Dynamic Load Models in PowerWorld Simulator

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Modular Structure of Generator Dynamic Models

- Generators have included a modular structure for several decades (1970s and onward)
- Synchronous generators had up to 8 separate modules with coordinated initialization
  - Machine
  - Exciter
  - Governor
  - Stabilizer
  - Under Excitation Limiter
  - Over Excitation Limiter
  - Compensator Model
  - Relay Model
- Even more have been added recently
  - Aerodynamic Model (Type 3 Wind)
  - Pref Controller (Type 3 wind and LCFB1)
  - Plant Controller (renewable models)
  - AGC Controller (Implemented in Version 19 of PowerWorld Simulator)

Load Models have not kept up

- Load Models have been stuck with only two modules
  - Load characteristic
  - Load relay
- The MOTORW model introduced in PSLF in the 1990s was a step in the right direction
  - MOTORW included a parameter indicating what *percentage* of the load was a motor
  - This meant we now had 3 modules
    - Dynamic Model
    - Algebraic Model
    - Relay Model
  - No longer required you to split the power flow load record to permit a load model split

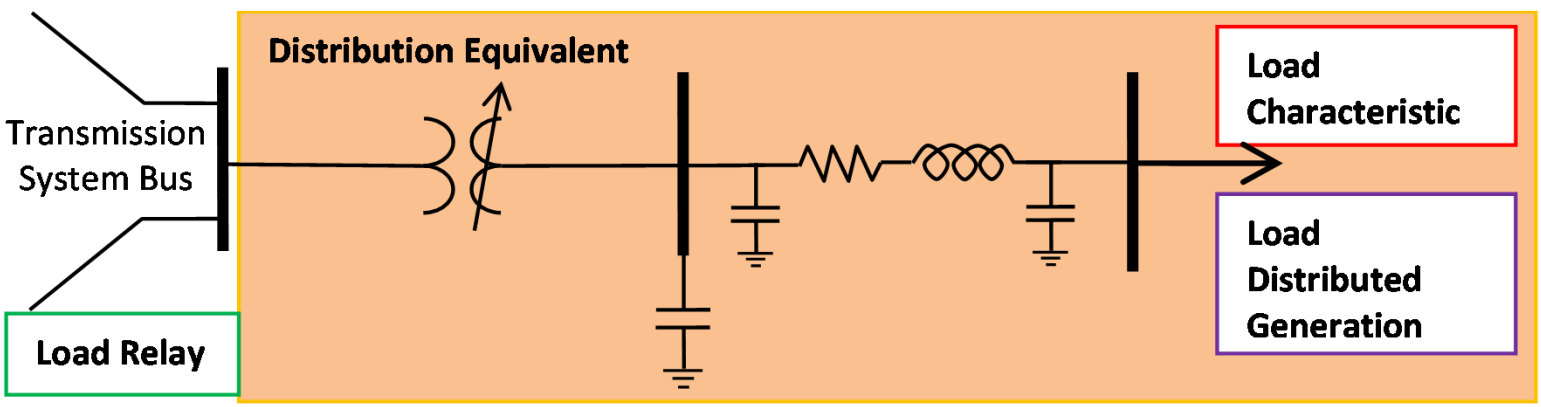
Initial Implementation of Distribution Equivalent

- Composite load model (CMPLDW) was designed within the WECC LMTF in the mid 2000s
  - The distribution equivalent is stuck inside the load characteristic
  - Has meant that new load models in WECC are gravitating toward being smashed into the CMPLDW framework
- Load Distributed Generation (Roof-top Solar for example)
  - This also needs to be at the end of Distribution Equivalent

It is Time to Modularize: Just like Generators

- Natural for a load record to have 4 modules associated with transient stability
  - Load Characteristic
    - Ability to generically split up into any combination of components will be available in PowerWorld Simulator Version 20 in Summer 2017
  - Relay Model
  - Distribution Equivalent
    - Added in PowerWorld Simulator Version 17 in January 2013
  - Load Distributed Generation Model
    - Added in PowerWorld Simulator Version 19 in November 2015

Attributes of a load are not always related to one another and thus independent dynamic models should be available



Load Record: Distributed Generation

- Discussed in WECC LMTF for a few years and decision was made in 2014 to model with three new user input fields with each Load Record
  - **Dist MW Input**: the user entered MWs of distributed generation at the load
  - **Dist Mvar Input**: the user entered Mvars of distributed generation at the load
  - **Dist Status**: The status of the distributed generation (Open or Closed)
- Available in PowerWorld Simulator 19 in year 2015

	Number of Bus	Name of Bus	Area Name of Load	Zone Name of Load	ID	Status	MW	Mvar	MVA	S MW	S Mvar	Dist Status	Dist MW Input	Dist Mvar Input	Dist MW	Dist Mvar	Net Mvar	Net MW
1	2	Two	Top	1	1	Closed	80.00	20.00	82.46	80.00	20.00	Closed	40.00	0.00	40.000	0.000	20.000	40.000
2	3	Three	Top	1	1	Closed	220.00	40.00	223.61	220.00	40.00	Open	110.00	0.00	0.000	0.000	40.000	220.000
3	4	Four	Top	1	1	Closed	160.00	30.00	162.79	160.00	30.00	Closed	80.00	0.00	80.000	0.000	30.000	80.000
4	5	Five	Top	1	1	Closed	260.00	40.00	263.06	260.00	40.00	Open	130.00	0.00	0.000	0.000	40.000	260.000
5	6	Six	Left	1	1	Closed	400.00	0.00	400.00	400.00	0.00	Closed	200.00	0.00	200.000	0.000	0.000	200.000
6	7	Seven	Right	1	1	Closed	400.00	0.00	400.00	400.00	0.00	Closed	200.00	0.00	200.000	0.000	0.000	200.000

Other Load Record Fields

- **Dist MW**, **Dist Mvar**: this is the actual MWs being seen by the power flow solution
  - This will be 0.0 if **DistStatus** = Open
  - This will be reduced if the voltage falls below the minimum voltage for constant power load
- **Net MW**: this is equal to the subtraction of the fields **MW** – **Dist MW**
- Net Mvar: this is equal to the substraction of the fields Mvar – Dist Mvar

	Number of Bus	Name of Bus	Area Name of Load	Zone Name of Load	ID	Status	MW	Mvar	MVA	S MW	S Mvar	Dist Status	Dist MW Input	Dist Mvar Input	Dist MW	Dist Mvar	Net Mvar	Net MW
1	2	Two	Top	1	1	Closed	80.00	20.00	82.46	80.00	20.00	Closed	40.00	0.00	40.000	0.000	20.000	40.000
2	3	Three	Top	1	1	Closed	220.00	40.00	223.61	220.00	40.00	Open	110.00	0.00	0.000	0.000	40.000	220.000
3	4	Four	Top	1	1	Closed	160.00	30.00	162.79	160.00	30.00	Closed	80.00	0.00	80.000	0.000	30.000	80.000
4	5	Five	Top	1	1	Closed	260.00	40.00	263.06	260.00	40.00	Open	130.00	0.00	0.000	0.000	40.000	260.000
5	6	Six	Left	1	1	Closed	400.00	0.00	400.00	400.00	0.00	Closed	200.00	0.00	200.000	0.000	0.000	200.000
6	7	Seven	Right	1	1	Closed	400.00	0.00	400.00	400.00	0.00	Closed	200.00	0.00	200.000	0.000	0.000	200.000

Treatment of Distributed Generation in Power Flow

- Summary Information with Areas, Zones, Substations, etc…
  - Dist MW is separate summation from Load MW

