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Al-Baidar Center For Studies And Planning

A Feasibility Study Of The Iran To Iraq Natural Gas Pipeline

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Al-Baydar Center Publications for Studies and Planning

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A feasibility study of the Iran to Iraq natural gas pipeline

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Introduction

As part of its policy to provide electrical energy to consumers, the Ministry has developed a plan to build combined gas stations (gas + steam) to produce electrical power distributed over the governorates of Iraq. These power plants use various types of fuels to produce electric power: natural gas, gas oil, fuel oil, and crude oil.

It is evident that the best type of fuel to operate gas stations is natural gas to ensure that the production units operate with the highest efficiency, that no chemicals added to treat other fuels are needed, and that the units do not need additional maintenance operations.

By following up the Ministry of Oil plan, it seems that the infrastructure will not be able to meet the needs of power plants from natural gas for years to come, and with the aim of covering the deficit in the quantities of natural gas supplied to the gas stations in its simple cycle of operating and future units, the Ministry of Electricity has developed an urgent plan to import Gas oil or operating units on crude or heavy oil, which requires the use of any chemical additives whose value may reach (15) million dollars annually, "in addition to reducing the availability rate to 70%.

The attached pictures represent the effect of using crude and heavy oil on energy production units and to ensure the optimum operation of gas units and to save the sums spent on maintenance and chemicals when operating on other types offuels.



1. The proposed project

In light of the indicators of delay in investing the associated gas and preparing it to operate the electric power production stations and according to the fuel plan with the Ministry of Oil to equip it in 2014, which is still late in implementing its commitment to this year 2021. Where a start was made in 2009 in preparing feasibility studies and then obtaining approvals to equip some new and operating gas stations on natural gas imported from Iran, and the contract was signed in 2011 to construct the first line in the central region, whose feasibility study was adopted as the basis for the construction of a second line later in the southern region. The feasibility study was approved for the implementation of the first path of supplying gas with the following specifications:

• The length of the gas pipeline is 300 km, of which 12 km are within the Iranian borders.

- The diameter of the tube is 42 inches.
- Quantities of gas proposed to be transported at 800 mqm / day.

	plant	Installed Capacity (MW)
1	The old Doura gas power plant	4×25
2	The new Doura gas power plant	6×123
3	Al Qudes gas power plant	6×123 4×43
4	Al Sadder gas power plant	44×160
	Total installed capacity	2408

The following power plants proposed to run on imported gas are:

2. Conducting a preliminary technical and economic feasibility study for a project to construct a pipeline to transport natural gas from Iran to Iraq / Baghdad with a comparison of costs when operating units on different types of fuel. These costs include:

- Operating and Maintenance.
- Fuel (natural gas, gas oil, and crude oil).
- wasted energy.
- Construction of a natural gas pipeline.

3. Study proposals:

- Gas power plants operate by the following available capacities:
- w 85%on natural gas.w 75%when running on gas oil.w 60%on crude oil.

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• Periods of stopping for the purpose of washing (16) hours for every (168) operating hours when the unit is operating on crude oil.

- The cost of one liter of imported gas oil, along with transportation costs.
- = Gas oil price + Transportation price.

= 51 + 13 = 64 cents / liter.

- The price of imported gas according to the world market is 15 cents / m3.
- The price of crude oil per barrel is \$ 60, or 38 cents / liter.
- The cost of chemical additives is (0.5) cents to produce a KWh

• The maintenance cost of gas units when operating on gasoil fuel is equivalent to (1.5) times the cost of maintaining them when operating on natural gas fuel, and when operating on crude oil fuel is equivalent to (2.25) times the cost of maintaining them when operating on natural gas fuel.

• The lost energy cost (3) cents per KWh

4. Study methodology

4.1 Calculation of the available energy to the proposed plants when operating on different types of fuels:

	The old Doura gas power plant is 4×25 MW	
Total design capabilities of the	The new Doura gas power plant is 6×123 MW	The total installed capacities is 2388 MW
stations	Al Sadder gas power plant is 4×160 MW	
	Al Qudes 6 × 123	
	4 × 43 MW	

Available capacities when operating stations with natural gas	0.85 × 2388 = 2030 MW
The available capacities when operating the stations with gas oil	0.75 × 2388 = 1790 MW
The available capacities when operating the stations with crude oil	0.6 × 2388 = 1432 MW.

