

# **KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 0**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 10 % and consider 0.9 p.f.

### **Due Dates:**

- 1) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

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## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 1**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 12 % and consider 0.9 p.f.

### **Due Dates:**

- 2) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

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## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 2**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 10 % and consider 0.93 p.f.

### **Due Dates:**

- 3) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

# **KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 3**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 8 % and consider 0.92 p.f.

### **Due Dates:**

- 4) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

# **KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 4**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 14 % and consider 0.92 p.f.

### **Due Dates:**

- 5) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

# **KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 5**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 14 % and consider 0.87 p.f.

### **Due Dates:**

- 6) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

# **KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

## **ELECTRICAL ENGINEERING DEPARTMENT**

**EE-520 (992)**

**Dr. Ibrahim O. Habiballah**

**Power Plant Expansion Project**

**Version 6**

The aim of this project is to extend the generation capacity at a Power Plant Company (PPC). PPC system is fed mainly by three gas turbines 21 MVA each, operating at 60 HZ. Two generating units, of 31 MVA each, are to be added to the existing plant. The five generators should be able to supply up to 105 MW of power with acceptable voltage profile (i.e., within 95 and 105 percent of the rated value).

Load flow and short circuit studies must be conducted for many system loads at various power factors. It is required to check the adequacy of the existing and proposed equipment under various operating conditions. The data of the existing and expanded PPC system are given in Tables 1 and 2, respectively.

### **Load Conditions:**

Increase all loads by 15 % and consider 0.86 p.f.

### **Due Dates:**

- 7) Submission of Load Flow preliminary output results (Due April 3).
- 2) Submission of Load Flow complete output results (Due April 10).
- 3) Submission of Short Circuit preliminary output results (Due April 17).
- 4) Submission of Short Circuit complete output results (Due April 27).
- 5) Submission of final project report (Due May 1st).

Table 1a. Existing PPC Bus data (Load p.f. = 0.8)

#	NAME	TYPE	KV	PL MW	QL MVAR	PG MW	QMAX	QMIN
1	GT1	SW	13.80	0.00	0.00	0.00	30.00	-30.00
2	GT2	GEN	13.80	0.00	0.00	17.00	30.00	-30.00
3	GT3	GEN	13.80	0.00	0.00	17.00	30.00	-30.00
4	33KVMA	LOAD	33.00	0.00	0.00	0.00	0.00	0.00
5	SWBUS1	LOAD	13.80	0.00	0.00	0.00	0.00	0.00
6	SWBUS2	LOAD	13.80	0.00	0.00	0.00	0.00	0.00
7	KHALID	LOAD	33.00	23.00	17.25	0.00	0.00	0.00
8	FAISAL	LOAD	33.00	23.00	17.25	0.00	0.00	0.00
9	FARM	LOAD	33.00	1.00	0.75	0.00	0.00	0.00
10	ARAMCO	LOAD	13.80	3.00	2.25	0.00	0.00	0.00
11	COLLEG	LOAD	13.80	1.00	0.75	0.00	0.00	0.00
12	33KVMA	LOAD	33.00	0.00	0.00	0.00	0.00	0.00
15	SW4601	LOAD	0.46	0.08	0.06	0.00	0.00	0.00
16	SW4602	LOAD	0.46	0.08	0.06	0.00	0.00	0.00

Table 1b. Existing PPC Line data (on 100 MVA base)

FROM	TO	C#	R	p.u.	X	p.u.	B	p.u.	FROM KV	TO KV	TAP	MVA
1	4	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
2	12	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
3	4	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
4	5	1	0.00600	0.14988	0.00000	33.00000	13.80000	1.00000	5			
4	7	1	0.02299	0.08607	0.00279							
4	7	2	0.02299	0.08607	0.00279							
4	9	1	0.17815	0.35853	0.01206							
4	12	1	0.00000	0.00001	0.00000							
5	10	1	0.20374	0.41004	0.00042							
5	15	1	0.04996	1.24900	0.00000	13.80000	0.46000	1.00000	1			
6	11	1	0.09168	0.18452	0.00019							
6	16	1	0.04996	1.24900	0.00000	13.80000	0.46000	1.00000	1			
12	6	1	0.00600	0.14988	.0.0	33.00000	13.80000	1.00000	5			
12	8	1	0.02508	0.09389	0.00305							
12	8	2	0.02508	0.09389	0.00305							