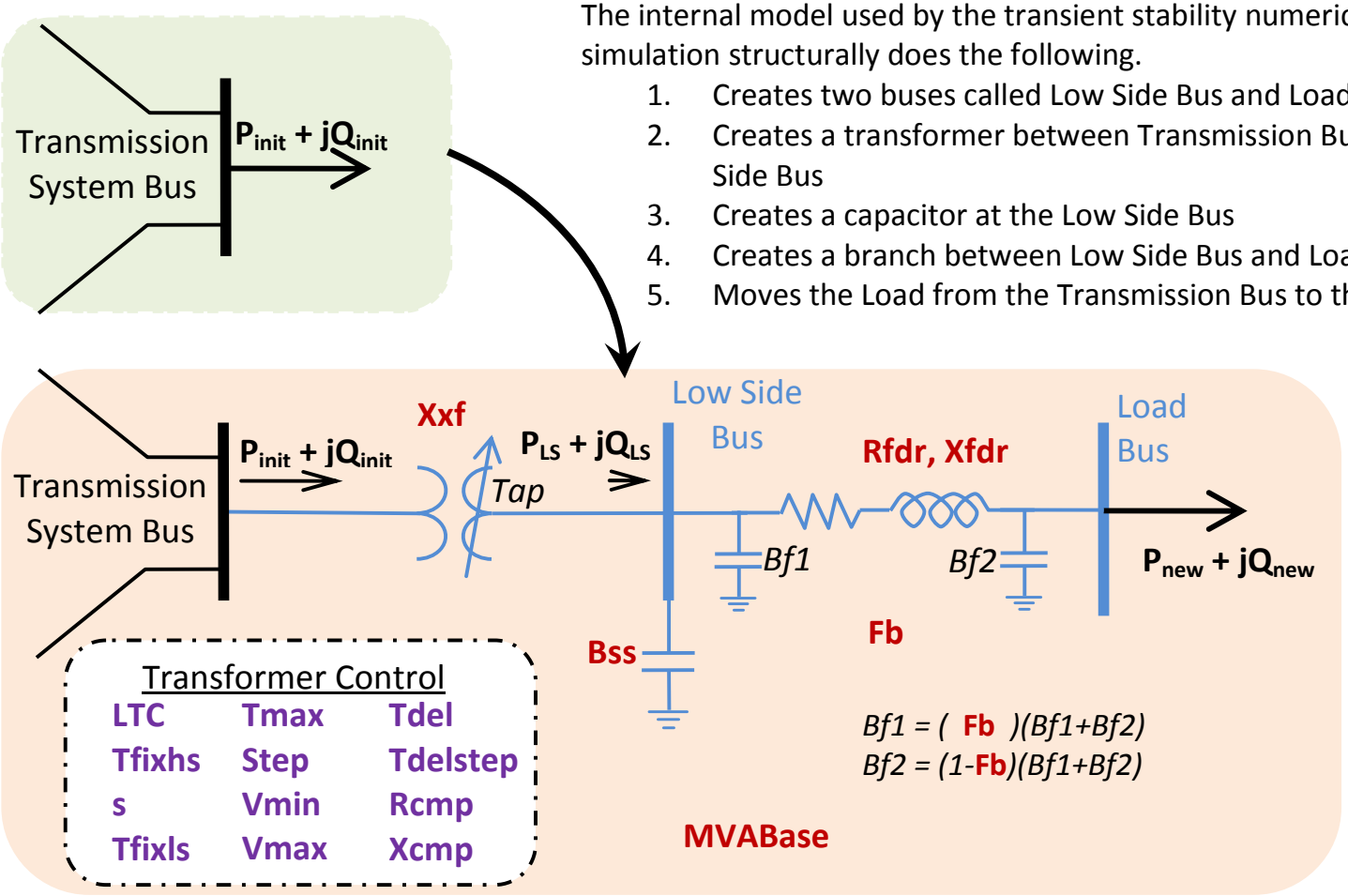
	Area Num	Area Name	AGC Status	Gen MW	Load MW	Dist MW	Shunt MW	Tot Sched MW	Int MW	ACE MW	Lambda	Loss MW
1	1	Top	ED	367.42	720.00	120.000		0.00	-359.54	-359.54	0.00	6.96
2	2	Left	ED	199.52	400.00	200.000		0.00	-200.82	-200.82	0.00	0.34
3	3	Right	ED	400.99	400.00	200.000		0.00	0.36	0.36	0.00	0.64

- Injection Group Treatment
  - Injected MW = Gen MW – Load MW – Dist Gen MW
- Contingency Actions
  - "Set, Change, Move" actions only act on Load portion
  - Open and Close actions also open the distributed gen

Load Distribution Equivalent

The internal model used by the transient stability numerical simulation structurally does the following.

1. Creates two buses called Low Side Bus and Load Bus
2. Creates a transformer between Transmission Bus and Low Side Bus
3. Creates a capacitor at the Low Side Bus
4. Creates a branch between Low Side Bus and Load Bus
5. Moves the Load from the Transmission Bus to the Load Bus



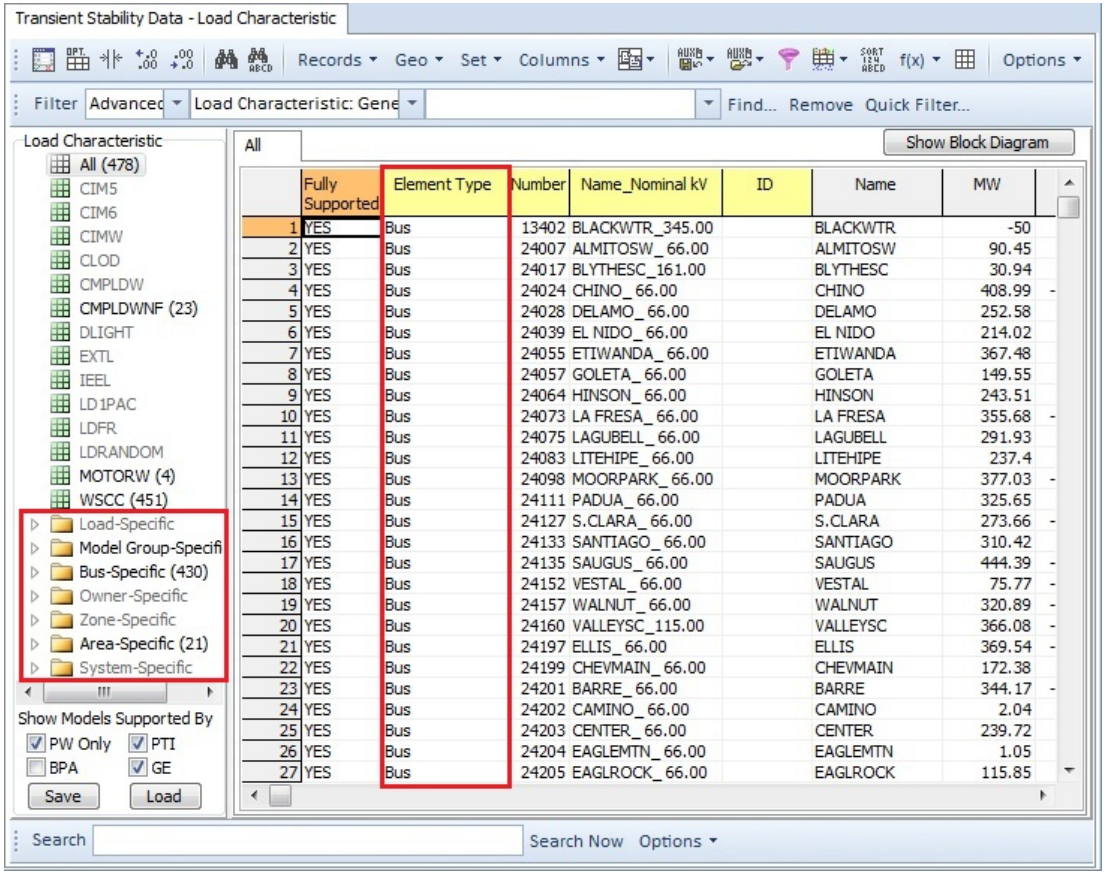
Load Model Features for Data Management

- Dynamic model structure for loads: 4 model types
  - Load Characteristic
    - Describes load behavior (CMPLDW, WSCC, MOTORW, CIM5, CIM6, etc)
    - Can be assigned in hierarchy levels (Load Model Group, Bus, Owner, Zone, Area, System)
  - Load Distribution Equivalent
    - Assigned to the load record
    - Not part of load characteristic, so can be used in combination with any load characteristic
  - Load Distributed Generation
    - Describes the behavior of the distributed generation
  - Load Relay
- Load Model Group
  - Special named object that contains Characteristics, Distributed Generation or Relay models. Load object may then refer to the Model Group
- Load Component
  - Special named object that contains a Characteristic
  - Then used inside the CompLoad characteristic
- Special Load Characteristic: CompLoad
  - New type of load characteristic model (like CIM5, IEEL, MOTORW, LDELEC, etc.)
  - This gives a combination of other load characteristics

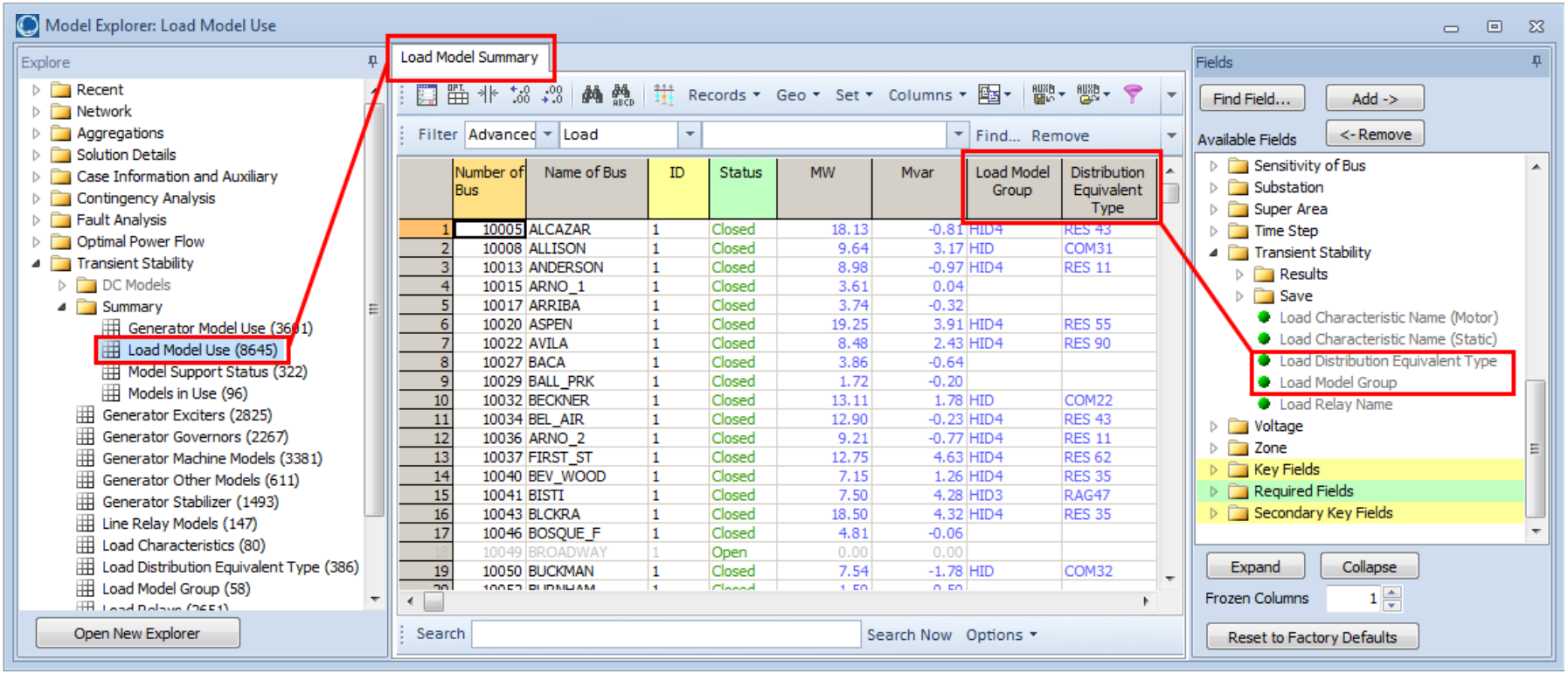
Load Characteristic Models

- Load models apply to either a load, Load model group, bus, owner, zone, area, or the entire case

Precedence:
1. Load-specific
2. Load Model Group-specific
3. Bus-specific
4. Owner-specific
5. Zone-specific
6. Area-specific
7. System-specific
8. Default load modeling option with transient stability options



Load Model Group
Load Distribution Equivalent Type



Load Model Group

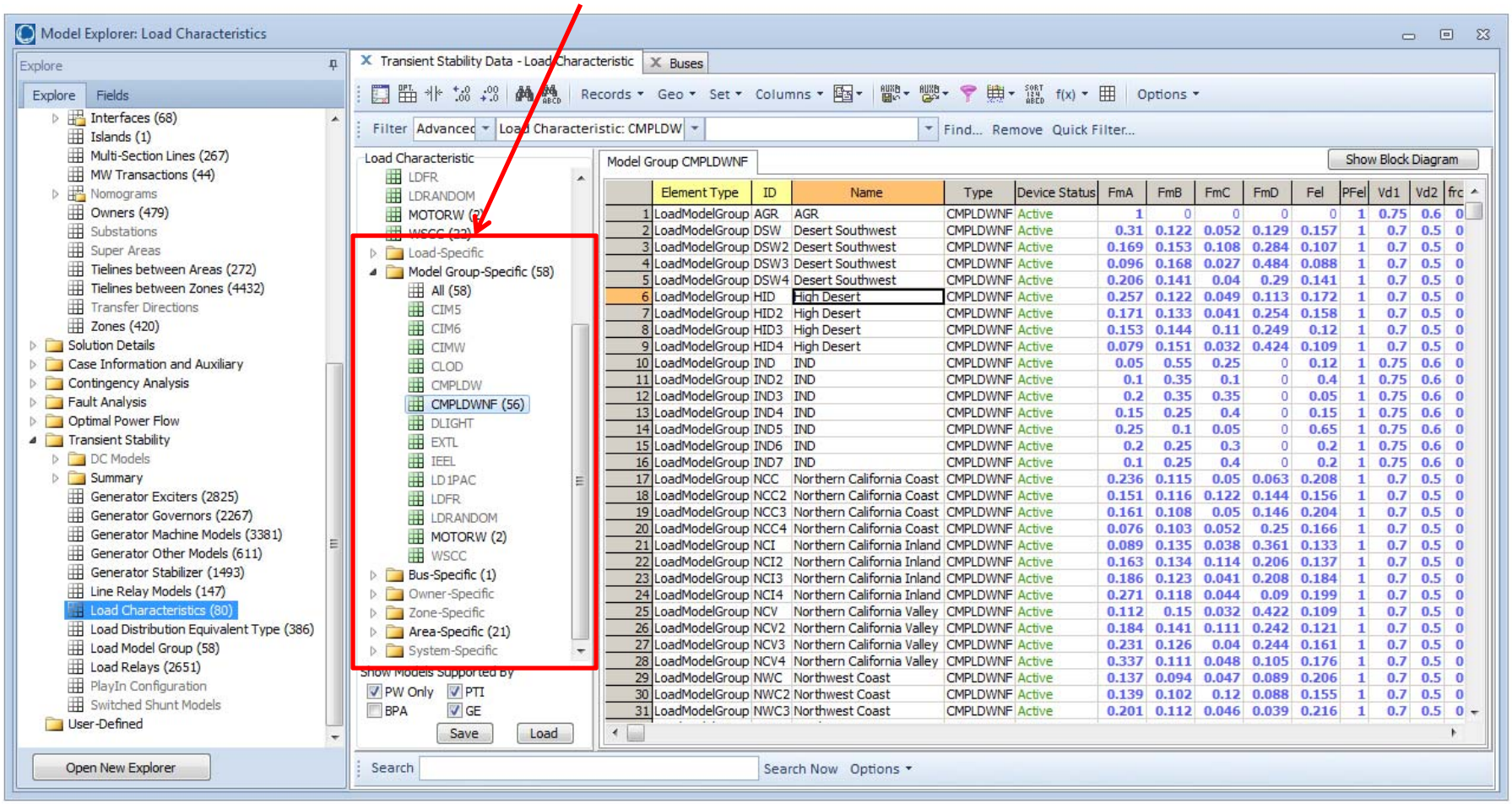
- Identified by unique name
- List of Load Characteristic Models assigned to it
  - CIM5, CIM6, MOTORW, WSCC, CMPLDWNF, etc.
- Allows flexibility in grouping load characteristic models with the same parameters
  - Useful when existing aggregations (such as area, zone, etc) don't capture this
  - *Climate-based* grouping such as "High Desert"
  - *Economic-based* grouping such as "Server Farm" or "Mining Operation"

