SHEBERGHAN GAS FIELD DEVELOPMENT PROJECT (SGFDP)

CRITICAL PATH
FOR
SHEBERGHAN GAS FIELD DEVELOPMENT

February 15, 2011

Sheberghan Gas Field Development Project (SGFDP)
USAID Contractor

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Table of Contents

I. ABBREVIATIONS

ADB	Asian Development Bank
AEAI	Advanced Engineering Associates International, Inc.
BCM	Billion Cubic Meters
DABS	Da Afghanistan Breshna Sherkat
EITI	Extractive Industries Transparency Initiative
GoIRA	Government of Islamic Republic of Afghanistan
IPP	Independent Power Producer
MCM	Million Cubic Meters
MoF	Ministry of Finance
MoM	Ministry of Mines
MEW	Ministry of Energy and Water
PMU	Project Management Unit
SGFDP	Sheberghan Gas Field Development Project
SWG	Sheberghan Working Group
USAID	United States Agency for International Development

II. EXECUTIVE SUMMARY

The Critical Path for Sheberghan Gas Field Development Report (CPR) is the sixth deliverable for "The USAID/Afghanistan's Sheberghan Gas Field Development Project" (SGFDP). The goal of this USAID assistance project is to design a roadmap for development of Sheberghan gas fields and to attract a private investor to construct and operate a 200 megawatt (MW) gas-fired power plant in Sheberghan in the form of an Independent Power Producer (IPP). It is anticipated that Afghan Gas Enterprise (Afghan Gas) will play a major role in supplying gas to the IPP, as well as the development of the gas fields. The Overseas Private Investment Corporation (OPIC) is working closely with a group of investors who have shown interest in investing in the construction and operation of the 200MW gas-fired power plant.

Since coordination and collaboration among all stakeholders is essential to the success of this project, SGFDP has established the Sheberghan Project Management Unit (PMU) at the Afghan Geological Survey to track Sheberghan gas and power related activities and associated infrastructure. In the case of Sheberghan gas/power related infrastructure projects; there are two distinct sets of activities: the rehabilitation of the Northern Fertilizer and Power Plant (NFPP) and the construction of a 200MW gas-fired power plant using the IPP model. In order to better analyze the relationships between these complex activities and their timelines, the Critical Path Method is used.

The Critical Path Method is one of several techniques for managing complex projects. The critical path tells us how long a project will take to complete and which activities are "critical," meaning that they have to be done on time or the whole project will take longer. The critical path is normally the longest path that the project takes to complete. The critical path is normally diagrammed in network fashion; however, in this report we will utilize a Gantt chart to demonstrate these relationships.

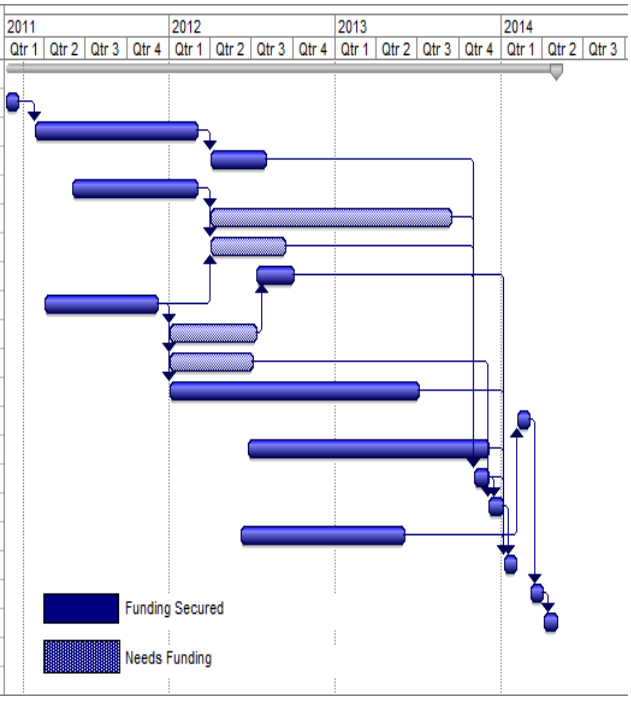
Overall, the CPR divides the activities involving the Sheberghan gas field development in two main sections: 1) the rehabilitation of the NFPP; and 2) the construction of the IPP. In the sections that follow, the individual activities, their relationship to other activities, and their sequence have been described in detail. It is important to point out that while most activities can be started at the same time, the sequence of testing & commissioning of these projects has to be in the precise order. For example, for the IPP, the construction of the power plant can start at the same time as the construction of the processing plant, but, the processing plant must be commissioned prior to the commissioning of the IPP. Therefore, the commissioning of the two projects must happen in sequence, not the construction.

