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ENERGY CRITERIA FOR IRANIAN POWER PLANT

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Abstract- In this paper, energy ranking is suggested for Iranian power plants. The method describe how to measuring efficiency of power plant and allocate energy labeling for it. First three categories of thermal power plants are selected (steam, gas and combined cycle). For every power plant is defended energy efficiency by using input, output method. Ultimately, the policies in Iran's energy sector and international standards, energy labels are looking design is using its 59 thermal power plants existing 23 plants (38%) Category Energy G, 20 plants (34%) Category energy F, 12 plants (20%) Category energy E received also four plants (8%) unsuccessful energy labeling and must get out the network. If the efficiency of power plant approaches to 85 percent the allocation ranking of A referred to this power plant. Ranking A for power plant shows that this power plant would be CHP (combine heat and power).

Keywords: Efficiency Criteria, Thermal Power Plants, Thermal Value of Fuel.

I. INTRODUCTION

Moreover, power plants use fossil in Iran. Now, power plants are important consumers of the fuel in industry, such as gas. In general, share of energy carrier in power plant includes to 13% Diesel fuel, 46% of crude oil, 31% of natural gas from of total energy consumption of IRAN. The average efficiency of power plants includes Energy Department, private sector and large industries, 36.5%, 33.5% and 29.5% respectively. On the other hand, efficiency of power plant are 36/3% for steam power plants 28/9% for gag power plant, 44/5% for combined cycle and 34/3% for Diesel power plant. In view of the fact that, the efficiency of power plant are very low in comparison with developed countries. In order word, determining of energy efficiency and energy ranking in power plants is necessary.

It is required to calculate the efficiency of power plants with the best method and to audit energy efficiency and to optimize power plant. Therefore, in this paper is determined the standard methods for calculating efficiency of all three types of thermal power plants can be expressed separately and then measure performance separately for each plant.

Thermal power plants have different thermodynamic cycles can be done. Steam power plants have Rankin cycle, and for gas power plants have Brighton cycle and finally for combined cycle power plants, include a combination of these cycles.

Considering the difference in efficiency of each of these ideal thermodynamic cycles include, not only the expected return criteria for each type of thermal power plants vary, but the different designs, each of the main components affecting efficiency units, each particular plant, and also location and consequently the establishment of plants in different environmental conditions that affect the efficiency of power plant units, the expected return criteria for each plant is also different.

In addition to the above other factors, including plant life cycle, the quality of each power plant technology and equipment, and facilities operation and maintenance of the efficiency of thermal power units are effective. Conclude from all these results is that the standard thermal efficiency in power plants for each plant should be specifically determined by this criterion based on various factors including the type of plant, plant design parameters, location, plant life, technology and any plant and equipment facilities operation and maintenance of power plant.

II. ENERGY EFFICIENCY CRITERIA FOR POWER PLANTS

Criteria energy provided for each type of power plants as that may include the following:

- Efficiency of the current status of each plant to the information provided
- Rate deviation from the expected position for planning to improve efficiency.

The criteria for compiling the following information are extracted:

A) The net design efficiency: Based on the technical information obtained from the plant or using modeling software for example Thermo Flow

B) The amount of deviation allowed efficient design: Applying coefficients life cycle, operation, maintenance and technology obtained and the fact that some power plants between 2000 to 2006 years in two periods (10 years of operation, the second 10 years or third) were changed and the coefficient for each of the life of this era, for those two values obtained for the coefficient C Factor and editing criteria are used.

C) Expected range of net plant efficiency: The low range value obtained by multiplying the efficiency of the C Factor and design limit is the amount of design efficiency
D) Current gross efficiency: using information provided in reports produced for the amount of net product during the period considered is calculated
E) Net current efficiency: using information provided in the report produced for the amount of net production during the period considered is calculated.

What criteria developed for power plant efficiency must be considered is that given the diversity of technology in power plants has a wide range, power plants classified as general and limited to several groups developed the same criterion for their practical terms is impossible. If the realization of this wide range of medium should be considered in that case also planning to improve efficiency of care would not be appropriate. Therefore, this report efficiency of each power plant shall have been developed by comparison with its own power and according to that index, and energy efficiency standards for power plants.

Determine the efficiency of power plants following parameters is required.
- Net energy output of the generator unit: Net energy output generator unit consists of gross energy output from the generator unit uses less energy internal electrical excitation unit and generator system, according to KW hr.
- Net output power generator unit: Net power output generator unit is to be minus gross exit generator unit power unit and generator system excitation, according to KW.