Load Characteristic Aggregate Models

- Load Characteristic used will be the model available at the lowest point in the precedence hierarchy as follows
  1. Load-specific
  2. Load Model Group-specific
  3. Bus-specific
  4. Owner-specific
  5. Zone-specific
  6. Area-specific
  7. System-specific
  8. Default load modeling option with transient stability options

Load Characteristic Models

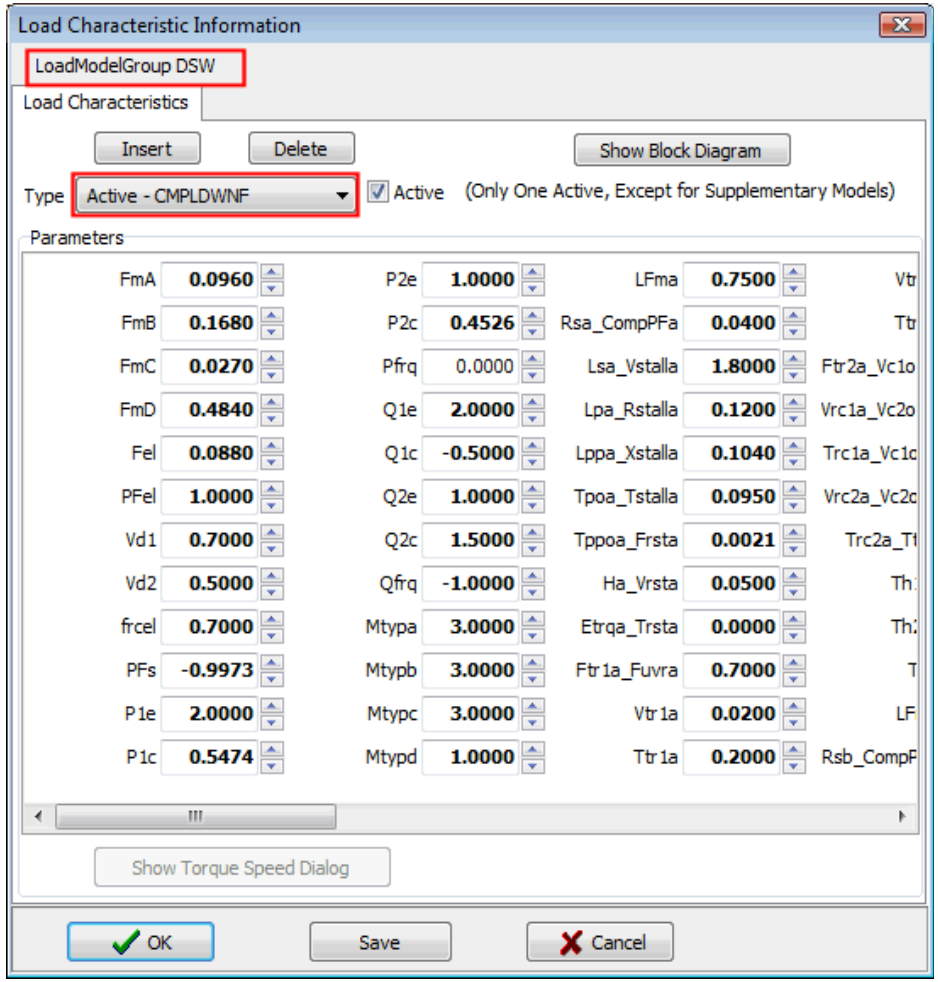
Load Model Hierarchy



	Element Type	ID	Name	Type	Device Status	FmA	FmB	FmC	FmD	Fel	PFel	Vd1	Vd2	frc
1	LoadModelGroup	AGR	AGR	CMPLDWNF	Active	1	0	0	0	0	1	0.75	0.6	0
2	LoadModelGroup	DSW	Desert Southwest	CMPLDWNF	Active	0.31	0.122	0.052	0.129	0.157	1	0.7	0.5	0
3	LoadModelGroup	DSW2	Desert Southwest	CMPLDWNF	Active	0.169	0.153	0.108	0.284	0.107	1	0.7	0.5	0
4	LoadModelGroup	DSW3	Desert Southwest	CMPLDWNF	Active	0.096	0.168	0.027	0.484	0.088	1	0.7	0.5	0
5	LoadModelGroup	DSW4	Desert Southwest	CMPLDWNF	Active	0.206	0.141	0.04	0.29	0.141	1	0.7	0.5	0
6	LoadModelGroup	HID	High Desert	CMPLDWNF	Active	0.257	0.122	0.049	0.113	0.172	1	0.7	0.5	0
7	LoadModelGroup	HID2	High Desert	CMPLDWNF	Active	0.171	0.133	0.041	0.254	0.158	1	0.7	0.5	0
8	LoadModelGroup	HID3	High Desert	CMPLDWNF	Active	0.153	0.144	0.11	0.249	0.12	1	0.7	0.5	0
9	LoadModelGroup	HID4	High Desert	CMPLDWNF	Active	0.079	0.151	0.032	0.424	0.109	1	0.7	0.5	0
10	LoadModelGroup	IND	IND	CMPLDWNF	Active	0.05	0.55	0.25	0	0.12	1	0.75	0.6	0
11	LoadModelGroup	IND2	IND	CMPLDWNF	Active	0.1	0.35	0.1	0	0.4	1	0.75	0.6	0
12	LoadModelGroup	IND3	IND	CMPLDWNF	Active	0.2	0.35	0.35	0	0.05	1	0.75	0.6	0
13	LoadModelGroup	IND4	IND	CMPLDWNF	Active	0.15	0.25	0.4	0	0.15	1	0.75	0.6	0
14	LoadModelGroup	IND5	IND	CMPLDWNF	Active	0.25	0.1	0.05	0	0.65	1	0.75	0.6	0
15	LoadModelGroup	IND6	IND	CMPLDWNF	Active	0.2	0.25	0.3	0	0.2	1	0.75	0.6	0
16	LoadModelGroup	IND7	IND	CMPLDWNF	Active	0.1	0.25	0.4	0	0.2	1	0.75	0.6	0
17	LoadModelGroup	NCC	Northern California Coast	CMPLDWNF	Active	0.236	0.115	0.05	0.063	0.208	1	0.7	0.5	0
18	LoadModelGroup	NCC2	Northern California Coast	CMPLDWNF	Active	0.151	0.116	0.122	0.144	0.156	1	0.7	0.5	0
19	LoadModelGroup	NCC3	Northern California Coast	CMPLDWNF	Active	0.161	0.108	0.05	0.146	0.204	1	0.7	0.5	0
20	LoadModelGroup	NCC4	Northern California Coast	CMPLDWNF	Active	0.076	0.103	0.052	0.25	0.166	1	0.7	0.5	0
21	LoadModelGroup	NCI	Northern California Inland	CMPLDWNF	Active	0.089	0.135	0.038	0.361	0.133	1	0.7	0.5	0
22	LoadModelGroup	NCI2	Northern California Inland	CMPLDWNF	Active	0.163	0.134	0.114	0.206	0.137	1	0.7	0.5	0
23	LoadModelGroup	NCI3	Northern California Inland	CMPLDWNF	Active	0.186	0.123	0.041	0.208	0.184	1	0.7	0.5	0
24	LoadModelGroup	NCI4	Northern California Inland	CMPLDWNF	Active	0.271	0.118	0.044	0.09	0.199	1	0.7	0.5	0
25	LoadModelGroup	NCV	Northern California Valley	CMPLDWNF	Active	0.112	0.15	0.032	0.422	0.109	1	0.7	0.5	0
26	LoadModelGroup	NCV2	Northern California Valley	CMPLDWNF	Active	0.184	0.141	0.111	0.242	0.121	1	0.7	0.5	0
27	LoadModelGroup	NCV3	Northern California Valley	CMPLDWNF	Active	0.231	0.126	0.04	0.244	0.161	1	0.7	0.5	0
28	LoadModelGroup	NCV4	Northern California Valley	CMPLDWNF	Active	0.337	0.111	0.048	0.105	0.176	1	0.7	0.5	0
29	LoadModelGroup	NWC	Northwest Coast	CMPLDWNF	Active	0.137	0.094	0.047	0.089	0.206	1	0.7	0.5	0
30	LoadModelGroup	NWC2	Northwest Coast	CMPLDWNF	Active	0.139	0.102	0.12	0.088	0.155	1	0.7	0.5	0
31	LoadModelGroup	NWC3	Northwest Coast	CMPLDWNF	Active	0.201	0.112	0.046	0.039	0.216	1	0.7	0.5	0

