SHEBERGHAN GAS FIELD DEVELOPMENT PROJECT

RANKING OF POTENTIAL WELLS FOR TWINNING AND COST ESTIMATES

Revised March 18, 2011

Sheberghan Gas Field Development Project (SGFDP)
USAID Contractor

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ABBREVIATIONS

AEAI	Advanced Engineering Associates International
BCM	billion cubic meters
CO_2	carbon dioxide
Gustavson	Gustavson Associates, LLC
H_2S	hydrogen sulfide
m^3	cubic meters
MCM	million cubic meters
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

Advanced Engineering Associates International (AEAI) is working on a project to develop a roadmap for the construction of a 200 MW gas-fired thermal power plant near Sheberghan, Jowzjan Province, by an independent power producer (IPP). Gustavson Associates, LLC (Gustavson) has been retained by AEAI to give recommendations for a gas supply for the power plant. In particular, Gustavson was requested to conduct an assessment of previous well test results to rank well candidates for twinning[1] efforts, and to develop cost estimates for well development.

A draft of this report was reviewed by the Ministry of Mines (Hydrocarbon Unit) and AEAI.[2] They concur with the findings of the report.

Gustavson has access to a large quantity of Soviet era data, including results from exploration wells. These exploration wells have been plugged and abandoned, and are no longer capable of production. However, the Soviet era data reduce the risks associated with new drilling. The actual results of twinned wells will almost certainly differ from historical rates as reported in production test results, but the previous results offer very useful guidance. Based on an earlier power plant design, Gustavson assumed that the power plant would require 1.2 million m^3 per day of gas[3], i.e., 13.1 BCM over a 30 year lifetime

Gustavson relied on Soviet era field-specific technical reports as well as montage displays of structure maps and cross-sections of the exploration wells. Excerpts from these technical reports are included as an annex to this report. Gustavson used a Colorado based technical Russian translator to translate and help identify key parameters within the Russian technical reports. Gustavson also relied on data, mostly individual well records that were collected in previous efforts to support the Promotion of Oil and Gas Producing Areas to the Private Sector report. We based the field development recommendation on reserve estimates as well as other data contained within the Promotion of Oil and Gas Producing Areas to the Private Sector report published in June 2005. Gustavson acquired additional well information in data acquisition trips made in late November to early December 2010 and February 2011. Only certain data was made

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[1] "Twinning" refers to drilling a well nearby a previously drilled well.

[2] Email from Edrees Saljuki, Feb. 1, 2011

[3] The Sheberghan area gas fields that were considered all contain about 10% acid gas (a combination of CO2 and H2S). The supply rate to the plant is assumed to be sweetened gas, i.e., gas that has been processed to remove the acid gases.

available to Gustavson and the quality of the reports, maps, and well logs were in some cases so degraded that reading them was nearly impossible, let alone copying them. Gustavson reviewed and catalogued all available data in order to assess the fields with Jurassic potential. A map of the fields that were considered is shown on Figure 1.