4.2. The calculation of operation and maintenance costs

The calculation of the operation and maintenance costs depends on the costs of the added chemicals and the spare material costs required to perform the maintenance operations when operating on various fuels (the cost of the added chemicals as previously mentioned is "(0.5 cent / kWh).

The operating and maintenance costs for each generating unit are estimated at (5) million dollars for one time for the GE Frame 9 units and Siemens 94.2 V units of capacities of 123 MW and 160 MW respectively.

The total cost of maintenance of the (5) million dollars can be approached for one maintenance cycle for each (150) megawatts. Accordingly, the costs that can be approved for the purposes of operation and maintenance and for different fuels are as follow:

The total cost of one-time operation and maintenance for all stations when operating with natural gas:	$\frac{\text{Installed capacity} \times 5}{150} = \frac{5 \times 2388}{150}$ = 80 million US Dollars
The total cost of operating and maintenance for all power plants operating with gas oil:	80×1.5 = 120 million US Dollars
The total cost of operating and maintenance for all power plants operating with crude oil:	80 × 2.25 = 180 million US Dollars

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Based on what was mentioned above, the maintenance cost to produce per kilowatt/hour when working with different fuels can be calculated as follows.

True of friel	operation and maintenance costs		
1 ype of fuer	(Total maintenance amount in Dollar / annual energy production KWh)		
Gas oil	$\frac{120 \text{ million Dollar}}{1790 \times 8760} = 0.77 \text{ cent per KWh}$		
	180 million Dollar		
Crude oil	1432×876 = 1.4 + 0.5 = 1.9 cents per kWh		
Natural gas	80 million Dollar		
	2030×8760 = 0.45 cent per kWh		

4.3.Calculate the cost of fuel

As mentioned in the introduction, the following world prices for fuel have been adopted:

Natural gas = 15 cents / m3.

Gas oil + transport = 64 cents / liter.

Crude Oil = 38 cents / liter.

For the purpose of calculating the cost of producing a kilowatt. Hourly for all fuels, it has been assumed that the amount of fuel consumption for producing kilowatt/ hour of fuel is equal and is estimated at (0.3) liters for gas oil and crude oil and (0.3) m3 per kWh for natural gas.

In light of the above data, the fuel cost required to produce one kilowatt/ hour and according to the type of fuel will be as follows:

	Type of fuel	the cost is in cent per KWh
1	Natural gas	15× 0.3 = 4.5
2	Gas oil	64 × 0.3 = 19
3	Crude oil	38 × 0.3 = 11.4

4.4. Calculation of the cost of lost energy

The rate of the lost energy price when operating the units can be counted up to 3 cents per kilowatt hour. This figure has been adopted as a result of previous experiences in this field, and the amount of lost energy when operating on different fuels is calculated from the availability ratio in the previously calculated capacities as follows:

Energy lost cost when operating with gas oil	nergy lost cost	
compared to running with natural gas	2030 - 1790 = 240 MW	
Energy lost when operating with crude oil compared to operating with natural gas	1432-2030 = 598 MW	
Energy lost when operating with crude oil compared to operating with gas oil	1790-1432 = 358 MW	

Thus, the calculations for the lost energy cost are as follows:

The cost is a cent per kilowatt/hour

 $3\times240/$ 2030 =0.35 cent /KWh

3 × 598/ 2030 =0.9 cent /KWh

3 × 358/ 2030 =0.6 cent /KWh

5. Calculations for the cost of constructing the proposed natural gas pipeline

The proposed gas pipeline is planned to supply sufficient quantities of natural gas to operate available capacities of not less than 0200 megawatts, and the physical specifications of the pipeline are as follows:

- The diameter of the pipe is 42 inches.
- Pipe thickness is 0.5 inch.

For the purpose of calculating the cost per meter of this pipeline, the following equation approved by the Ministry of Oil can be used:

 $1 \text{ Ton} / \text{m} = 0.01589 \text{ (D-T)} \times \text{T}$

D: The diameter of the pipe is 42 inches.

T: The thickness of the pipe is 0.5 inch.

1 Ton / m = 0.01589 (42 – 0.5) × 0.5 = 0.3297 Ton / m

Depending on the length of the pipe is 300 km.

The amount of iron used = 0.3297×300 km = 98910 tons

Two types of piped are available:

- Chinese \$ 1,200 / ton.
- German \$ 2000 / ton.

