Lab # 06

Load Flow Analysis of Single line diagram

In this lab we will first implement/design the single line diagram in ETAP and then calculate load flow analysis. In the right side of etap we have element toolbar. Click on the Power grid icon one time and drag it.

Now click on the bus and drag it in the workspace.

Bus1 0 kV

Now click on the two winding transformer.

T1 0 MVA

And then drag another bus. Also click on the motor and drag it in the one line diagram.

O Mtr1 0 kW

Now to connect the pins we have three separate options. First you can find the connection pin at the end of one element click it once and extend it to the other element you are connecting to. The second way is to click on the element in simple way and drag it to the element you are connecting to. The final way is to double click on the element section and in the info section you have to specify the bus you are going to be connecting to. So you final single line diagram will be like this.



Now after this we enter the data for each element in this single line diagram and to run Load flow calculation. We will first start by entering the data in the transformer by double clicking the transformer icon and then click on the rating tab.

	Reliability		Remarks		Comment
Info	Rating In	npedance Ta	ap Grounding	Sizing	Protection Harmoni
0 MVA	IEC Liquid-Fill (Other 65 C			0 0 kV
-Voltage Prim Sec	Rating kV	FLA		Bus kVnom 0 0	Z Base MVA 0
Power F	Rating				Alert - Max
Ra Derai	MVA 0 Other 65 red 0				MVA 0 © Derated MVA @ User-Defined
% Dera	ting 0				Installation Atitude 1000 m Ambient Temp.
	М	FR			30 C
Type / (Class Type Fill •	Sub Other	Type • Oth	Class	Temp. Rise

We will enter 13.8 kV in the Primary and for the secondary we will enter 14.6 KV and also enter the rated MVA as 10. When you enter the MVA rating you will notice that the etap automatically set the Max MVA to 10 and calculate the full load amps FLA primary and secondary.

Reliability		Comment			
Info Rating Imped	lance Tap	Grounding	Sizing	Protection	Harmonie
10 MVA IEC Liquid-Fill Oth	er 65 C			13.8 1	4.6 kV
Voltage Rating kV Prim.	FLA 418.4 395.4	B	us kVnom 0 0	Z Base M	VA IO
Power Rating	Other 65			Alert - Max	
MVA Rated 10 Other 65 Derated 10				M 1 O Derated O User-Def	VA 0 MVA ined
% Derating 0				Installation Attitu 10 Ambie	ude 00 m nt Temp.
MFR				3	0°℃
Туре	Sub Type		Class	Te	mp. Rise
Liquid-Fill 👻	Other	- Othe	-	-	5 -

ETAP also provide typical values for various parameters. For example go to impedance page and click on the typical Z & X/R button. You will notice that the etap populate the %Z impedance and X/R ratio for transformer. Next select OK.

	Reliability		Rer	marks	Comment	
Info	Rating	Impedance	Tap	Grounding	Sizing	Protection Harmonic
10 MVA	IEC Liquid-	Fill Other 65 C				13.8 14.6 kV
Impedance	e					Z Base
	%Z	X/R	R/X	%X	%R	
Positive	8.35	13	0.077	8.325	0.64	MVA
-	0.25	12	0.077	0.005		10
Zero	0.35	13	0.077	8.325	0.64	OOther 65
	Typical	Z & X/R	Typical X/R			
Z Variatio	n					Z Tolerance
			%Z	% Z Va	nation	
@	@ -5 % Tap		8.35 0			+ 0 *
@	5 %	Тар	8.35	0)	- 0 *
No Load	Test Data (U	sed for Unbalar	ced Load Flo	w only)		
		% FLA	kW		% G	% B
Po	ositive	0	0		0	0
	Zero	0	0		0	0
	Delta Windi		Zero Sea	. Impedance		Typical Value

Now you will see that in the single line diagram both the bus 1 and bus 2 values will automatically updated.



Now enter the data in the Power Grid. Double click the power grid icon and go to its rating page. Here you will see that etap will automatically update the nominal voltage for this element.