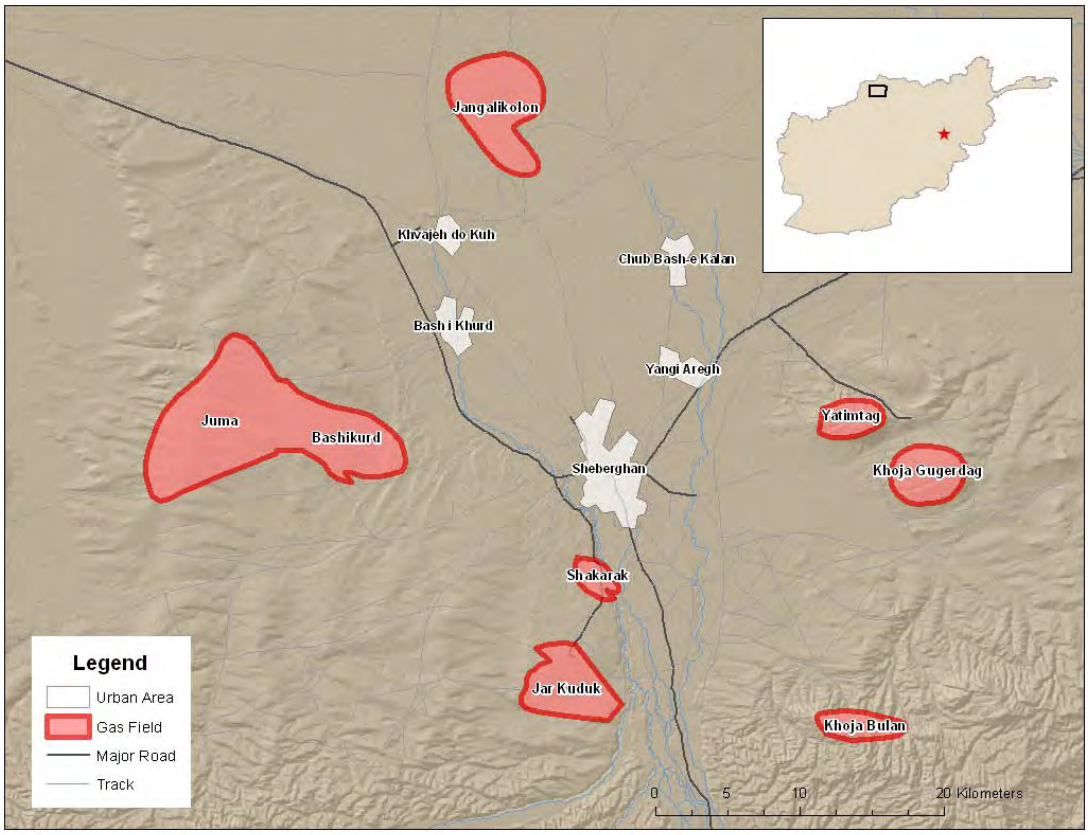

Figure 1 General Location Map

Source: USGS, 2006[4] and ESRI

Gustavson recommends that the Bashikurd and Juma fields be developed as the gas supply for the power plant. These two fields are adjacent to each other and are separated by a fault whose location is not known precisely. The Juma field alone appears to have sufficient reserves for the plant. However, the cost of drilling wells to supply gas can almost surely be reduced by selecting the best twinning candidates from the two fields rather than from Juma alone. One might consider leaving Bashikurd available for separate field development. However, the uncertainty about the location of the fault, and also about whether or not the fault is sealing, will almost certainly create operational difficulties.

[4] Klett, et al, 2006, Assessment of Undiscovered Technically Recoverable Conventional Petroleum Resources of Northern Afghanistan: Open-File Report 2006-1253.

The total acid gas concentrations at each of the Sheberghan area fields are similar, ranging from a low of 8.4% at Juma to a high of 12.1% at Khowja Gogerdak. So our field selection is based on the reserve size and preliminary estimates of drilling costs. Neither Jangal-e-kalan nor Khowja Gogerdak has sufficient reserves for the power plant. The P50 reserve estimate for either Jangal-e-kalan or Khowja Gogerdak is almost high enough to supply the plant for 30 years. However, we do not recommend Jangal-e-Kalan because only one well has been completed in the Jurassic and there is significant uncertainty about candidate locations for well drilling. We do not recommend Khowja Gogerdak since the production test rates in that field were significantly lower than those at Juma and Bashikurd. We estimate that cost per well would be lower at Khowja Gogerdak, but this saving is not sufficient to compensate for the lower production rates.

The finding about the well costs is based on Gustavson's preliminary estimates of the drilling costs, which are as follows:

Item	**Cost $ million**
Drill and complete a well at Juma or Bashikurd	$13.3
Drill and complete a well at Khowja Gogerdak	$11.5
Mobilize rig	$1.9
De-mobilize rig	$1.9
Inter-well move	$0.5
Reentry Bashikurd #9	2.0
Reentry Bashikurd #3	$4.0

Having determined that the Bashikurd/Juma fields were the best supply source for the power plant, we prepared a ranking of twinning candidates at those fields. As a result of the data gathering trip in February 2011, Gustavson was able to identify two well locations that are candidates for reentry in the existing wellbore rather than drilling a new well. The reentry candidates include Bashikurd #9 and #3 well.

According to records reviewed in Sheberghan, the Bashkurd #9 well only lacks perforation and testing in order to ready the well for production. For Bashikurd #3, the existing wellbore needs to be reentered and drilled an additional 500 meters, set a string of production casing and then perforate and test the well. If the wellbore conditions are good, then there would be substantial cost savings in using these two wells for gas supply. It is our recommendation that these two wells be reentered and rehabilitated first before drilling a new twinned exploration well. The reentry and rehabilitation will help achieve quick progress in reaching the overall objective.

If the conditions for reentry and rehabilitation of the above two wells can be done in a cost effective manner, then there should be more than adequate budget to drill at least one new well. Based on our analysis of the information available on the various well twinning candidates, we have developed a ranking of the wells.

