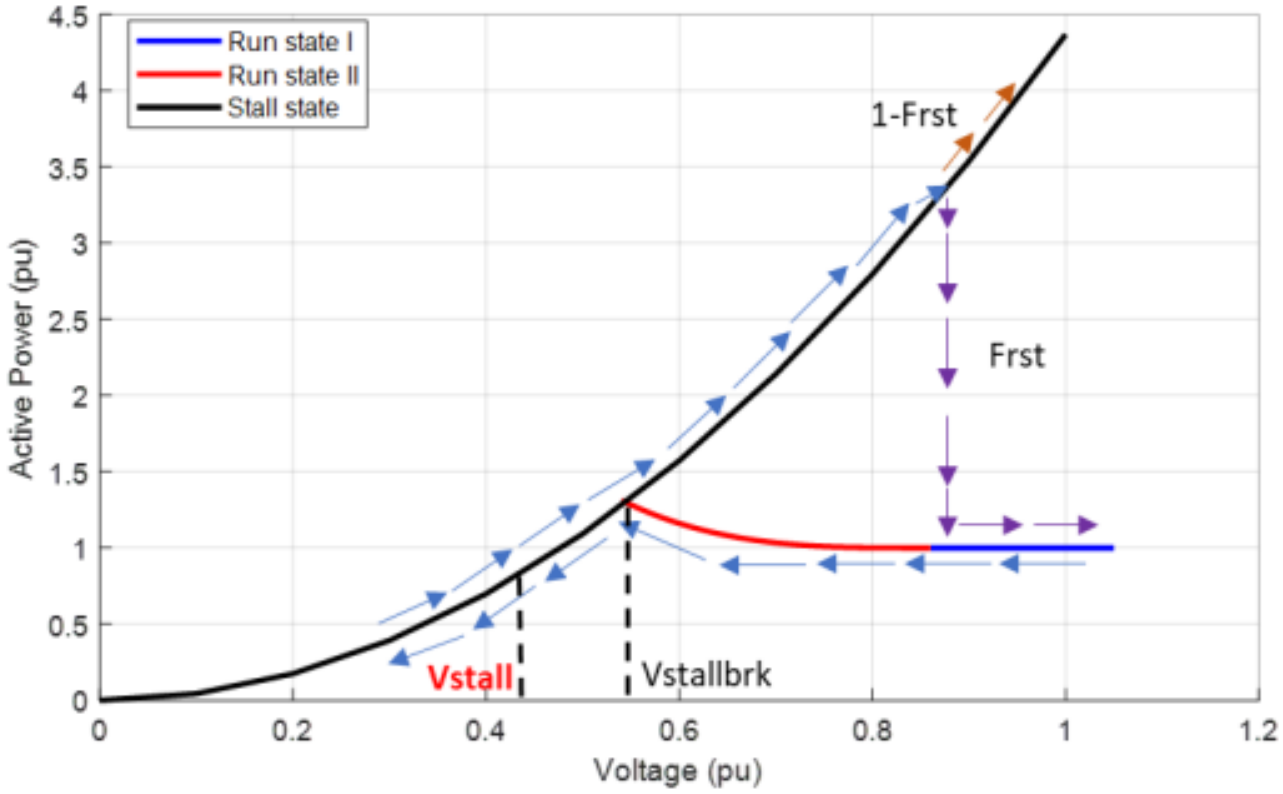
- Models single-phase residential AC loads
- LD1PAC_CMP model
- Alternatives have been discussed
  - Motor1ph and motorc
- Significant stalling due to:
  - Low inertia
  - Single Phase
  - Slow Thermal protection systems



The compressor motor model is divided into two parts:
Motor A – Those compressors that can't restart soon after stalling
Motor B – Those compressors that can restart soon after stalling