Table 1c. Existing PPC Machine data (on the machine base)

BUS	R	p.u.	KV	MVA	X	p.u.	X'	p.u.	X''	p.u.
GT1	.04	13.800	21.000	1.971	0.191	0.135				
GT2	.04	13.800	21.000	1.971	0.191	0.135				
GT3	.04	13.800	21.000	1.971	0.191	0.135				



Table 2a. Expanded PPC Bus data (Load p.f. = 0.8)

#	NAME	TYPE	KV	PL MW	QL MVAR	PG MW	QMAX	QMIN
1	GT1	GEN	13.80	0.00	0.00	17.00	30.00	-30.00
2	GT2	GEN	13.80	0.00	0.00	17.00	30.00	-30.00
3	GT3	GEN	13.80	0.00	0.00	17.00	30.00	-30.00
4	33KVMA	LOAD	33.00	0.00	0.00	0.00	0.00	0.00
5	SWBUS1	LOAD	13.80	0.00	0.00	0.00	0.00	0.00
6	SWBUS2	LOAD	13.80	0.00	0.00	0.00	0.00	0.00
7	KHALID	LOAD	33.00	43.00	32.25	0.00	0.00	0.00
8	FAISAL	LOAD	33.00	43.00	32.25	0.00	0.00	0.00
9	FARM	LOAD	33.00	2.00	1.50	0.00	0.00	0.00
10	ARAMCO	LOAD	13.80	4.00	3.00	0.00	0.00	0.00
11	COLLEG	LOAD	13.80	2.00	1.50	0.00	0.00	0.00
12	33KVMA	LOAD	33.00	0.00	0.00	0.00	0.00	0.00
13	NGEN1	SW	13.80	0.00	0.00	0.00	30.00	-30.00
14	NGEN2	GEN	13.80	0.00	0.00	25.00	30.00	-30.00
15	SW4601	LOAD	0.46	0.08	0.06	0.00	0.00	0.00
16	SW4602	LOAD	0.46	0.08	0.06	0.00	0.00	0.00

Table 2b. Expanded PPC Line data (on 100 MVA base)

FROM	TO	C#	R	p.u.	X	p.u.	B	p.u.	FROM KV	TO KV	TAP	MVA
1	4	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
2	12	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
3	4	1	0.00288	0.07206	0.00000	13.80000	33.00000	1.00000	30			
4	5	1	0.00600	0.14988	0.00000	33.00000	13.80000	1.00000	5			
4	7	1	0.02299	0.08607	0.00279							
4	7	2	0.02299	0.08607	0.00279							
4	9	1	0.17815	0.35853	0.01206							
4	12	1	0.00000	0.00001	0.00000							
5	10	1	0.20374	0.41004	0.00042							
5	15	1	0.04996	1.24900	0.00000	13.80000	0.46000	1.00000	1			
6	11	1	0.09168	0.18452	0.00019							
6	16	1	0.04996	1.24900	0.00000	13.80000	0.46000	1.00000	1			
12	6	1	0.00600	0.14988	.0.0	33.00000	13.80000	1.00000	5			
12	8	1	0.02508	0.09389	0.00305							
12	8	2	0.02508	0.09389	0.00305							
13	4	1	0.00153	0.03830	0.00000	13.80000	33.00000	1.00000	35			
14	12	1	0.00153	0.03830	0.00000	13.80000	33.00000	1.00000	35			

Table 2c. Expanded PPC Machine data (on the machine base)

BUS	R	p.u.	KV	MVA	X	p.u.	X'	p.u.	X''	p.u.
GT1	.04	13.800	21.000	1.971	0.191	0.135				
GT2	.04	13.800	21.000	1.971	0.191	0.135				
GT3	.04	13.800	21.000	1.971	0.191	0.135				
NGT1	.04	13.800	31.000	1.971	0.191	0.135				
NGT2	.04	13.800	31.000	1.971	0.191	0.135				