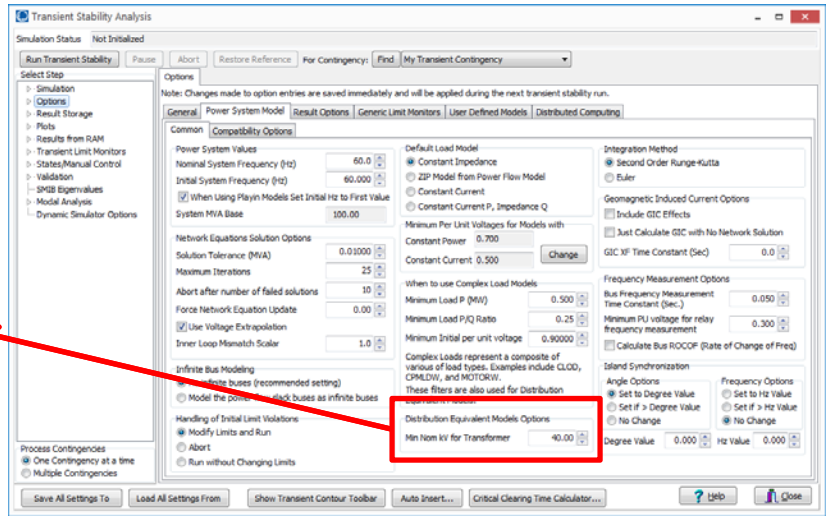
Model CMPLDWNF

- Identical to CMPLDW except that parameters for Load Distribution Equivalent have been removed (first 17 parameters and MVABase)



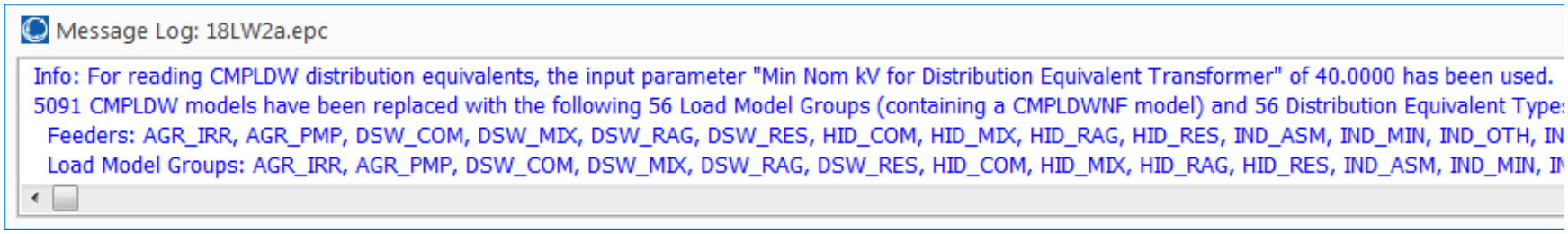
New Option in Version 20

- Distribution Equivalent Models Options
  - Min Nom kV for Transformer: 40 kV is default
  - Any load connected to a bus with a nominal voltage below this will ignore the transformer impedance (Xxf) specified with the distribution

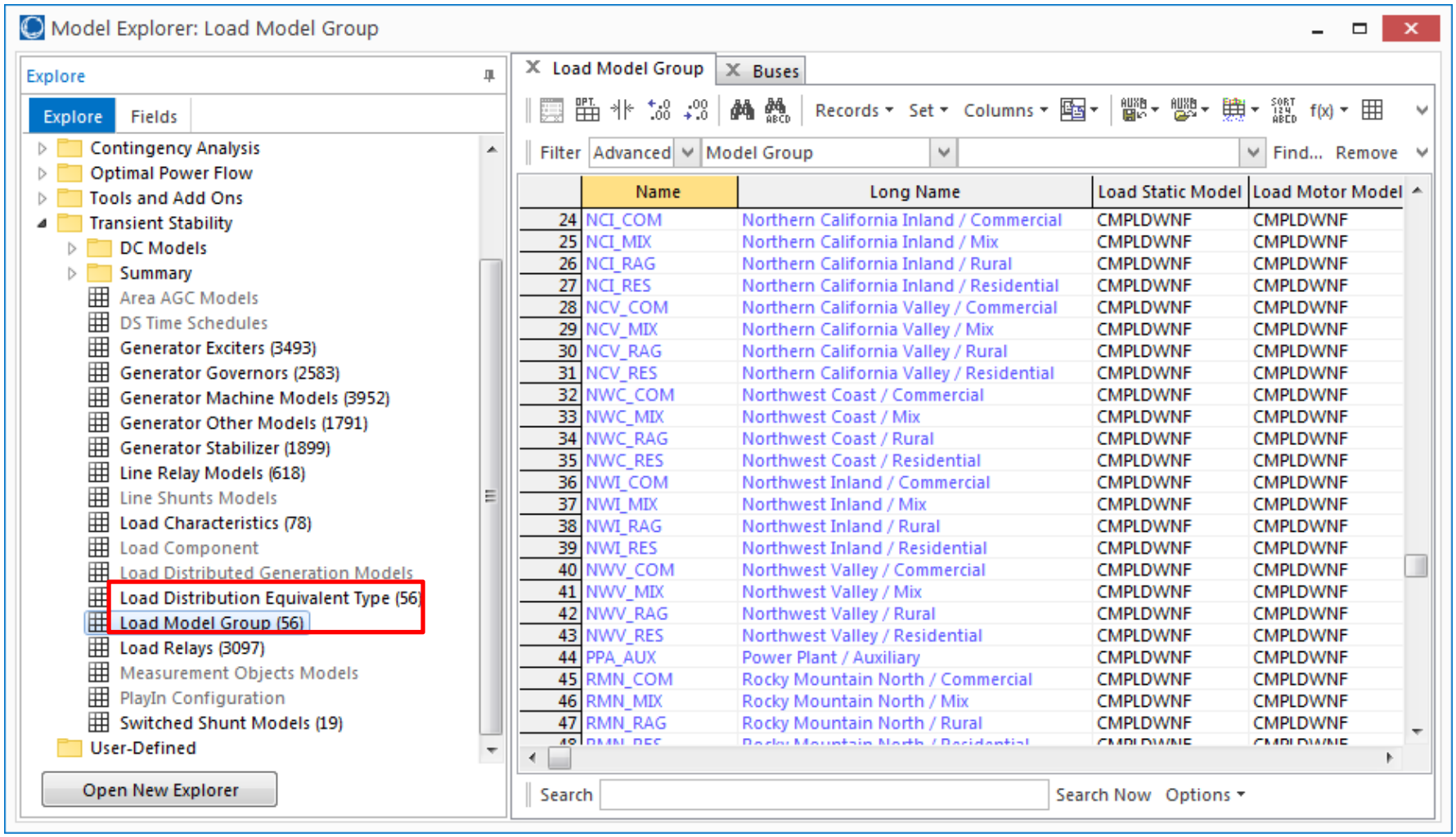


What Happens When you open EPC and DYD files

- Example: 18LW2a.epc and 18LW21.dyd
- Simulator groups together all CMPLDW records with same parameters
- Distribution Equivalents are created using first 17 parameters (and MVAbase) to create.
  - Each unique combination of these parameters
  - Try to use names from the load "long id" field
  - Also uses the new option in version 20 regarding the minimum Nom kV for Transformer
- LoadModelGroups are created using remaining values with each unique combination of these parameters
  - Try to use names from the load "long id" field