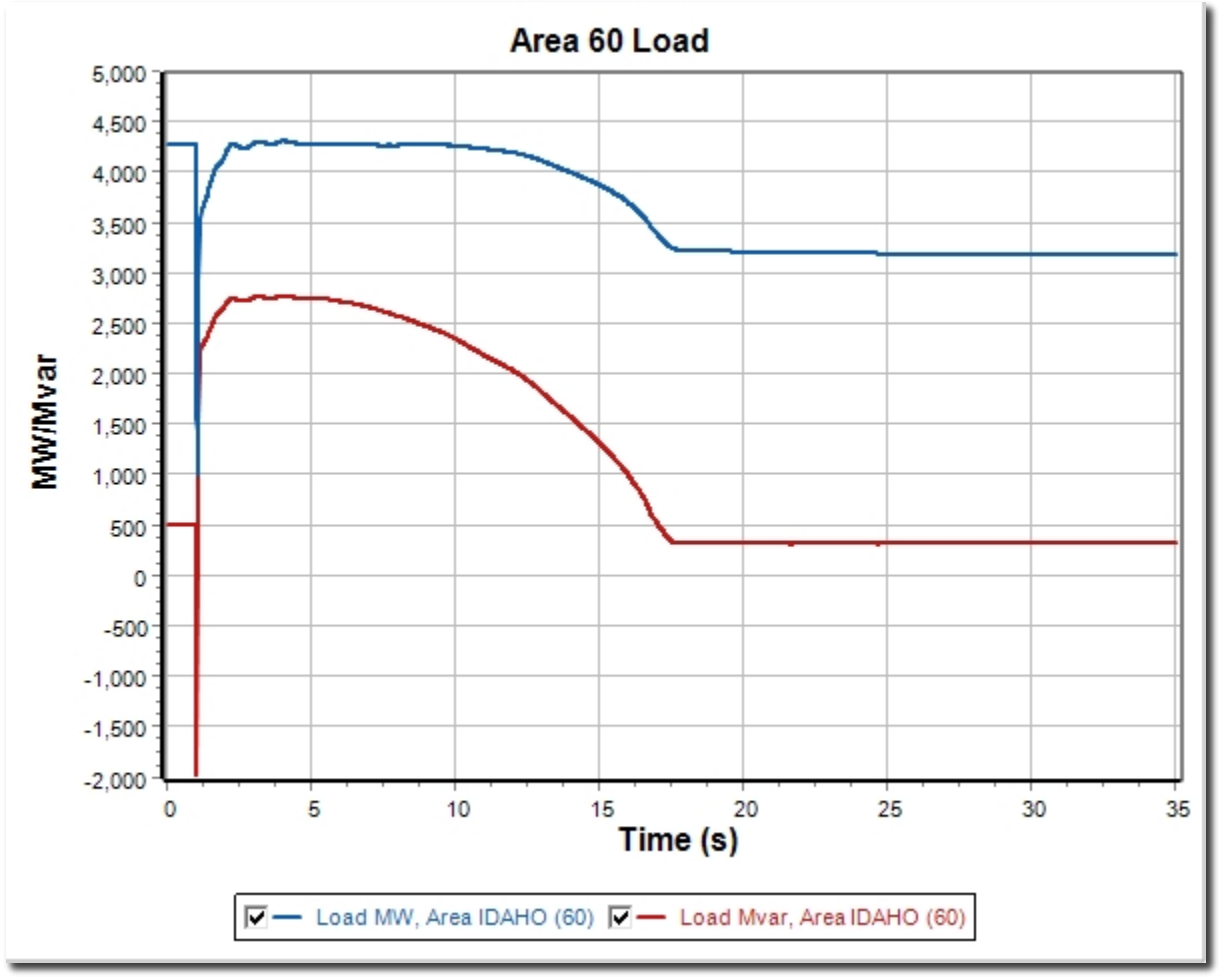
FIDVR due to Motor D

- When Voltage drops below **Vstall** for 2 cycles the motor enters the “Stall State”
- A fraction (Frst) of the load will restart ~20 cycles after voltage returns to above 0.95 Vpu
- Motors remain stalled until tripped offline by the thermal protection after ~15s



Impact on FIDVR

- Area 60 Mvar Load increased by ~2,200 Mvar
- 1,092 MW of Area 60 Load tripped offline (~25% of Load)
- ~925 MW attributed to Motor D load tripping
- Motor A-C trips 50-90% during low voltage
- Motor D trips 10%



Load Model Groups

- Loads are grouped by 2 things
- Climate Zone
  - Regional differences
- Feeder Type
  - Type of load being aggregate
- Load Model Data Tool (LMDT) modifies the load component proportions based off region for each Feeder Type

Suggested Load Designation

- Feeder Type is determined by energy use not customer count
- MIX should be used unless there is data to prove otherwise
- Proportion of Feeder Type should be relatively consistent across climate regions

WECC MVS Guidelines By Energy

ID	Feeder Type	Residential	Commercial	Industrial	Agricultural
RES	Residential	70 to 85%	15 to 30%	0%	0%
COM	Commercial	10 to 20%	80 to 90%	0%	0%
MIX	Mixed	40 to 60%	40 to 60%	0 to 20%	0%
RAG	Rural	40%	30%	10%	20%
IND	Industrial	0%	0%	100%	0%

Example 1,000 MW Area Load

ID	Load	Residential	Commercial	Industrial	Agricultural
RES	150	112.5	37.5	0	0
COM	60	15	45	0	0
MIX	550	247.5	247.5	55	0
RAG	120	48	24	18	30
IND	120	0	0	120	0
Total	**1000**	**423**	**354**	**193**	**30**

25HS Load Model Groups by Area

- Load Feeder Type varies significantly by Area
- Several Areas have 50% of their loads designated as RES
- Motor D makes up over 30% of load in some Areas
- 52% of Area 60 Load is RES
- ~27% of Area 60 is Motor D load

Area	Total Load	Motor D	Residential	Commercial	Industrial	Agriculture	Other	% Other
10 - New Mexico	2,881	26%	47%	33%	14%	1%	1%	2%
11 - El Paso	2,341	34%	59%	3%	1%	1%	0%	0%
14 - APS	10,225	30%	54%	2,769	1,184	137	489	5%
15 - SRP	8,861	27%	48%	2,489	1,905	-0%	184	3%
16 - SRP	3,665	19%	37%	1,342	826	-0%	154	4%
17 - AEPCO	986	24%	44%	287	64	256	104	15%
18 - Nevada	6,917	30%	53%	2,537	457	-0%	204	3%
19 - WAPA L.C	1,282	21%	39%	492	160	265	104	14%
20 - Mexico-CFE	3,788	23%	48%	1,091	287	-0%	125	2%
21 - IID	1,159	21%	41%	401	105	-0%	101	10%
22 - San Diego	4,919	18%	43%	2,488	519	21	42	1%
24 - So Calif	28,588	23%	48%	12,680	2,594	91	288	1%
26 - LADWP	6,907	18%	44%	3,042	670	-0%	179	3%
30 - PG and E	29,697	17%	39%	9,849	5,423	304	2,017	7%
40 - Northwest	30,203	13%	37%	9,328	5,546	297	3,838	13%
50 - BC Hydro	7,289	10%	36%	2,607	2,309	-0%	356	5%
52 - Fortis BC	893	21%	45%	181	268	307	231	1%
54 - Alberta	11,654	6%	27%	3,172	4,309	-0%	698	6%
60 - Idaho	4,283	27%	57%	1,255	383	347	96	0%
62 - Montana	2,395	9%	34%	269	234	141	287	10%
63 - WAPA UGP	204	9%	31%	18	61	39	84	41%
64 - Sierra	2,753	12%	23%	821	281	21	307	10%
65 - PACE	10,476	17%	35%	2,980	3,027	157	741	7%
70 - PSColorado	10,116	20%	42%	4,602	1,474	65	270	3%
73 - WAPA R.M	5,297	15%	35%	1,488	752	97	1,095	20%
Total	197,779	19%	42%	33%	18%	1%	6%	6%

Area 60 (IPC) Load Breakdown

- Worked with Distribution Planning to get updated load mix data
- RES Load dropped from 27% to 3%
- “Residential” Load now makes up ~30% of Peak Load instead of ~60%