The results of the well ranking are shown below:

Well Rank	Field	Well #	Total Depth, (m)	Choke Diameter (mm)	Gas Flow Rate[1] (thousand CM/day)	Total Estimated Sweetened Gas Supply[2] (thousand CM/day)	H_2S (%)	CO_2 (%)
1	Bashikurd	9 (Reentry)	3300	N/A	120	113	1.3	
2	Bashikurd	3 (Reentry)	3340	N/A	62	N/A		
3	Bashikurd	2	3460	22	520	469	0.55	9.15
4	Juma	2	3409	18	768	700	0.72	8.22
5	Juma	7	3409	15	435	403	0.11[3]	7.35[3]
6	Bashikurd	10	3397	20	446	400	0.70	9.49
7	Juma	9	3503	16	291	270	0.77	6.48
8	Juma	6	3450	13.1	268	247	0.53 (e)[4]	7.35 (e)[4]
Alternate	Bashikurd	15	3235	15	558	502	0.63 (e)[5]	9.32 (e)[5]

Notes:

1. Gas flow rates were taken from production test data

2. Estimates exclude H_2S, CO_2, and N_2

3. Conflicting information exists regarding the gas composition of Juma 7, two tests suggest methane content in the 59-77% range, whereas other gas composition data suggests a methane content similar to the other wells in the field of nearly 90%. We have assumed the latter for the estimated sweet gas supply.

4. Gas composition for Juma 6 is considered unreliable since there was no measurement for H_2S; therefore, the average of results from Juma wells 1, 5, and 6 were used since the gas composition is expected to be similar

5. Gas composition for Bashikurd 15 was unavailable; therefore, the average gas composition for Bashikurd 2 and 10 was used for the sweetened gas supply estimates

(e) = estimated

Our preliminary estimate of the cost to drill and complete these two new wells is $31 million and the cost of rehabilitation of Bashikurd #9 and #3 are about $6 million, a total of $37million. This includes the cost of drilling two wells at Bashikurd/Juma, mobilizing and demobilizing the drilling rig to the field, and moving the rig from one well location to the second as well as the rehabilitation of the two Bashikurd wells. This estimate will need to be refined once bids have been received for undertaking the work. The actual cost of the work will not be known until the drilling and completion activities are finished, since drilling contractors do not offer fixed prices, but rather specify fixed unit rates, such as day rates for drilling.

These four wells will serve two purposes:

i. They will provide a comparison with some of the Soviet era data, which will enable reserve estimates to be updated, and shed light on initial gas rates that can be delivered from new and rehabilitated wells.
ii. They will be capable of providing part of the gas supply for the proposed power plant.

The proposed new wells may produce at higher or lower rates than were measured in the existing wells. In any case, additional wells will almost certainly be required to provide sufficient rate and supply reliability for the proposed power plant. The production rate of each well will decline over time as gas reserves are depleted, so the drilling schedule must be planned accordingly.

We estimate that the cost of rig mobilization and demobilization (mob/de-mob) will be about $3.8 million. The power plant developer may wish to consider additional drilling beyond the two proposed wells to avoid the cost of another mob/de-mob at a later date.

I. INTRODUCTION

Gustavson has been requested to analyze possible gas supply options to support the development of a 200 MW gas-fired power plant. This analysis was performed at the request of Advanced Engineering Associates International (AEAI) as part of their work on the Sheberghan gas field development in Northern Afghanistan. The objective of our study was to identify well candidates that could be possibly twinned via new drilling and tested in order to prove up gas reserves for the proposed power plant. Gustavson also reviewed wells as potential re-entry and rehabilitation candidates. In addition, we prepared preliminary cost estimates for drilling the twin well candidates.

In a previous feasibility study prepared in 2005 for a 100 MW plant, the gas supply requirement was estimated to be about 600,000 m^3 per day.[5] The capacity of the newly proposed plant may be twice as large. AEAI has informed us to consider that the required gas amounts vary linearly with the increased plant size. Therefore, we assume that 1.2 million m^3 per day of sweetened gas (excluding CO_2 and H_2S) must be provided for the proposed gas-fired power plant. Over a 30 year period, this rate would equate to a total demand for approximately 13.1 BCM of sweetened gas. Therefore, we have focused our effort to identify fields that are capable of supplying this anticipated demand and this analysis is presented in subsequent sections of the report.

During a period starting from the 1960s and lasting until the Soviet withdrawal in 1989, several exploration campaigns were initiated in Northern Afghanistan in and around the vicinity of the town of Sheberghan. These exploration campaigns discovered several gas fields and some fields were put into production for both export and local consumption while others have not yet been developed. Some of the producing fields contain multiple gas reservoirs where the shallower sweet gas was produced historically from the Cretaceous age reservoirs while the deeper sour gas from Jurassic age reservoirs was not developed. Most of the producing reservoirs and fields have small amounts of remaining reserves and are currently strained just to meet demand from their existing customers.

Therefore, the best source of supply for the power plant is the deeper sour gas from Jurassic age reservoirs. These deeper reservoirs are available both in producing fields such as Khowja Gogerdak and Gerquduq and in discovered fields that were never developed.

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[5] This assumed a heat rate of 8273 kJ/kWh, i.e., an efficiency of about 43.5%, based on a reciprocating gas engine design. This is similar to the heat rate for a combined cycle plant. The actual heat rate will depend on the final power plant design.

As part of our analysis to identify the best candidates, Gustavson focused on fields containing significant Jurassic reserves, namely: Bashikurd, Juma, Jangal-e-Kalan, and Khowja Gogerdak. The sources relied upon for our analyses are largely Soviet era technical reports and individual well records maintained by Afghan Gas and Northern Directorate of Hydrocarbon Unit. In addition, we relied on a reserve report prepared by Gustavson in 2005 for the Ministry of Mines. Some of this data was obtained during field visits in November 2010 and February 2011 complemented by data that Gustavson already has in-house from previous studies.

It is important to note that the Soviet era reports are quite detailed and provide very good data about the discovered fields and the individual wells. However, most of the reports were prepared in the 1980s and while the data appears to be good it cannot be independently confirmed. Therefore, the production capacity must be independently confirmed through new drilling in order to get commitments on the part of private investors sponsoring the power plant project.

The review of the estimated reserves and production test data were a key element in the selection criteria that ultimately led to the recommendations set forth in this report. Certain geological and geophysical data was unavailable for the fields assessed and is discussed in greater detail in Section IV of this report.

Subsequent sections of this report present the following information:

- Cost Estimates
- Field Recommendation
- Well Ranking

II. COST ESTIMATES

There will be three main costs of providing gas for the power plant:

- The cost of drilling and completing production wells
- The cost of a gas sweetening plant for removal of H_2S and CO_2 from the produced gas
- The cost of disposal for the H_2S and CO_2 by-products

There will also be costs for surface facilities such as separators and gas gathering lines.

Since the total acid gas composition does not vary much across the four fields (total acid gas of 8.4 to 12.1%), the cost for a sweetening plant will be similar regardless of the field that is developed.

However, there will be different well costs for the different fields, and also different numbers of wells will be required. Preliminary estimates of well costs were prepared as part of our analysis. The preliminary estimates were based on the following:

- Bids received by USAID when tendering for drilling services in 2007 and 2008
- Well Construction Designs available from Afghan Gas files
- Information on estimated well costs for other wells in the region of Central Asia.

The cost estimates were prepared for two main fields namely, Bashikurd/Juma and Khowja Gogerdak. The approximate depth to the Jurassic reservoir at Bashikurd/Juma is 3,200 meters while the Jurassic is at an approximate depth of 2,200 meters at Khowja Gogerdak.

The result of our analysis is presented on Table 1.

Table 1 Drilling Cost Estimates

Item	Cost $ million
Drill and complete a well at Juma or Bashikurd	$13.3
Drill and complete a well at Khowja Gogerdak	$11.5
Mobilize rig	$1.9
De-mobilize rig	$1.9
Inter-well move	$0.5

The lower estimated costs at Khowja Gogerdak are due to the estimated savings from the overall reduction in time to drill the well plus savings in tangible equipment costs as a result of the shallower depth and well construction design. These cost estimates are considered as part of our overall selection criteria discussed in subsequent sections of the report.

While we believe that the above cost estimates are reasonable, it should be noted that they are preliminary and could be higher or lower when obtaining quotes from actual vendors. Costs for drilling new wells involve a variety of services and equipment that can change due to fluctuations in commodities prices such as steel and other raw materials along with demand for oilfield services globally.

III. FIELD RECOMMENDATION

Bashikurd, Juma, Jangal-e-Kalan, and Khowja Gogerdak fields were considered as potential candidates for twinning wells since they have development potential in the Jurassic reservoirs. The average depth to the productive Jurassic interval in the analyzed fields ranges from approximately 2,200 meters at Khowja Gogerdak to approximately 4,200 meters at Jangal-e-Kalan. We are not aware of any other significant discoveries beside those of the above mentioned fields. The geology of these fields was explained in detail in Gustavson's 2005 report.[6] A map illustrating the locations of the fields near Sheberghan is provided as Figure 1 (in the Executive Summary).

The field recommendation is based on criteria including depth to the productive intervals, gas composition, reserve estimates, initial production test results, and total well costs to provide enough gas to the power plant.

Gustavson's analysis of the data from the Jurassic wells in these fields is summarized in Table 2. As stated previously, Bashikurd, Khowja Gogerdak, and Jangal-e-Kalan alone do not appear to contain enough reserves to meet the potential power plant demand of 13.1 BCM over the next 30 years. The Jurassic Remaining Reserves of Sweetened Gas reported in Table 2 was calculated by taking the total Jurassic reserve value and reducing the volume estimated for the acid gas composition. For example, the P50 value for the total Jurassic gas reserves at Bashikurd is estimated at 6.65 BCM. The Jurassic remaining reserves of sweet gas (5.99 BCM) was estimated by reducing the Jurassic reserves by 10.37%, which is the concentration of acid gas at the Bashikurd Field. The same calculation was applied to the production test results reported in Table 2 and was based on gas composition data from the individual wells, where available.

The top well columns in Table 2 represent the production test results of: a) top well = well with highest initial production rate; 2) top 2 wells = sum of top well initial production rate and the second highest well initial production rate; 3) top 3 wells = sum of top 2 wells and the third highest well initial production rate; and 4) top 4 wells = sum of top 3 wells and the fourth highest well initial production rate. The purpose of this analysis is to show that developing Bashikurd and Juma together should require less new wells to be drilled in order to produce the amount of gas needed. For example, based on the initial production test results, it would take more than four wells at Khowja Gogerdak to produce the same amount of gas as two wells at

[6] Gustavson Associates, 2005, Final Report-Promotion of Oil and Gas Producing Areas to the Private Sector: Grant Agreement Number #H007-AF.

Bashikurd/Juma. Jangal-e-Kalan tested one well with high production rates; however, with only one Jurassic penetration in this field, not enough information is currently available to analyze the full development potential of this field.

Based on the reserve analysis alone, Juma is the only field with enough reserves to support the proposed gas-fired power plant. It seems apparent that Juma would be the logical choice for development; however, upon careful review and analysis of the data available, there are benefits to developing both Bashikurd and Juma concurrently. Combining the reserves of Bashikurd and Juma (reported as Bashikurd/Juma in Table 2) provides more than enough estimated gas reserves to supply a power plant at a rate of 1.2 MCM/day for more than 30 years. Gustavson reviewed historical interpretations of the geology at both Bashikurd and Juma. Although the fields are typically separated for reference purposes, Gustavson has considered the two fields as a single supply source. The fields are located adjacent to each other and are separated by a fault. The interpretations of the fault position have changed over time and are expected to continue changing as more wells are drilled. Since these fields are adjacent to each other, a power plant constructed in the area would have the benefit of having gas supplied from the highest producing wells in both of these fields. Gustavson recommends that the twin well candidates focus on Bashikurd/Juma fields.[7]

[7] Afghan Gas and the Northern Directorate of the Hydrocarbon Unit have suggested that there are no unusual security concerns in the Bashikurd and Juma gas fields. We recommend that the security situation in the gas fields be reconfirmed before the commencement of drilling operations.

Table 2 Field Summary

Field	Jurassic Remaining Reserves of Sweetened Gas[1] (BCM)		Years of Supply[2] (based on P50)	Estimated Cost per Well ($ million)	Estimated Initial # of Wells Required[3]	Estimated Initial Total Well Cost ($ million)	Total Estimated Initial Sweetened Gas Supply[1] (thousand m^3/day)				Total Acid Gas (%)
	P90	P50					Top Well	Top 2 Wells	Top 3 Wells	Top 4 Wells	average
Bashikurd/Juma	16.07	25.18	57	13.3	3[5]	39.9	699.5	1,202.0	1,671.1	2,071.2	8.89[4]
Bashikurd	3.88	5.96	14	13.3	3	39.9	502.5	971.6	1,371.7	1,452.2	10.37
Juma	12.21	19.22	44	13.3	3	39.9	699.5	1,102.1	1,372.0	1,618.8	8.42
Jangal-e-Kalan	6.61	11.85	27	15			918.8				9.48
Khoja Gogerdak	7.78	11.91	27	11.5	6	69.0	356	625	733	828	12.12

Notes

1. Estimates exclude H_2S and CO_2

2. Years of Supply is based on a rate of 1.2 million CM/day of sweet gas, which will require additional drilling over time to maintain this rate

3. The number of wells, based on initial production test results, required to supply 1.2 million CM/day of sweetened gas

4. The average for Bashikurd/Juma is a volume weighted average

5. More than 2 wells will be required initially because the twinning recommendation does not include two highest rate wells (See section IV.)

IV. WELL RANKING

As part of Gustavson's work on this project, we ranked wells based on a number of criteria. The previous section explained why Bashikurd/Juma was selected for the gas supply. So Gustavson focused the well ranking efforts on wells within the Bashikurd/Juma Fields. The ranking can be used to determine locations for future drilling of twinned wells in the vicinity of the existing wells. The twinned wells may behave better or worse than the existing wells. A reservoir engineering study should be conducted after the drilling of the new wells, in order to determine the appropriate flow rate for each well. Such a study may conclude that rates should be restricted below the maximum capacity of the well.[8]

Gustavson's recommendation is to reenter Bashikurd No. 9 and No. 3 then drill a new twin well at Bashikurd No. 2 and if additional funds remain, drill a new twin well at Juma No. 2. Table 3 shows data for the Bashikurd/Juma wells. These wells were ranked based on production test results and evaluation of geologic maps. Figure 2 shows the location of the four highest ranked wells.

The Bashikurd No. 15 well tested with a higher rate (558,000 m^3/day) than the Bashikurd 2 well (519,000 m^3/day); however, very limited data was available for Bashikurd No. 15. The well report was just obtained during the February 2011 data gathering trip and is currently being translated. It is noted that Bashikurd No. 9 (9B), the reentry candidate, is close to the reported location of Bashikurd No. 15 (15B). However, we have not seen a map where the 15B was posted so we are unaware of its specific location. Although the rate for the 9B is low (100,000 to 120,000 m^3/day), it appears that there are zones in the well that were never tested. Therefore, a decision can be made about twinning a well near 15B after we have the results from 9B.

[8] Engr. Khosti of the Hydrocarbon Unit has stated that an 8 mm choke size would be appropriate. This opinion should be considered as part of the proposed reservoir engineering study.

Table 3 Well Ranking Summary

Well Rank	Field	Well #	Total Depth, (m)	Choke Diameter (mm)	Gas Flow Rate[1] (thousand CM/day)	Total Estimated Sweetened Gas Supply[2] (thousand CM/day)	H_2S (%)	CO_2 (%)
1	Bashikurd	9 (Reentry)	3300	N/A	120	113	1.3	
2	Bashikurd	3 (Reentry)	3340	N/A	62	N/A		
3	Bashikurd	2	3460	22	520	469	0.55	9.15
4	Juma	2	3409	18	768	700	0.72	8.22
5	Juma	7	3409	15	435	403	0.11[3]	7.35[3]
6	Bashikurd	10	3397	20	446	400	0.70	9.49
7	Juma	9	3503	16	291	270	0.77	6.48
8	Juma	6	3450	13.1	268	247	0.53 (e)[4]	7.35 (e)[4]
Alternate	Bashikurd	15	3235	15	558	502	0.63 (e)[5]	9.32 (e)[5]

Notes:

1. Gas flow rates were taken from production test data

2. Estimates exclude H_2S, CO_2, and N_2

3. Conflicting information exists regarding the gas composition of Juma 7, two tests suggest methane content in the 59-77% range, whereas other gas composition data suggests a methane content similar to the other wells in the field of nearly 90%. We have assumed the latter for the estimated sweet gas supply.

4. Gas composition for Juma 6 is considered unreliable since there was no measurement for H_2S; therefore, the average of results from Juma wells 1, 5, and 6 were used since the gas composition is expected to be similar

5. Gas composition for Bashikurd 15 was unavailable; therefore, the average gas composition for Bashikurd 2 and 10 was used for the sweetened gas supply estimates

