

Load Flow Comparison Case # 2

Comparison of Load Flow Results against a Published Example

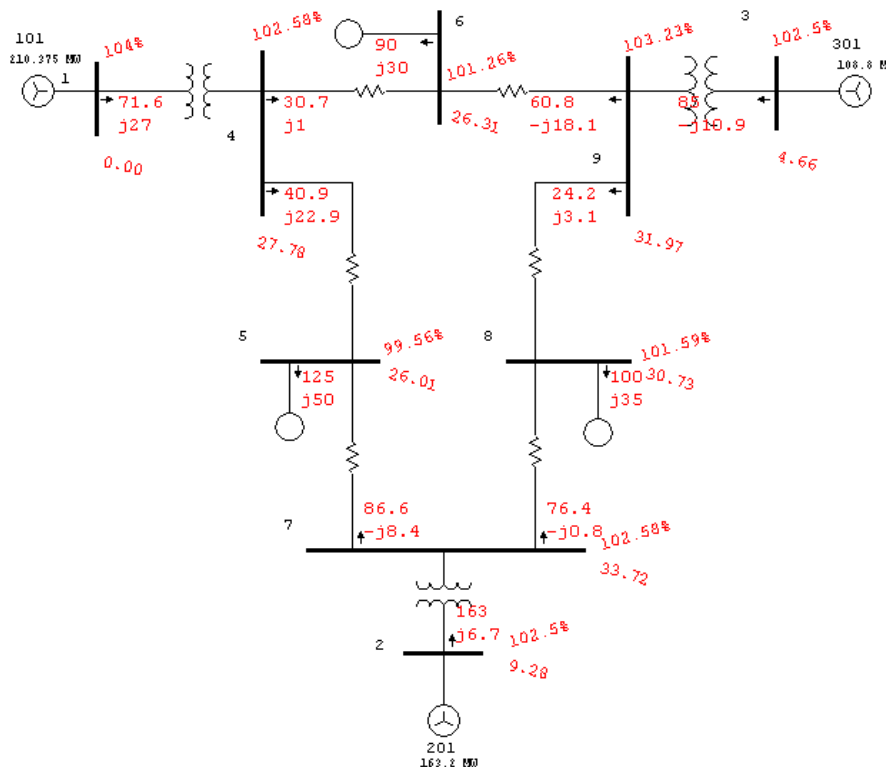
Excerpts from Validation Cases and Comparison Results (TCS-LF-008)

Highlights

- Comparison between ETAP Load Flow (LF) results against those published in the textbook “Power System Control and Stability” by P.M. Anderson and A.A. Fouad, page 38.
- Comparison of prefault load flow results (steady state initial load flow conditions for a Transient Stability Study).
- Nine bus system with multiple machines and generators.
- Simulation includes the three Load Flow methods.
- The difference in the results is less than 1% for all bus voltages and power flows.

System Description

This is a nine-bus system that is composed multiple machines including induction motors and synchronous generators.



Comparison of Results

The following tables of comparison show the differences between ETAP Results and those published in the textbook example. Please notice that the percent difference for all branch flows and bus voltages is less than 1%.

BUS	REFERENCE		ETAP								
			AGS			NR			FD		
#	% Mag.	Ang.	% Mag.	Ang.	% Diff Mag	% Mag.	Ang.	% Diff Mag	% Mag.	Ang.	% Diff Mag
1	104	0	104	0	0.0	104	0	0.0	104	0	0.0
2	102.5	9.3	102.5	9.3	0.0	102.5	9.3	0.0	102.5	9.3	0.0
3	102.5	4.7	102.5	4.7	0.0	102.5	4.7	0.0	102.5	4.7	0.0
4	102.6	27.8	102.58	27.8	0.0	102.58	27.8	0.0	102.58	27.8	0.0
5	99.6	26	99.56	26	0.0	99.56	26	0.0	99.56	26	0.0
6	101.3	26.3	101.26	26.3	0.0	101.26	26.3	0.0	101.26	26.3	0.0
7	102.6	33.7	102.58	33.7	0.0	102.58	33.7	0.0	102.58	33.7	0.0
8	101.6	30.7	101.59	30.7	0.0	101.59	30.7	0.0	101.59	30.7	0.0
9	103.2	32	103.23	32	0.0	103.23	32	0.0	103.23	32	0.0

Table 3: Comparison of ETAP Bus Voltage Results against those published in the Textbook Example.

From	To	REFERENCE		ETAP											
BUS	BUS			AGS				NR				FD			
#	#	MW	Mvar	MW	Mvar	% Diff MW	% Diff Mvar	MW	Mvar	% Diff MW	% Diff Mvar	MW	Mvar	% Diff MW	% Diff Mvar
1	4	71.6	27	71.64	27.05	-0.1	-0.2	71.64	27.05	-0.1	-0.2	71.64	27.05	-0.1	-0.2
2	7	163	6.7	163	6.65	0.0	0.8	163	6.65	0.0	0.8	163	6.65	0.0	0.8
3	9	85	-10.9	85	-10.86	0.0	0.4	85	-10.9	0.0	0.4	85	-10.86	0.0	0.4
4	5	40.9	22.9	40.49	22.89	1.0	0.0	40.49	22.89	1.0	0.0	40.49	22.89	1.0	0.0
4	6	30.7	1.03	30.7	1.03	0.0	0.0	30.7	1.03	0.0	0.0	30.7	1.03	0.0	0.0
6	9	-59.5	-13.5	-59.46	-13.46	0.0	0.0	-59.46	-13.5	0.0	0.0	-59.46	-13.46	0.0	0.0
7	5	86.6	-8.4	86.62	-8.38	0.0	0.2	86.62	-8.38	0.0	0.2	86.62	-8.38	0.0	0.2
7	8	76.4	-0.8	76.38	-0.8	0.0	0.0	76.38	-0.8	0.0	0.0	76.38	-0.8	0.0	0.0
8	9	-24.1	-24.3	-24.1	-24.3	0.0	0.0	-24.1	-24.3	0.0	0.0	-24.1	-24.3	0.0	0.0
9	8	24.2	3.12	24.18	3.12	0.1	0.0	24.18	3.12	0.1	0.0	24.18	3.12	0.1	0.0

Table 4: Comparison of ETAP LF Power Flows against published Textbook Results.

Reference:

1. "Power System Control and Stability", P.M. Anderson and A.A. Fouad, page 38.
2. ETAP Load Flow V&V Documents, Case Number TCS-LF-008.