Fuel lower heating value (LHV): for liquid fuel and gas, lower heating value of fuel constant pressure heat from fuel combustion unit mass at constant pressure is defined as a situation where all of the water vapor phase during the combustion process is needed.

A. Determine the Efficiency Criteria for Gas Plants

Determine the efficiency of gas power plants following parameters are required: Efficiency (yield) of pure thermal unit, efficiency (yield) of pure thermal unit consists of net energy ratio of output generator unit, the total heat into the gas turbine or other definition of net output power generator unit to the incoming gas turbine heat rate.

Net thermal efficiency of unit = (1)

$$\frac{\text{Output Net Energy of the Unit Generator(Kw hr)} \times 3600}{\text{Heat Entered into the Gas Turbine(kJ)}}$$

Net thermal efficiency of unit= (2)

$$\frac{\text{Output Net Power of the Unit Generator(Kw)}}{\text{Heat Rate Entered into the Gas Turbine (kJ/sec)}}$$

Heated by gas turbine:
A gas turbine, heating is to heat resulting from fuel combustion in gas turbine combustion chamber is calculated as follows.
For the liquid fuel and gas:
Heat Entered into the Gas Turbine (kJ) = Low Heat Value of Fuel (kJ/kg) × Fuel Consumption (kg) (3)

If the temperature of liquid fuel temperature measurements of liquid fuel heating value (25°C) is different from the conditions entered into the turbine heat gas obtained from the following relationship:
Heat Entered into the Gas Turbine (kJ) = Low Heat Value of Fuel (kJ/kg) × Fuel Consumption (kg) + SH_p (4)
SH_p = Liquid Fuel Consumption (kg) $\times (h - h_{25})$ (5)
where
h: Specific enthalpy of liquid fuel in operating temperature (kJ/kg)
h_{25}: Specific enthalpy of liquid fuel (25°C)

If the gas temperature and pressure measurements of temperature and pressure gas convection (15°C and 1 atmosphere) vary the conditions of heat into the gas turbine to be obtained from the following relationship:
Heat Entered into the Gas Turbine (kJ) = Low Heat Value of Fuel (kJ/kg) × Fuel Consumption (kg) + SH_p (6)
SH_p = Gas Fuel Consumption (kg) $\times (h - h_{g,b})$ (7)
h: Specific enthalpy of gas fuel in operating temperature (kJ/kg)
$h_{g,b}$: Specific enthalpy of gas fuel under standard conditions

Turbine heat rate into the gas: the rate of heat into the gas turbine is to heat resulting from fuel combustion per unit time (sec) is calculated as follows:
For liquid fuel and gas:
Heat Rate Entered into Gas Turbine (kJ/sec) = Low Heat Value of Fuel (kJ/kg) × Rate of Fuel Consumption (kg/sec) (8)

If the temperature of liquid fuel temperature measurements of liquid fuel heating value (25°C) vary in the rate of heat into the gas turbine to be obtained from the following relationship:
Heat Rate Entered into Gas Turbine (kJ/sec) = Low Heat Value of Fuel (kJ/kg) × rate of Fuel Consumption (kg/sec) + SH_p (kg/sec) (9)
SH_p = Rate of Liquid Fuel Consumption (kg) $\times (h - h_{25})$ (10)

If the gas temperature and pressure measurements of temperature and pressure of fuel gas heating value (15°C and 1 atmosphere) vary the rate of heat into the gas turbine to be obtained from the following relationship:
Heat Rate Entered into Gas Turbine (kJ/sec) = Low Heat Value of Fuel (kJ/kg) × Rate of Fuel Consumption (kg/sec) + SH_p (kg/sec) (11)
SH_p = Rate of Gas Fuel Consumption (kg) $\times (h - h_{g,b})$ (12)

To calculate the efficiency (yield) of pure thermal units of gas can be used in two ways:

- Direct method of energy input and output (Input-Output)
- Indirect method thermodynamic calculations by writing heat balance for the complex set of volume controlled gas turbine (turbine, compressor, combustion chamber) and the shaft can be calculated from this relationship.

Shaft can be calculated from the relationship between generator output power, shaft power calculated by multiplying the product Randmanhay Tjhzat generator and main transitions (Main Transmission Gearing) - documents extracted from the manufacturer - will be achieved.

The frequency and duration of experiment: In order to test the efficiency should be measured in three consecutive times that each should not be less than 5 minutes and more than 20 minutes is performed. The total test time is less than 15 minutes and not more than 60 minutes.

