

## Load Flow Comparison Case # 4

### Comparison of ETAP Load Flow Results against a Published Example

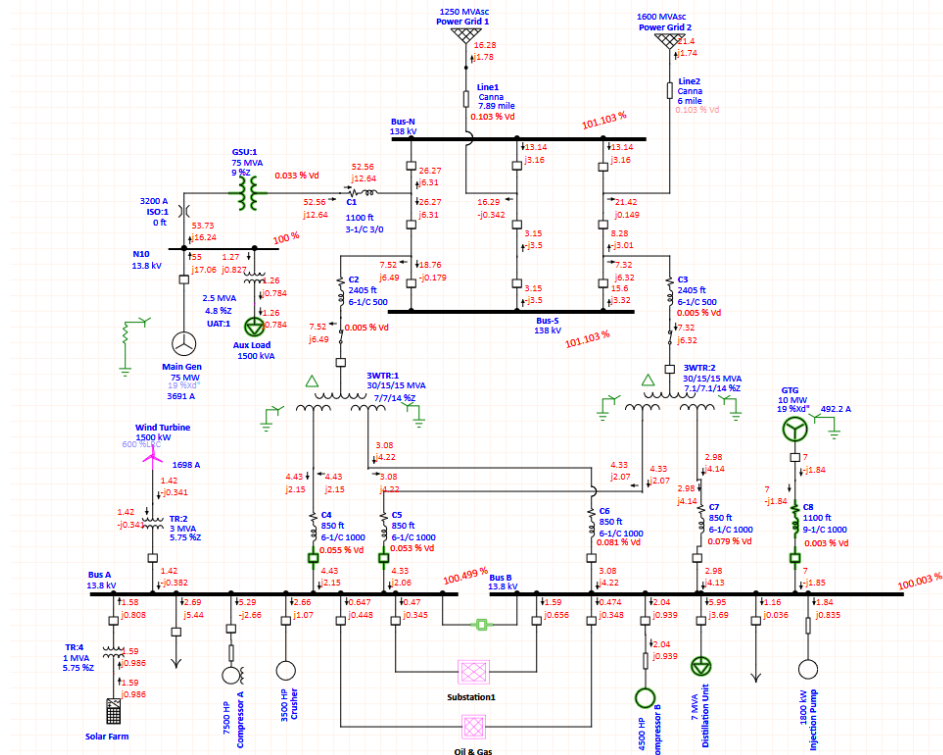
#### Excerpts from Validation Cases and Comparison Results (Example - IEEE 3002 system)

##### Highlights

- Comparison between ETAP Load Flow (LF) results against those published in IEEE Std 3002.2-2018.
- Considers different types of industrial and commercial loads.
- Comparisons are made against bus voltage magnitude and angle, and power flows (MW and Mvar flows).
- One of the scenarios, normal loading conditions is provided for comparison.
- Comparison of results for the Newton Raphson Method, Adaptive Newton Raphson method, and Fast-Decoupled methods are provided.

##### System Description

This is typical industrial and commercial power systems, which includes two generators, two utility sources, 13 transformers. And the load includes both commercial and industrial load such as distillation unit load, flare system load, receptable load, turbine load, arc furnace load, server rack load, lighting load, and different induction motor load such as compressor, condenser, drill, crusher. etc. It also includes one wind turbine and an adjustable speed drive.



(Normal loading condition, compared with Fig. 16 in IEEE 3002.2-2018)

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### Comparison of Results

The following two tables of comparison show the differences between ETAP results and those published in the standard. The difference in the results is less than 0.001 % for all bus voltages and less than 0.5% for all power flows.

BUS	REFERENCE		ETAP								
			ANR			NR			FD		
#	% Mag.	Ang.	%Mag.	Ang.	% Diff Mag	% Mag.	Ang.	% Diff Mag	% Mag.	Ang.	% Diff Mag
B1	99.94	-30.5	99.94	-30.5	0.00	99.94	-30.5	0.00	99.94	-30.5	0.00
Bus1A	100.44	-61.3	100.44	-61.3	0.00	100.44	-61.3	0.00	100.44	-61.3	0.00
Bus1B	98.52	-63.1	98.52	-63.1	0.00	98.52	-63.1	0.00	98.52	-63.1	0.00
Bus2	100.00	-30.3	100.00	-30.3	0.00	100.00	-30.3	0.00	100.00	-30.3	0.00
Bus2A	97.94	-92.5	97.94	-92.5	0.00	97.94	-92.5	0.00	97.94	-92.5	0.00
Bus2B	96.49	-94.3	96.49	-94.3	0.00	96.49	-94.3	0.00	96.49	-94.3	0.00

Table 1: Bus Voltage Comparison for Load Flow method against published results (compared with Table 9 in IEEE 3002.2-2018)

COMPARISON BETWEEN ETAP AND REFERENCE FOR LOAD FLOW															
From BUS	To BUS	REFERENCE		ETAP											
				ANR				NR				FD			
		MW	MVAR	MW	Mvar	% Diff MW	%Diff Mvar	MW	Mvar	% Diff MW	%Diff Mvar	MW	Mvar	% Diff MW	%Diff Mvar
B1	Bus A	-2.68	-5.42	-2.68	-5.41	0.00	-0.18	-2.68	-5.41	0.00	-0.18	-2.68	-5.41	0.00	-0.18
B1	N28	2.67	8.22	2.67	8.22	0.00	0.00	2.67	8.22	0.00	0.00	2.67	8.22	0.00	0.00
B1	filters	0.00	-2.80	0.00	-2.81	0.00	0.36	0.00	-2.81	0.00	0.36	0.00	-2.81	0.00	0.36
Bus 1A	N21	-0.47	-0.33	-0.47	-0.33	0.00	0.00	-0.47	-0.33	0.00	0.00	-0.47	-0.33	0.00	0.00
Bus 1A	Bus 2A	0.46	0.39	0.46	0.39	0.00	0.00	0.46	0.39	0.00	0.00	0.46	0.39	0.00	0.00
Bus 1B	N22	-1.58	-0.56	-1.58	-0.56	0.00	0.00	-1.58	-0.56	0.00	0.00	-1.58	-0.56	0.00	0.00
Bus 1B	Bus 2B	0.42	0.29	0.42	0.29	0.00	0.00	0.42	0.29	0.71	0.00	0.42	0.29	0.00	0.00
Bus2	Bus B	-2.04	-0.94	-2.04	-0.94	0.00	0.00	-2.04	-0.94	0.00	0.00	-2.04	-0.94	0.00	0.00
Bus2A	Bus 1A	-0.46	-0.37	-0.46	-0.37	0.00	0.00	-0.46	-0.37	0.00	0.00	-0.46	-0.37	0.00	0.00
Bus2A	UPS1	0.03	0.02	0.03	0.02	0.00	0.00	0.03	0.02	0.00	0.00	0.03	0.02	0.00	0.00
Bus2B	Bus 1B	-0.42	-0.28	-0.42	-0.28	0.00	0.00	-0.42	-0.28	0.00	0.00	-0.42	-0.28	0.00	0.00
Bus2B	UPS2	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00

Table 2: Power Flow Comparison for Load Flow method against published results (compared with Table 9 in IEEE 3002.2-2018)

### Reference

1. "IEEE Recommended Practice for Conducting Load-Flow Studies and Analysis of Industrial and Commercial Power Systems," in *IEEE Std 3002.2-2018*, pp.1-73, 12 Nov. 2018
2. ETAP Software Example: \Example-Other\IEEE 3002 System

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