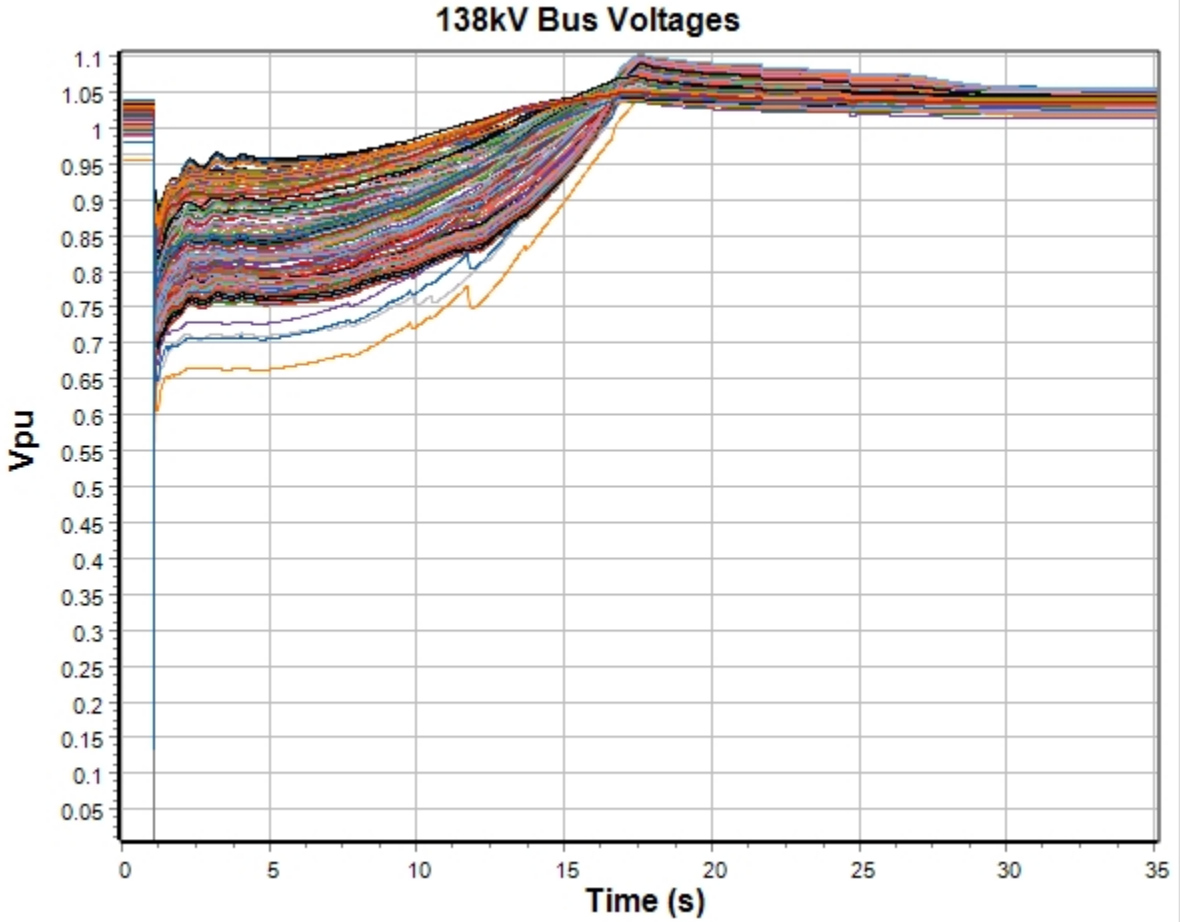
Existing Load Breakdown

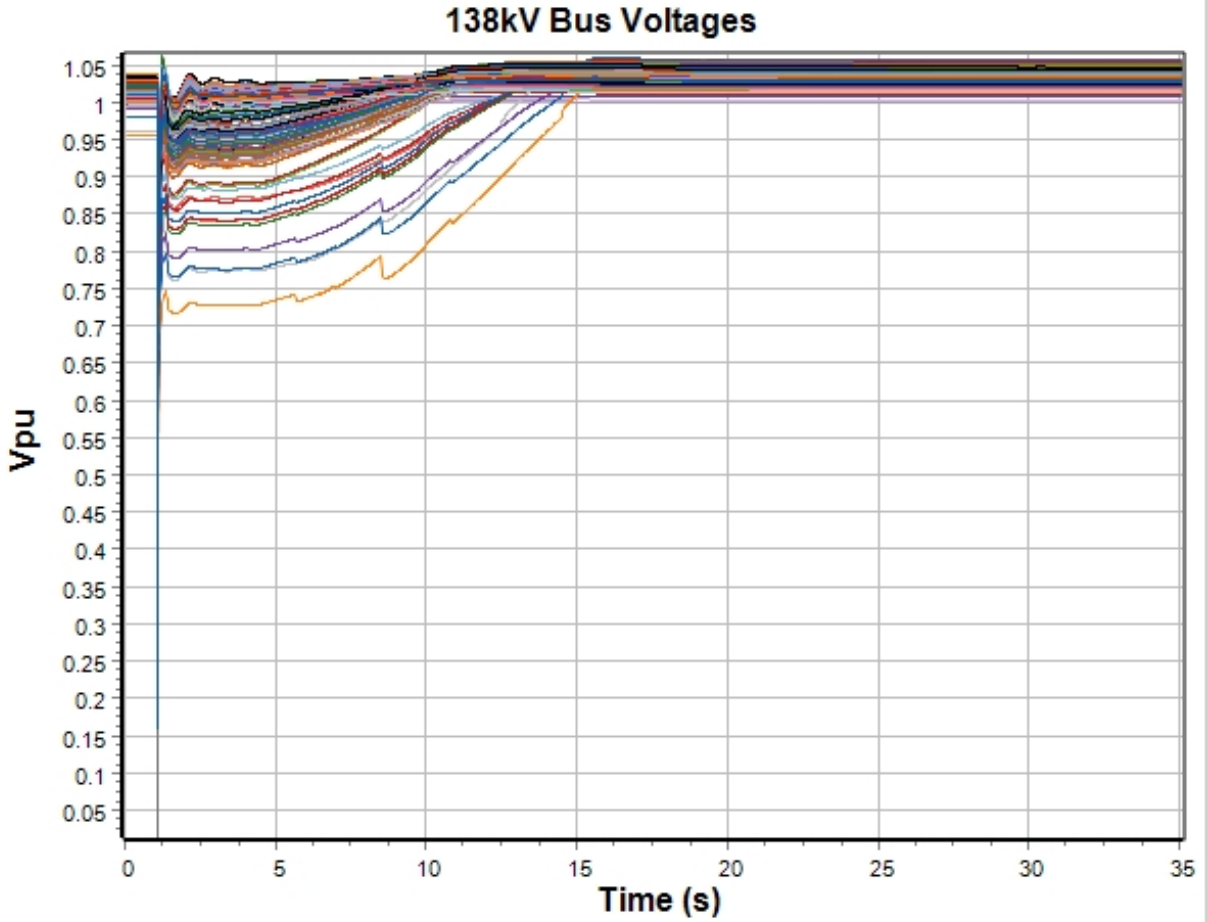
ID	Load	Residential	Commercial	Industrial	Agricultural
RES	2,209	1,657	552	-	-
COM	191	48	143	-	-
MIX	276	124	124	28	-
RAG	1,217	487	243	183	304
IND	79	-	-	79	-
AGR	-	-	-	-	-
Total	3,973	2,316	1,064	289	304
		58%	27%	7%	8%

New Load Breakdown

ID	Load	Residential	Commercial	Industrial	Agricultural
RES	13	10	3	-	-
COM	81	20	60	-	-
MIX	1,832	824	824	183	-
RAG	783	313	157	118	196
IND	568	-	-	568	-
AGR	696	70	-	-	626
Total	3,973	1,237	1,045	868	822
		31%	26%	22%	21%

FIDVR comparison





Suggested Actions

- Utilities should check that their Load Types are accurate
- **Stop Disabling Stalling**
- Work with Base Case builders and Distribution Planners to submit updated Load Types in future WECC base cases
- Re-discuss if the MotorD model needs to be updated

Area	Total Load	% MotorD	% RES
10 - New Mexico	2,881	26%	49%
11 - El Paso	2,341	34%	57%
14 - APS	10,225	30%	50%
15 - SRP	8,861	27%	40%
16 - SRP	3,665	19%	0%
17 - AEPCO	986	24%	23%
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Sources

- WECC MVWG Load Long ID Instructions
- WECC Comp Load Model Specification_final.pdf
- PNNL-24425.pdf
- EPRI Technical Reference on the Composite Load Model