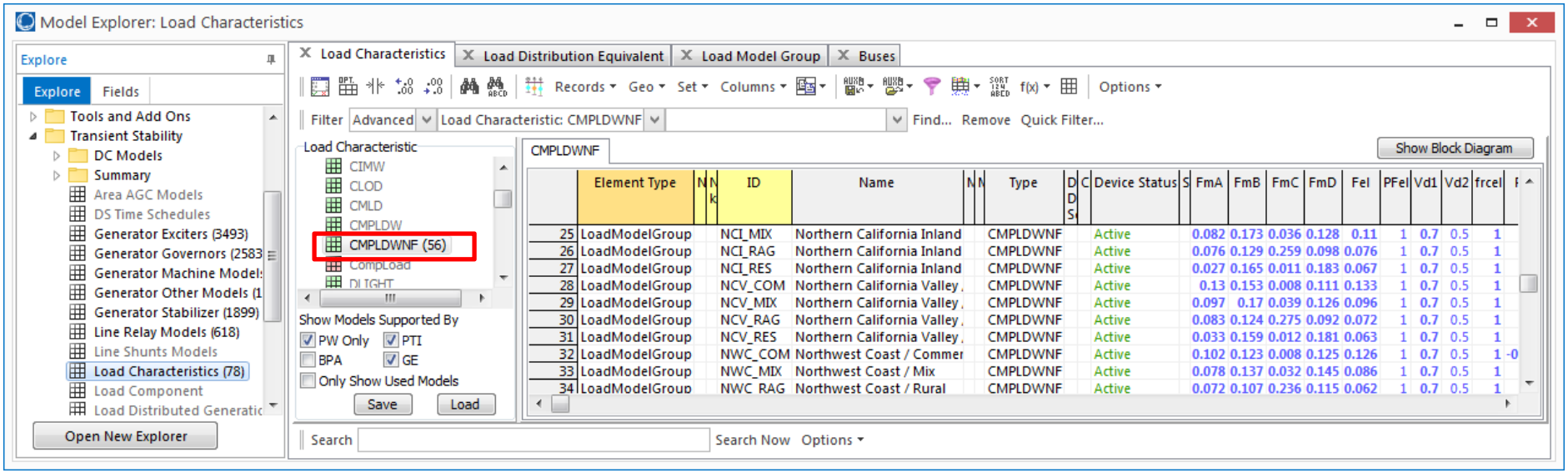


56 Load Model Groups



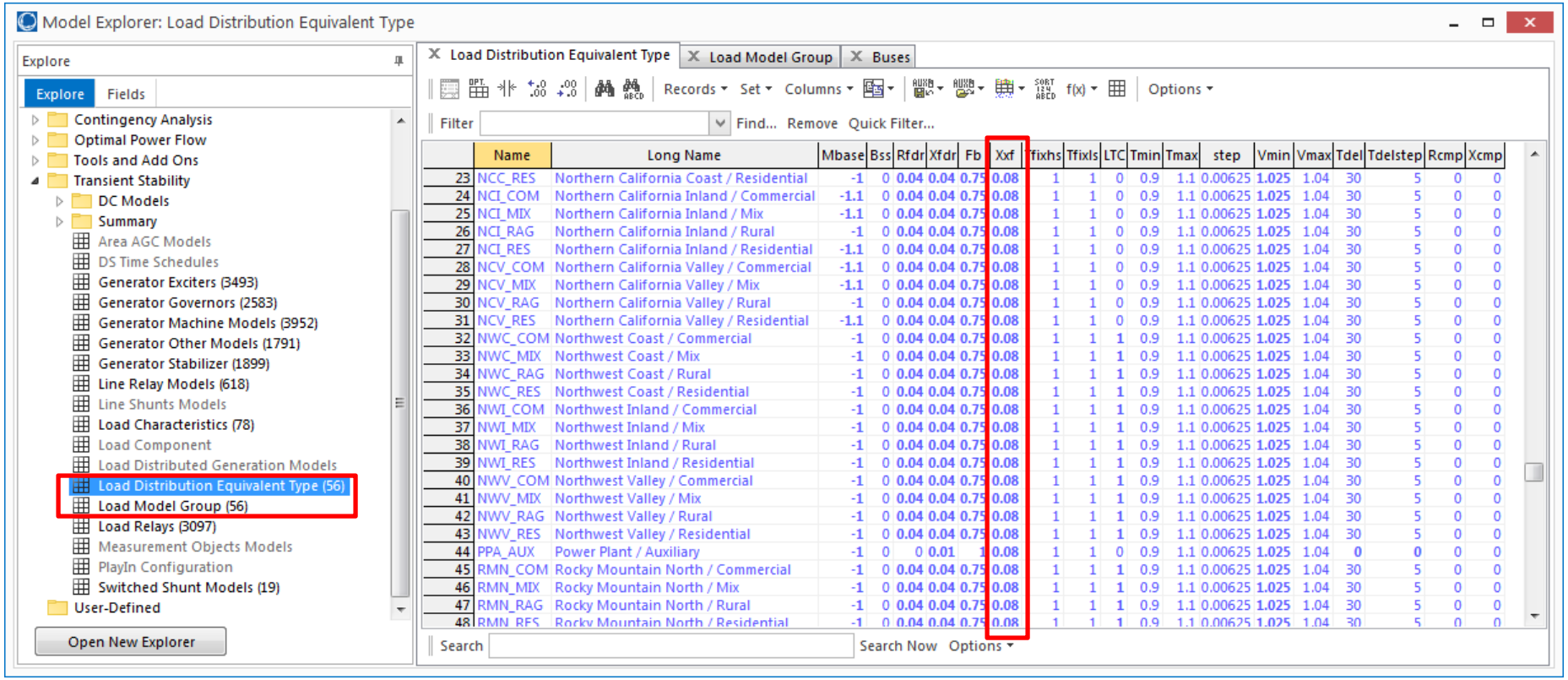
	Name	Long Name	Load Static Model	Load Motor Model
24	NCI_COM	Northern California Inland / Commercial	CMPLDWNF	CMPLDWNF
25	NCI_MIX	Northern California Inland / Mix	CMPLDWNF	CMPLDWNF
26	NCI_RAG	Northern California Inland / Rural	CMPLDWNF	CMPLDWNF
27	NCI_RES	Northern California Inland / Residential	CMPLDWNF	CMPLDWNF
28	NCV_COM	Northern California Valley / Commercial	CMPLDWNF	CMPLDWNF
29	NCV_MIX	Northern California Valley / Mix	CMPLDWNF	CMPLDWNF
30	NCV_RAG	Northern California Valley / Rural	CMPLDWNF	CMPLDWNF
31	NCV_RES	Northern California Valley / Residential	CMPLDWNF	CMPLDWNF
32	NWC_COM	Northwest Coast / Commercial	CMPLDWNF	CMPLDWNF
33	NWC_MIX	Northwest Coast / Mix	CMPLDWNF	CMPLDWNF
34	NWC_RAG	Northwest Coast / Rural	CMPLDWNF	CMPLDWNF
35	NWC_RES	Northwest Coast / Residential	CMPLDWNF	CMPLDWNF
36	NWI_COM	Northwest Inland / Commercial	CMPLDWNF	CMPLDWNF
37	NWI_MIX	Northwest Inland / Mix	CMPLDWNF	CMPLDWNF
38	NWI_RAG	Northwest Inland / Rural	CMPLDWNF	CMPLDWNF
39	NWI_RES	Northwest Inland / Residential	CMPLDWNF	CMPLDWNF
40	NWV_COM	Northwest Valley / Commercial	CMPLDWNF	CMPLDWNF
41	NWV_MIX	Northwest Valley / Mix	CMPLDWNF	CMPLDWNF
42	NWV_RAG	Northwest Valley / Rural	CMPLDWNF	CMPLDWNF
43	NWV_RES	Northwest Valley / Residential	CMPLDWNF	CMPLDWNF
44	PPA_AUX	Power Plant / Auxiliary	CMPLDWNF	CMPLDWNF
45	RMN_COM	Rocky Mountain North / Commercial	CMPLDWNF	CMPLDWNF
46	RMN_MIX	Rocky Mountain North / Mix	CMPLDWNF	CMPLDWNF
47	RMN_RAG	Rocky Mountain North / Rural	CMPLDWNF	CMPLDWNF

56 CMPLDWNF created (one for each LoadModelGroup)



56 Load Distribution Equivalents

- Note: All Xxf > 0 in example. This is because the option for 40 kV threshold handles ignoring Xxf when required