(e) = estimated

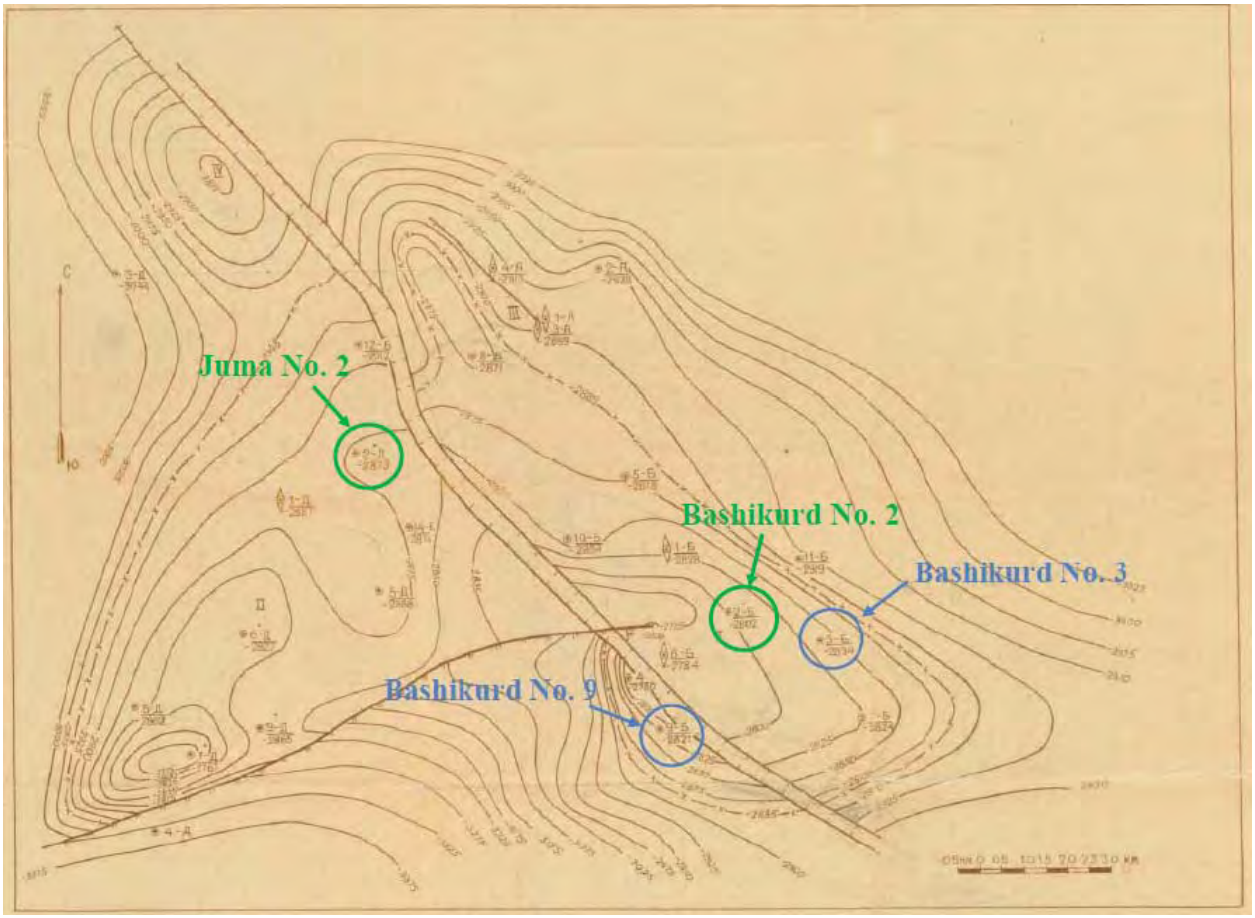

Figure 2 Location of Recommended Wells

As described in the previous section, the highest production test result was from Jangal-e-Kalan No. 4. This well does not appear on Gustavson's well ranking summary because: 1) Jangal-e-Kalan does not appear to contain enough reserves to solely support the gas-fired power plant; 2) only one test result was available in this field with only one Jurassic penetration and there is no way to know how other wells within the field may behave once tested; and 3) with our recommendation to focus development efforts on Bashikurd/Juma, it does not make sense to drill a new well that is distal from the proposed development. A summary of test results for each of the wells considered is provided in Table 4.