Po	wer Grid Editor - U1							×				
6	Info	Rating Short (Circuit H	amonic	Reliability	Energy	Price E	emarks	Comment			
ľ												
	13.8 kV Swing											
		Rated k	V	13.8	() E	Balanced	🔘 Uni	balanced				
			,					-		_		
		Gen. Cat.	%V	Vangle	MW	Mvar	%PF	Qmax	Qmin			
	1	Design	100	0								
	2	Nomal	100	0								
	3	Shutdown	100	0								
	5	Standby	100	0								
	6	Startup	100	0								
	7	Accident	100	Ō								
	8	Summer Load	100	0								
	9	Winter Load	100	0								
	10	Gen Cat 10	100	0								
	— Ор	erating										
			% V	Vang	le	MW	Mvar					
			0	0		0	0					
		🗈 🔞 🔽		U1						OK	Cancel	
				•••								

Now double click on the induction machine and go to the name plate page. Here we will see that the rated voltage will automatically be selected as standard rating. Now enter the KW power for this element. The KW power we will be entering is 500. When we enter this value and click outside the box etap will automatically update the Power factor its efficiency the full load amps and the other data.

W 14.6 kV	Imp	Model	Inertia	Load	I Star	t Dev	Start Cat
W 14.6 kV					Cabl	e lefe eet	
						e mio not	available
Other	-	F	FL		NL	0	L
		10	/0% 75%	۰ 50 %	0 %	10	0 %
500 kV	14.6	% PF 9/	2.2 92.2	92.2	0	0	
581 FLA	22.97	% Eff 93	3.37 93.3	7 93.37	0	0	
	%	FLA 1	00 75	50	0	10	0
0.05 RPM	1499	Poles	4 RPM	1500		SF 1	
ary			None				
			Moto	r Load	Feed	er Loss	
ading Category	% Loading	kW	kW	kvar	kW	kvar	
sign	100	500	535.5	224.9	0	0	
mal	90	450	482	202.4	0	0	
ake	0	0	0	0	0	0	
	-	-	-			0	
nter Load	0	0	0	0	U	0	
nter Load mmer Load	0	0	0	0	0	0	
	500 kV 581 FLA 0.05 RPM ary	500 kV 14.6 581 FLA 22.97 %I 0.05 RPM 1499 ary	500 kV 14.6 % PF 9 581 FLA 22.97 % Eff 93 %FLA 1 0.05 RPM 1499 Poles any	500 kV 14.6 % PF 92.2 92.2 581 FLA 22.97 % Eff 93.37 93.3 %FLA 100 75 0.05 RPM 1499 Poles 4 RPM ary None Moto sigin 100 500 535.5 mmal 90 450 482	500 kV 14.6 % PF 92.2 92.2 92.2 581 FLA 22.97 % Eff 93.37 93.37 93.37 %FLA 100 75 50 0.05 RPM 1499 Poles 4 RPM 1500 ary None Motor Load ading Category % Loading kW kvar 90 450 482 202.4	500 kV 14.6 % PF 92.2 92.2 92.2 0 581 FLA 22.97 % Eff 93.37 93.37 0 % FLA 100 75 50 0 0.05 RPM 1499 Poles 4 RPM 1500 my None Motor Load Feed ading Category % Loading kW kWare kW mmal 90 450 482 202.4 0	500 kV 14.6 % PF 92.2 92.2 92.2 0 0 581 FLA 22.97 % Eff 93.37 93.37 0 0 0 ½FLA 100 75 50 0 10 0.05 RPM 1499 Poles 4 RPM 1500 SF 1 ary None None Motor Load Feeder Loss ading Category % Loading kW kwar kW kvar 90 450 482 202.4 0 0

Now we have entered all the necessary data and ready for the load flow analysis. Click on the load flow icon on the left corner.



And then click on the right side corner run load flow analysis.

Î	P→ q↓
Run Loa	d Flow

When you click on it will ask you report name so enter LFA for load flow. Then click OK ETAP will show you the calculation and the result of the single line diagram.



Lab Task:

Design the single line diagram as explain in the lab with different ratings and specifications.

Marks Obtained:

Remarks: