مركز البيان للدراسات والتخطيط
Al-Bayan Center for Planning and Studies

Feasibility study: Constructing an Iran-Iraq natural gas pipeline

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Al-Bayan Center Studies Series

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Feasibility study:
Constructing an Iran-Iraq natural gas pipeline

Dr. Karim Wahid Hassan*

Introduction

As part of its policy to provide electricity to consumers, the Iraqi Ministry of Electricity has developed a plan to build gas stations for the production of electrical energy distributed over the provinces of Iraq, using different types of fuel to produce electricity: natural gas, gas oil, fuel oil and crude oil.

It goes without saying that the best kind of fuel to run gas stations is natural gas. This type of fuel to produce electrical energy ensures the proper function of the production units to the highest possible efficiency. Additionally, there is no need to use chemical additives to handle other fuels, or additional units for maintenance.

Studying the Ministry of Oil's plan, it seems that the infrastructure will not be able to meet the needs of energy production plants of natural gas for years to come. In an attempt to meet the aim of covering the deficit to cover ready natural gas amounts to gas stations and operating and future units, the Ministry of Electricity has put forward an urgent plan to import gas oil or operate units that run on crude or heavy oil, which require the use of chemical additives that could be worth $15 million a year, in addition to the decrease in the availability rate of up to 70%.

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The following image displays the impact of the use of crude or heavy oils on the production units of energy. In order to achieve optimum operation of the gas units, sufficient amounts must be provided to spend on maintenance and appropriate chemicals when running on other fuels.

1.The proposed project

In light of expected delays in gas investments and properly equipping electric power plants to operate the production of energy, and according to the fuel plan with the Ministry of Oil, the preparation of feasibility studies was decided in 2009 after obtaining necessary approvals to equip some of the operating and new gas stations on natural gas imported from Iran through the implementation of a pipeline with these general specifications:-

1. The length of the gas pipeline approximately 300km, including 12 km within the Iranian border.

2. Tube diameter measures approximately 42inches.

3. The proposed gas volumes transported 800 million cubic feet day.

The proposed stations to run on imported gas are:-

Sequence	Station	Design capacity (MW)
1.	Old gas cycle	25 x 4
2.	New gas cycle	123 x 6
3.	Quds Gas	123 x 6 43 x 4
4.	Sadr Gas	160 x 4
5.	Total design capacity	2408

2. The objective of the study

The aim of this study is to conduct a preliminary technical and economic feasibility study for the construction of a pipeline to transport natural gas from Iran to Iraq/Baghdad, with a comparative analysis of the cost of the units when running on different types of fuel. These costs include:-

1. Operation and maintenance.

2. Fuel (natural gas, gas oil, crude oil).

3. Lost energy.

4. Building a pipeline for transportation of natural gas.

3.Data of the study

a) Gas stations operate on the factor of availability:

1. 85% for natural gas.
2. 75% on gas oil.
3. 60% on crude oil.

When operating

b) Halted for the purpose of washing in periods of 16 hours per 168 operating hours when the operation runs on crude oil.

c) The cost of a litre of imported gas oil with transportation costs.

= The price of gas oil + transport cost

= 51 + 13 = 64 cents / litre.

d) The price of imported gas according to the global market price 15 cents / m3.

e) The price of crude oil $60 per barrel, or 38 cents per litre.

f) Chemical additives cost 0.5 cents to produce a kWh.

g) The cost of maintenance of the gas units when they run on gas oil fuel are equivalent to 1.5 times their maintenance cost than when they run on natural gas fuel and equalise costs when they run on fuel oil by 2.25 times the cost of maintenance when they run on natural gas fuel.

h) Lost energy cost 3 cents per kWh.

4.The methodology of the study

4.1. Expenses of available energy to the proposed plants when functioning on different types of fuel:

Total design capacity of the stations	Old cycle New cycle Sadr Quds	Total 2388 MW
Potential capacity of stations operating on natural gas	0.85 x 2388 = 2030 MW	
Potential capacity of stations operating on gasoil	0.75 x 2388 = 1790 MW	
Potential capacity of stations operating on crude oil	0.60 x 2388 = 1423 MW	

4.2. Accounting operation and maintenance costs

Operating and maintenance expenses depend on the cost of chemical additives, reserve costs and materials necessary to conduct maintenance operations when operating on different fuels (cost of chemical additives as previously stated [0.5 cents / kWh]). The operation and maintenance cost per unit obstetric once is estimated to cost $5 million for Frame 9 and V94.2 types 123MWatts and 160MWatts respectively.

Overall, the cost of maintenance at $5 million is valid per maintenance round and per 150MW.

The following table displays operation and maintenance costs according to fuel type:-

Total operation and maintenance cost for all stations when functioning on natural gas – one round	Design capacity x5 / 150 = 2388 x 5 / 150 = 80 million
Total operational costs of units on gas oil	80 x 1.5 = $120 million
Total operational costs of units on crude oil	80 x 2.25 = $180 million

In light of the above table, the following are calculated maintenance costs per kWh according to fuel type:-

Fuel Type	Operation and maintenance costs (Total maintenance cost / Annual energy production)
Gas Oil	million $120 / 8760 x 1790 = 0.77cents per MW/h
Crude Oil	$180 million / 8760 x 1432 = 1.4 + 0.5 = 1.9 cents per MW/h
Natural Gas	$80 million / 8760 x 2030 = 0.45cents per MW/h

4.3. Calculating fuel costs

As mentioned in the introduction, the following global prices for fuel were adopted:

Natural Gas: 15 cents / m3

Gas Oil plus transportation fees: 64 cents / litre

Crude Oil: 38 cents / litre

For calculation purposes the cost of production per kWh for all types of fuel, an assumption is made that the amount of fuel consumed to produce a kWh, fuel amounts estimate to 0.3 litres for the gas oil and crude oil and 0.3 m3 per kWh for natural gas.

In light of the above data, the following table displays the essential amounts of fuel for every kWh and according to fuel type:-

	Fuel Type	Costs Cents per kWh
1.	Natural Gas	15 x 0.3 = 4.5
2.	Gas Oil	64 x 0.3 = 19.2
3.	Crude Oil	38 x 0.3 = 11.4

4.4. Calculating the cost of lost energy

Calculating total energy lost depends on an assumption by an average cost of operating units at 3 cents per kWh. This figure was adopted as a result of previous experiences in this field, and calculates the amount of energy lost when running on different kinds of fuel ratio of availability in the calculated capacity previously, as follows:.

	Lost energy MW
The cost of energy lost when running on gas oil compared to gas operation	2030 - 1790 = 240
Energy lost when running on crude oil as compared to natural gas	2030 - 1432 = 598
Energy lost when running on crude oil compared to gas oil	1790 - 1432 = 358

And thus the cost of energy lost accounts as follows:

Cost cents per kWh	
$\frac{240 \times 3}{2030}$	= 0.35
$\frac{598 \times 3}{2030}$	= 0.9
$\frac{358 \times 3}{2030}$	= 0.6

5.The cost of establishing the proposed natural gas pipeline

The proposed pipeline is estimated to provide quantities of natural gas enough to run for no less than 2000MW for hours. The physical specifications of the pipeline are as follows:

The tube's diameter: 42 inches

The tube's thickness: 0.5 inches

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

1 Ton/m = 0.01589 (D-T)

tube diameter: 42' tube thickness: 0.5'

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

- assuming the length of the pipeline 300 km.

The amount of iron used = 0.3297 x 300 km = 98,910 tons.

Two types of tubes are available:

1. Chinese: $ 1200 / ton.

2. German: $ 2000 / ton.

The German type was chosen. Thus the cost of the pipeline calculates to:

98910 x 2000 = $197,820,000 for the total length of 300km.

- assuming the cost for pipeline installation with pumping stations required for the gas lift valves and pressure can be up to 200% of the cost of the pipeline:

$$\text{Total cost} = \frac{197820000}{100} \times 300$$

= $593,460,000 for 300km.

The total cost to build the gas pipeline for

300 km

is

$600 million

6.Analysis

6.1. Energy produced during a year on different types of fuel

= available capacity x 8,760MW/h

Natural Gas	2030 x 8760 = 17,782,800
Gas Oil	1790 x 8760 = 15,680,400
Crude Oil	1432 x 8760 = 12,544,320

6.2. Additional power available MW/h

Operating on gas compared to the operation on gas oil	240 x 8760 = 2,102,400
Operating on gas compared to operation on crude oil	598 x 8760 = 5,238,480
Operating on gas oil compared to operation on crude oil	358 x 8760 = 3,136,080

6.3. The production cost per kWh: cent / kWh

Operating on gas	Operating and maintenance cost + cost of fuel = 0.45 + 4.5 = 4.95
Operating on gas oil	Operating and maintenance cost + fuel cost + missing energy cost = 0.77 + 19.21 + 0.35 = 20.32
Operating on crude oil	Operating and maintenance cost + fuel cost + missing energy cost = 1.9 + 11.4 + 0.9 = 14.2

6.4. The total cost for the production of energy for a year ($)*

* Costs include lost energy costs.

6.5. Net production costs

In calculating net kWh production costs for different types of fuels, the following formula is used:

Net production cost = total cost - the cost of energy lost

Net production of fuels cost as follows: ($/per year)

Operating on Gas Oil	3,186,257,300 – 0.35 x 15,680,400 = $3,131,475,900
Operating on Crude Oil	1,781,593,400 – 0.9 x 12,544,320 = $1,668,701,520

7.Saving money

Accumulated funds saved while operating on different types of fuels can be calculated as follows:

1. The amount of savings when operating on natural gas compared to gas oil for one year net

= total cost of the natural gas oil - (net of the total cost of the gas x capacity rate of gas oil / capacity rate on natural gas)

= 3,131,475,900 – (880,248,600 x 1790/2030)

= $2,355,296,100 per annum for the four stations.

2. The amount of savings when operating on natural gas compared to crude oil.

= 1,668,701,520 – (880,248,600 x 1432/2030)

= $1,047,757,680 annually for the four stations.

3. The amount of savings when operating on crude oil compared to gas oil.

= 3,131,475,900 – (1,668,701,520 x 1432/1790)

= $1,045,599,000 annually for the four stations.

8. Conclusion

A preliminary feasibility study for the construction of a pipeline to transport natural gas from Iran to Iraq/Baghdad has been conducted to equip the following stations:

1. Old cycle.
2. New cycle.
3. Jerusalem.

4. Sadr.

The estimated production of 2030 MW and up to 800 mq mq of gas processed per day via a 42 inch round and 0.5 thick tube of German manufacture, costing $2,000 per metre for a total length of 300km.

Annual savings have been calculated for operating on natural gas compared to gas oil and crude oil.

Drawing on information obtained from the Ministry of Oil, the total costs for establishing the pipeline have been calculated by the data above.

In summary, the following are the results that were obtained:

The amount of cost savings when operating on natural gas as compared to gas oil	$1045 million/ per annum
The amount of cost savings when operating on natural gas as compared to crude oil	$1047 million/ per annum
The cost of constructing a natural gas pipeline length of 300 km	$600 million/ per annum

The amounts are calculated according to the international oil market prices for natural gas, gas oil and crude oil.

9.Further conclusions

Firstly: In comparing costs savings in amounts as a result of running on natural gas for the proposed units, with the cost of establishing gas pipeline, it is clear that covering the project costs may be covered through savings amounts in maintenance and operating costs during the period of less than one year.

Secondly: it is possible for other stations to run on the tube through its current size, additionally increasing the quantities imported to add further generating hours.

Thirdly: Providing material through the export of crude oil rather than consumption in power plants.

Fourth: The units running on natural gas are less polluting to the environment compared to the operation on crude oil.

Fifth: the possibility of conversion to combined cycle operation.

Sixth: In the event of increased natural gas production by the Ministry of Oil in the future, and reaching a stage of self-sufficiency in the operation of power plants and covering the needs of other ministries, then in this case the surplus of natural gas may be exported to other countries via the Iranian gas pipeline.

Seventh: This project will contribute to the employment of Iraqi workers