	Name	Long Name	Mbase	Bss	Rfdr	Xfdr	Fb	Xxf	Tfixhs	Tfixls	LTC	Tmin	Tmax	step	Vmin	Vmax	Tdel	Tdelstep	Rcmp	Xcmp
23	NCC_RES	Northern California Coast / Residential	-1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
24	NCI_COM	Northern California Inland / Commercial	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
25	NCI_MIX	Northern California Inland / Mix	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
26	NCI_RAG	Northern California Inland / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
27	NCI_RES	Northern California Inland / Residential	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
28	NCV_COM	Northern California Valley / Commercial	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
29	NCV_MIX	Northern California Valley / Mix	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
30	NCV_RAG	Northern California Valley / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
31	NCV_RES	Northern California Valley / Residential	-1.1	0	0.04	0.04	0.75	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
32	NWC_COM	Northwest Coast / Commercial	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
33	NWC_MIX	Northwest Coast / Mix	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
34	NWC_RAG	Northwest Coast / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
35	NWC_RES	Northwest Coast / Residential	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
36	NWI_COM	Northwest Inland / Commercial	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
37	NWI_MIX	Northwest Inland / Mix	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
38	NWI_RAG	Northwest Inland / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
39	NWI_RES	Northwest Inland / Residential	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
40	NWV_COM	Northwest Valley / Commercial	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
41	NWV_MIX	Northwest Valley / Mix	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
42	NWV_RAG	Northwest Valley / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
43	NWV_RES	Northwest Valley / Residential	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
44	PPA_AUX	Power Plant / Auxiliary	-1	0	0	0.01	1	0.08	1	1	0	0.9	1.1	0.00625	1.025	1.04	0	0	0	0
45	RMN_COM	Rocky Mountain North / Commercial	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
46	RMN_MIX	Rocky Mountain North / Mix	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
47	RMN_RAG	Rocky Mountain North / Rural	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0
48	RMN_RES	Rocky Mountain North / Residential	-1	0	0.04	0.04	0.75	0.08	1	1	1	0.9	1.1	0.00625	1.025	1.04	30	5	0	0

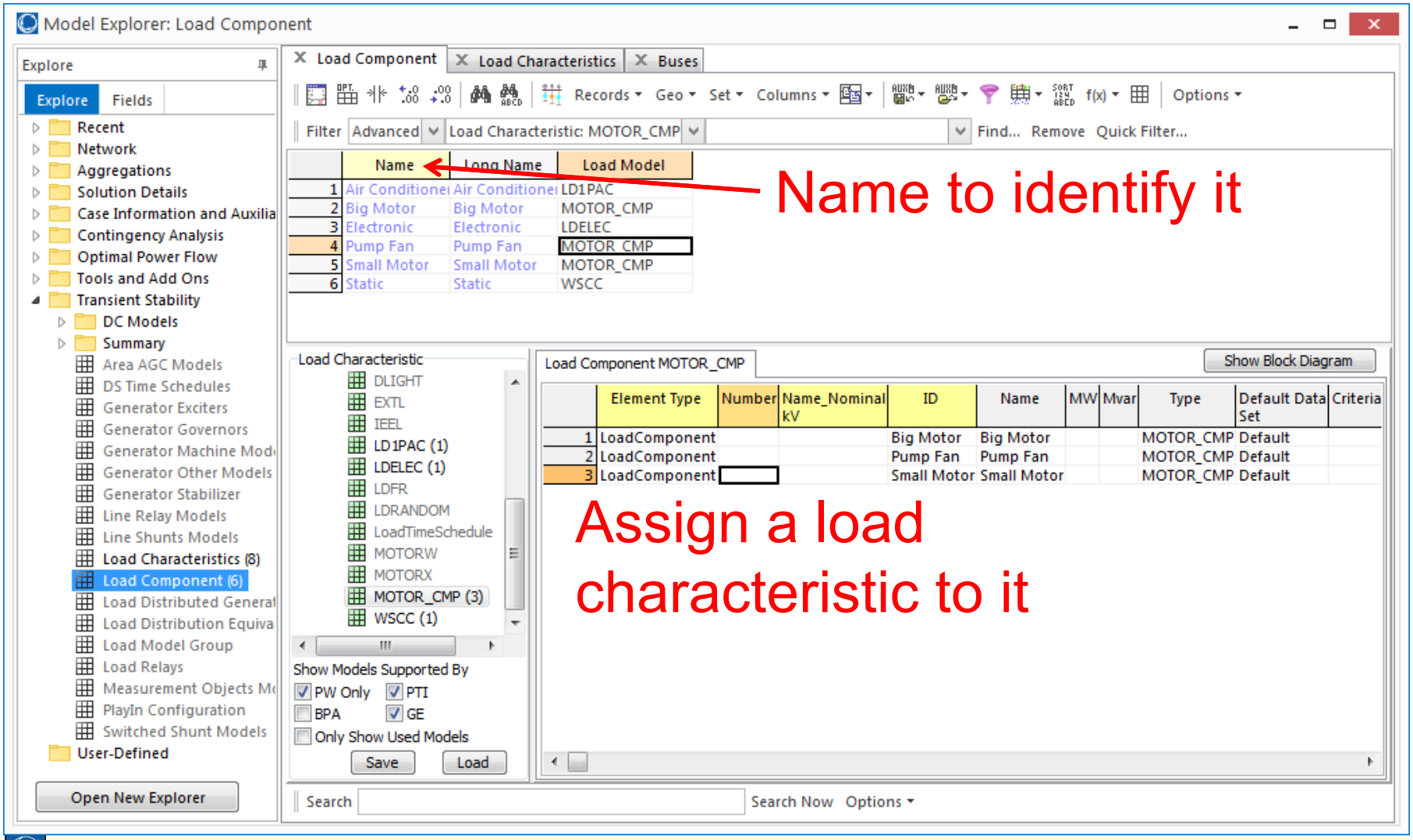
Existing summary

- For data in existing cases, we think that managing 56 load characteristics and 56 distribution equivalents is manageable.
- Thus, CMPLDW works OK, but…
  - Model components *are fixed*
    - Always 4 motors (usually 3 induction motors and 1 single phase air conditioner)
    - 1 electronic load
    - 1 static load
  - This makes adding new pieces to the structure very cumbersome

New in Version 20 of Simulator Available Summer 2017

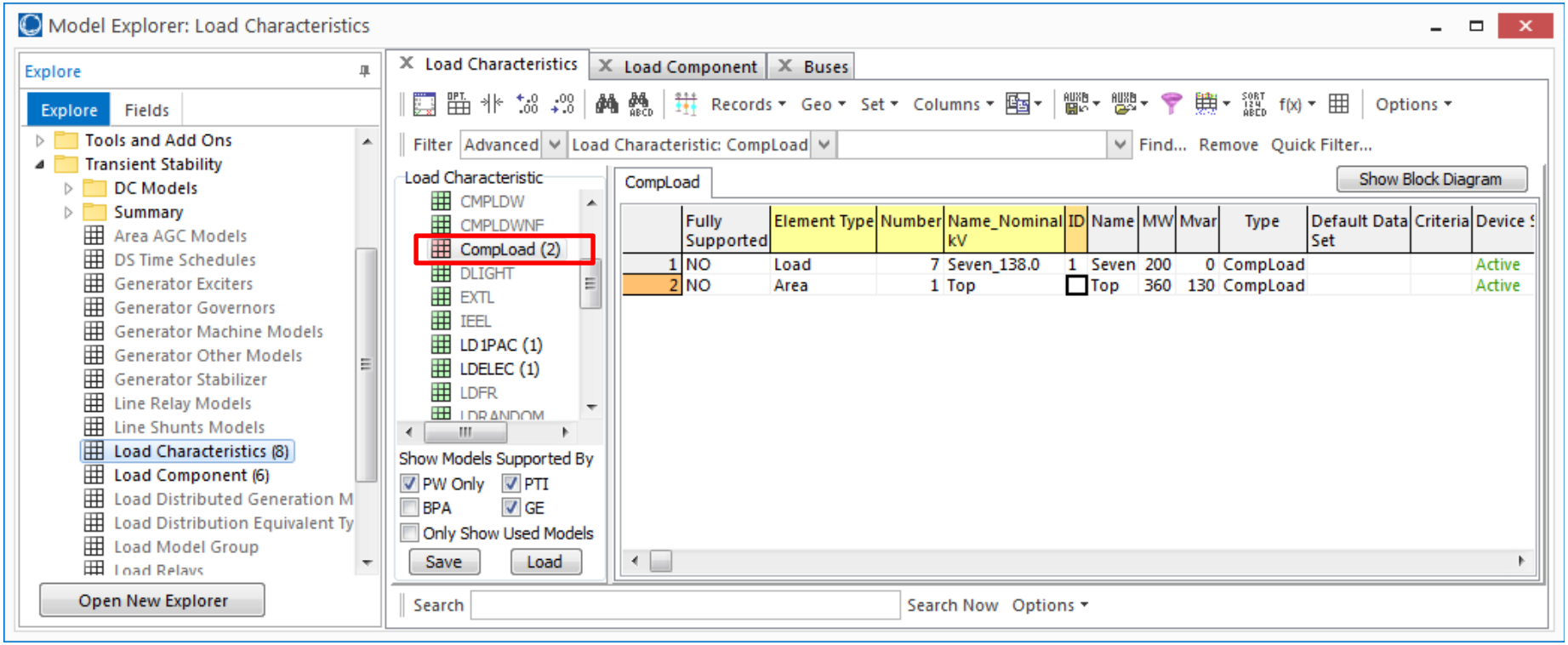
- Ability to make any combination of load characteristics
  - A new LoadComponent object
    - Name to identify it
    - Load characteristic assigned to it
  - Make a new type of load characteristic called CompLoad
    - Allow it to reference up to 10 LoadComponent objects along with assigning a fractions of each of those 10
- Most existing load characteristics can then be assigned to the LoadComponent
  - Benefit: As new stand-alone load characteristics are added to software, they are *immediately* available in the CompLoad structure

New Object Record: LoadComponent



New Load Characteristic: CompLoad

- CompLoad is a new type of load model
  - Just like other load characteristics (WSCC, MOTORW, CIM5, etc.)
  - Assign to a Load, LoadModelGroup, Bus, Area, Zone, Owner, or System

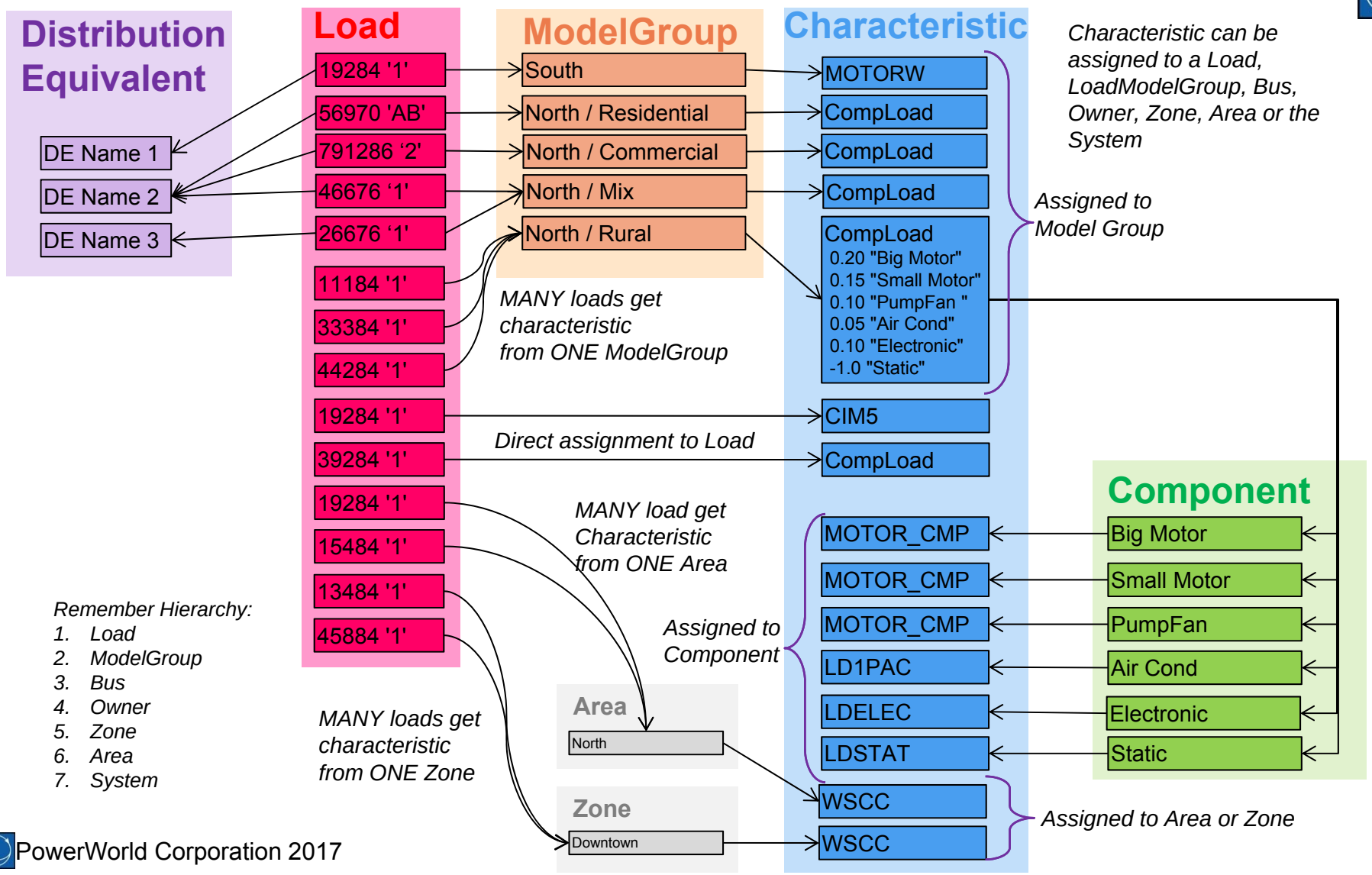


Nomenclature Review

- Dynamic model structure for loads: 4 model types
  - Load Characteristic
    - Can be assigned in hierarchy levels (Load Model Group, Bus, Owner, Zone, Area, System)
  - Load Distribution Equivalent
    - Load object can be assigned to one
- Load Model Group
  - Load object can be assigned to one
- Load Component
  - Special named object that contains a Characteristic
  - Then used inside the CompLoad characteristic
- New Load Characteristic: CompLoad
  - New type of load characteristic model that gives a combination of other load characteristics

Object References Picture

Shaded Regions represents data tables
Darker boxes inside tables represent one record of that table



Restriction of Load Characteristics that can be assigned to a LoadComponent

- CompLoad only assigns *one percentage* to each LoadComponent it uses
  - This percentage applies to the total ***MW***
  - What about Mvar?
- Restriction for Load Characteristic: must automatically assign its Mvar based on the MW.
  - Induction Motor models already do this as does LD1PAC
  - Stand-alone model LDELEC has a new parameter (pfel)
  - Stand-alone model IEEL has a new parameter (Pfs)
  - (basically this is an issue for the algebraic load models!)
- Each component of the CompLoad will thus automatically determine its own Mvar value based on its own MW
  - Similar to existing motor models, the CompLoad will then include a capacitance to match the initial conditions for Mvar.

What would happen with existing WECC data?

- New LoadComponent records would be created
  - 46 IEEL models that represent various combinations of ZIP models
  - 6 LD1PAC_CMP models. Only difference is different Vstall values
  - 9 MOTOR_CMP models representing different combinations of three-phase motors
  - 3 LDELEC models represents slightly different Vd1/Vd2 values
- The 56 CMPLDWNF records assigned to LoadModelGroups would be replaced by 56 CompLoad records instead

Summary

- Modularize!
  - Following attributes of a load are not always related to one another.
  - Independent dynamic models should be used
    - Characteristic
    - Distributed Generation
    - Distribution Equivalent
    - Relays
- Aggregation Level Models
  - Load Model Group, Bus, Owner, Zone, Area, Case
- Named Load Components
  - CompLoad Characteristic represents a combination of other load model types