Table 4 Summary of Well Data

Well Number	Total Depth (m)	Productive Formation	Choke Diameter (mm)	Gas Flow Rate[1] (thousand m^3/day)	Estimated Sweetened Gas Supply[2] (thousand m^3/day)	Total Acid Gas (%)
Bashikurd						
1	3270	Kugitan	10.4	89.04	80.5	9.6
2	3460	Kugitan	22	519.52	469.1	9.7
6	3830	Kugitan	12.5	56.56	50.9	10.0
10	3397	Kugitan	20	445.5	400.1	10.2
15	3235	Kugitan	15	558	502.0[4]	9.95[4]
Juma						
1	3852	Kugitan	25	11.5	11.5	N/A
2	3409	Kugitan	18	768.2	699.5	8.9
6	3450	Kugitan	13.1	268	246.9	7.9
7	3409	Kugitan	15	435	402.5	7.5
9		Kugitan	16	291	269.9	7.3
Jangal-e-Kalan						
4	4222	Kugitan	26	1015	918.8	9.5
Khoja Gogerdak						
3	2788	Kugitan	15.85	306	268.9	12.1[3]
10	2546	Kugitan	19	54	47.5	
40	2500	Kugitan	16	123	108.1	
41	2508	Kugitan	16	405	355.9	
42	2583	Kugitan	18	107	94.0	

Notes:

1. *Gas flow rates were taken from production test data*
2. *Estimates exclude H_2S, CO_2, and N_2*
3. *Individual well results were unavailable; therefore, the average composition field-wide was applied to the calculations for estimated sweetened gas supply*
4. *Gas composition for Bashikurd 15 was unavailable; therefore, the average gas composition for Bashikurd 2 and 10 was used for the sweetened gas supply estimates*

The Hydrocarbon Unit of the Ministry of Mines reports that Bashikurd well #9 is an exploitation well that may be capable of production, possibly after a workover. Bashikurd well #9 was drilled and cased with corrosion resistant production casing through the target reservoir, but was not perforated. The work remaining on this well in order to prepare for production is to re-enter the well, confirm that there are no obstructions in the well bore, and then perforate and test the Jurassic interval

In addition to Bashikurd well #9, Bashikurd well #3 appears to be another candidate for re-entry and rehabilitation. Bashikurd well #3 was drilled to a total depth of 3,345 meters, but the second technical casing string ends beneath the Jurassic Anhydrite at approximately 3,000 meters. During drilling of this well, favorable pressures that indicated the presence of gas were encountered. Due to the pressures observed during drilling, this well was slated to become an exploitation well; however, production casing was not available so the well was never converted to an exploitation well.

Remaining work in order to prepare Bashikurd well #3 for production involves drilling and casing of this well to approximately 3,500 meters to be followed by perforation and production tests. Gustavson recommends that the re-entry and rehabilitation work be completed prior to the drilling of a new exploitation well. The locations of these wells are illustrated in Figure 3. Given the relatively low risk associated with re-entering these wells, this option appears to be the most efficient way to achieve early successes for the project.

V. CONCLUSIONS

Over thirty years, the estimated gas demand for a proposed 200 MW power plant is 13.1 BCM. Upon review of all of the available information, the combined reserves of the Bashikurd and Juma fields are the best overall gas supply source for the proposed power plant. The combined P50 reserves are estimated to be 25.18 BCM based on a previous reserve estimate prepared by Gustavson in 2005.

The selection of candidate wells for twinning was based on production test rates and a review of geologic maps. Table 3 provides a ranking of the twin well candidates located in the Bashikurd and Juma fields. It is recommended that Bashikurd wells #3 and #9 be re-entered and rehabilitated prior to twinning and one or two exploration wells. Bashikurd Well No. 2 and Juma Well No. 2 are the top ranking candidates for twinning.

The reentry candidates should result in substantial cost savings. Our preliminary estimate of the cost to drill and complete two new wells and rehabilitate Bashikurd #9 and #3 is $37 million. t. The new well costs of $31 million includes the cost of drilling two wells at Bashikurd/Juma, mobilizing and demobilizing the drilling rig to the field, and moving the rig from one well location to the second. We estimate that the reentry work for Bashikurd #9 and #3 will cost about $6 million. However, this estimate is based on the information provided by Afghan Gas on the two wells. The actual costs will only be known once the rig is mobilized and the wells are reentered. This estimate will need to be refined once bids have been received for undertaking the work. The actual cost of the work will not be known until the drilling and completion activities are finished, since drilling contractors do not offer fixed prices, but rather specify fixed unit rates, such as day rates for drilling.

These wells will serve two purposes:

(i) They will provide a comparison with some of the Soviet era data, which will enable reserve estimates to be updated, and shed light on initial gas rates that can be delivered from new and rehabilitated wells.

(ii) They will be capable of providing part of the gas supply for the proposed power plant.

The Ministry of Mines (Hydrocarbon Unit) and AEAI have reviewed our findings and concur with the recommendations. Their technical experts certainly have the knowledge and expertise that is helpful to the overall objective.