That required as the relationship listed in Section A shows the measured efficiency (yield) of pure thermal units following information is required:
- Net energy output from the generator / (Kwh) power generator net output (KW) - Fuel consumption of liquid / gas (Kg) or fuel consumption rate of liquid / gas.
- Heating value liquid fuel / gas In addition, information availability information unit manufacturer, including changes in times and the efficiency curve with changes of temperature, pressure, and humidity is essential for test results to the reference conditions specified is correct.

To determine the efficiency (efficiency) is required to plant monthly reports daily the following parameters were measured and the accuracy of reporting.

- Average daily temperature
- Fuel consumption separately for each type of fuel
- The total net electricity production unit
- Average unit load

Based on this information efficiency (efficiency) the average monthly temperature, using the relationship of (13) should be calculated.

$$\text{Average Thermal Efficiency of the Month} = \frac{\text{Total Net Electrical Energy Produced Per Unit during the Month}}{\text{Low Heat Value of Gas Fuel (kJ/kg)} \times \text{Gas Consumption during the Month} + \text{Low Heat Value of Liquid Fuel (kJ/kg)} \times \text{Liquid Fuel Consumption during the Month}} \quad (13)$$

Information obtained from these measurements yield (efficiency) the average monthly per unit thermal power plants is calculated. The result of thermal efficiency calculation unit in the monthly mean temperature - the average daily temperature is calculated - and the average load measured during the month, shows way to determine the efficiency criterion (yield) of pure steam units in power plants.

B. Determine the Efficiency Criteria for Steam Power Plants

The energy labeling for steam power plant is similar to gas power plant so that, we ignore the explanation for other power plant.

C. Determine the Efficiency Criteria for Combined Cycle Power Plants

The energy labeling for combined cycle power plant is similar to gas power plant so that, we ignore the explanation for other power plant.

III. RESULTS

Also, the efficiency obtained according to production, based on the efficiency of existing power plants, they are classified. This classification simply based on power efficiency is presented and the type of plant that has no effect. The same issue has led to be based on efficiency and value regardless of the type of power plant efficiency of each plant types with different compared to single criterion.

This huge decision about the construction of each type of power plants is effective and this criterion can be invested for the construction of new power plants to the plants with higher efficiency lead. The classification of groups with high thermal efficiency has also been incorporated in the terms, if at the same time electricity and heat production systems were considered, the classification of high efficiency as well as to cover them. Classification was done in total six groups were defined.

20-30%	G
30-40%	F
40-50%	E
50-60%	D
60-70%	C
70-85%	B
85% up	A

Annual Efficiency		
2013	2009	
24.1	22.2	1
25.6	24.7	2
22.4	20.4	3
30.2	29.1	4
No labeling	18.9	5
22.8	20.8	6
30	23.8	7
28	20.8	8
23.3	22.4	9
23.1	21.2	10
24.3	23.2	11
23.7	21.9	12
24	23.6	13
24.5	23.4	14
25.4	24.9	15
27.6	26.3	16
23	21.3	17
35	28.4	18
No labeling	14.3	19
No labeling	11.7	20
No labeling	17.8	21

Annual Efficiency		
2013	2009	
24	22.1	1
31.2	29.1	2
37.1	36.2	3
36.2	34.9	4
37	36.6	5
26.7	25.3	6
34.9	32.4	7
38.1	37.8	8
40.3		9
37.8	36	10
37	36.1	11
36	35	12
37.1	35.2	13
40		14
41	39	15
37	**36.5**	16
31	30.1	17
39.8		18
39	38.2	19

Annual Efficiency		
2013	2009	
49.6	46.7	1
47.3	45.9	2
48.3	45.9	3
46.1	43.5	4
47.2	44.8	5
48	46.2	6
49.4	48.1	7
46.4	43	8
47	43.9	9
47.7	45.5	10
48.1	47.1	11
48	45	12

IV. CONCLUSIONS

It is resulted that:

- 4 of 31 existing gas power plants (12%) did not accept energy labeling because the efficiency of these power plant were less than 20% and should be out. 20 power plants (64%) has received Category G and 7 (23%) Category F.
- 3 of 19 steam power did not calibrate, therefore, the remaining 16 plants according to the Energy category label design, 13 plants (81%) Category F receive energy and three plants (19%) Category G Energy has received.
- All of combined cycle power plant has received E label
- So the 59 thermal powers available, which returns it obtained 23 plants (38%) Category Energy G, 20 plants (34%) Category Energy F, 12 plants (20%) Category energy E received the four plants (8%) did not receive any labeling.
- It is possible that improve energy efficiency power plant minimum 1.2% by execute the simple technical.

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BIOGRAPHIES

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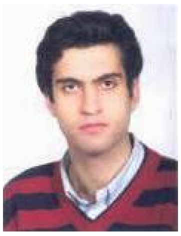

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