The German type of pipe was chosen , so the cost of the pipe is:

98910 × 2000 = 197,820,000 dollars for a distance of 300 km

Assuming that the cost of erecting the pipeline with the required pumping stations to raise the gas pressure and the valves is up to 200% of the cost of the pipe.

Total cost = 197,820,000 × 300/100

= \$ 593,460,000 , For a distance of 300 km

6. Analysis:

6.1. Energy produced during one year for all types of fuel = available capacity \times 8760 MWh.

Natural gas 2030 × 8760 = 17,782,800 MWh

Gas oil 1790 × 8760 = 15,680,400 MWh

Crude oil 1,432 × 8760 = 12,544,320 MWh

6.2 Additional Available Capacity (MWh)

Operating with gas compared to operating with gas oil $240 \times 8760 = 2,102,400$

Operating with gas compared to operating with crude oil: 598 \times 8760 = 5,238,480

Operating with gas oil compared to operating with crude oil $358 \times 8760 = 3,136,080$

6.3. Cost of production per kilowatt. hour: cents / kWh.

Operating with Natural gas. Operation and maintenance costs + fuel costs

= 0.45 + 4.5 = 4.95

Operating with gas oil, operation and maintenance cost + fuel cost + lost energy cost

= 0.77 + 19.21 + 0.35 = 20.32

Operating with crude oil, operating and maintenance costs + fuel cost + lost energy cost

= 1.9 + 11.4 + 0.9 = 14.2

6.4. The total cost of producing energy during a year in dollars

Operating with gas 4.95 × 17,782,800 = 880,248,600

Operation with gas oil 20.35 × 15,680,400 = 3186,257,300

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Operating with crude oil 14.2 × 12,544,320 = 1781,293,400

Within the above costs, the lost energy costs are :included.

6.5. Net production costs

To calculate the net production cost per unit kWh for types of fuel, as following:

Net production cost = total cost - lost energy cost

The net production costs for the types of fuel are as follows, in dollars within one year:

Operating with gas oil: 3186,257,300 - 0.35 × 15,680,400 = 3131,475,900

Operating with crude oil: 1781,593,400 - 0.9 × 12,544,320 = 1668,701,520

7. Saving amounts

The saving amounts, when operating by the three types of fuel as follows:

• The amount of savings by the natural gas operation compared to the gas oil operation during a year = net total cost by gas oil operation – (net total cost by natural gas × available capacity by gas oil / available capacity by natural gas)

= 3131,475,900 - (2030× 880,248,600/1790)

- = 2355,296,100 dollars annually saving, for the four stations.
- The amount of savings by natural gas compared to crude oil.

(2030× 880,248,600/1432) - 1668,701,520 =

- = 1047,757,680 dollars annually "for the four stations.
- The amount of savings by crude oil compared to gas oil.
- = (1790× 1668,701,520/1432) -3131,475,900
- = 1045,599,000 dollars annually "for the four stations

• 8. Summary

The amount of savings compared to the amounts spent annually "when the units operate by natural gas compared with gas oil and crude oil."

The total cost of constructing the pipeline was calculated according to the above data.

The following is a summary of the results has obtained.

-The amount of cost savings due to operating by natural gas compared to the gas oil is 1045 million dollars a year.

-The amount of cost savings due to operating by natural gas compared to the crude oil is 1047 million dollars annually.

The cost of constructing a 300 km of natural gas pipeline is \$ 600 million.

The amounts has calculated on international oil market prices at \$ 60 / barrel of crude oil.

9. Conclusions

First: By comparing the savings with the amounts of costs resulting from operating with natural gas for the proposed units with the cost of constructing the gas pipeline, it becomes clear that the project costs can be covered by saving of the amounts of maintenance and operation costs within a period of less than one year.

Second: It is possible to operate other stations on this pipeline through the current volume. It is also possible to increase the imported quantities to additional power plants capacities.

Third: Significant financial savings by exporting the dedicated crude oil for the operation of instead of generating units.

Fourth: "Operating units with natural gas is less polluting" to the environment compared to operating with crude oil.

Fifth: The possibility of converting to the COMBIND CYCLE and increasing the production capacity by 50% of the available capacity.

Sixth: "In case of increasing the production of natural gas by the Ministry of

Oil in the future," and achieving self-sufficiency in operating power generation stations and covering the needs of other utilities, The surplus natural gas can be exported to other countries through the Iranian gas pipeline network.