Furthermore, the CPR is a dynamic document and this report is a snapshot of activities identified up until the publication of this report on February 15, 2011. We plan to use this as a tool to track and coordinate all the Sheberghan gas/power and related infrastructure activities, and will continue to update it on a regular basis.

As far as funding is concerned, some of the most critical items lack a funding source. The most critical of all is the sweetening plant for the IPP, which remains unfunded. It is estimated that this project alone will cost about $50 million. Without the sweetening plant, the IPP will not be able to operate. Even though the construction of the 200MW gas-fired power plant and the construction of the gas sweetening plant can start in parallel, there must

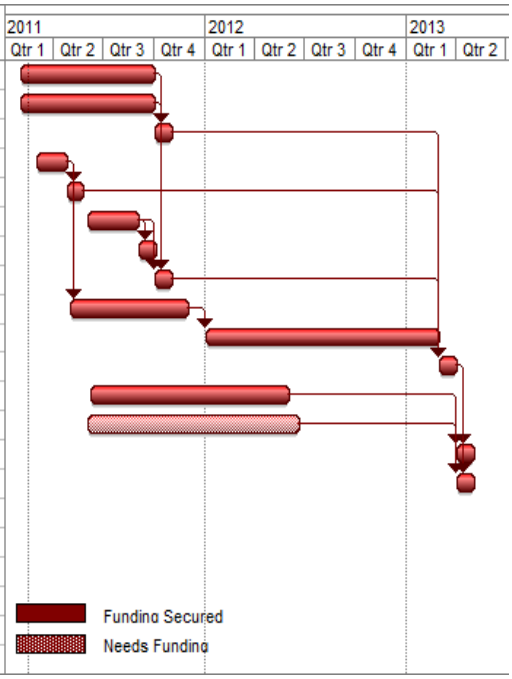
be a funding commitment for the construction of the gas sweetening plant in order to start the construction of the IPP. The critical path for the IPP is shown below.

ID	Task Name
0	Activities Related to the IPP
1	Ranking of Exploitation wells for twinning (Twinning)
2	New Well Drilling to support gas supply to the IPP
3	Construction of gathering lines from the two new wells
4	Engineering Design and Bidding Process for Gas Sweetening Plant
5	Construction of gas sweetening plant
6	Water system for supply to gas sweetening plant and power plant
7	Testing & Commissioning of the compressor station
8	Engineering Design for the 200MW gas-fired power plant
9	Construction of the Compressor station
10	Construction of gas pressure reg. & metering station at Gerquduq
11	Construction of the 200 MW gas-fired power plant
12	Commissioning of 220KV from Sheberghan to Mazar
13	Construction of NEPS II (Pul-e-Khumri to Kabul)
14	Commissioning of Gas Sweetening Plant for the IPP
15	Testing & commissiong of gas pressure reg. & metering station at Gerquduq
16	Construction of a 220kv transmission line from Sheberghan to Mazar
17	Commissioning of 200MW gas-fired Power Plant
18	Commissioning of NEPS II
19	Synchronization of the system



As the critical path for the NFPP below demonstrates, the funding for most activities has been secured. Since there is funding short fall for the rehabilitation of the fertilizer plant itself, we recommend the phase approach, as suggested by a report produced by Task Force for Business and Stability Operations (TFBSO). According to TFBSO, phase I rehabilitation will generate enough revenues for the fertilizer plant that it can then fund the next two phases.

ID	PMU ID	Task Name
1	1	Sheberghan to Mazar gas transmission pipeline
2	2	Gerquduq to Khowja Gogerdak gas transmission pipeline
3	3	Testing & commissioning of Gerquduq to Khoja Gogerdak gas pipeline
4	4	Flow Testing of Well #21
5	5	Production begins from Well #21
6	6	Rehabilitation of compressor station at Khowja Gogerdak
7	7	Testing & commissioning of compressor station
8	8	Testing & commissioning of gas pipeline from Sheberghan to Mazar
9	9	Engineering study of gas sweetening plant & bidding process
10	10	Construction of gas sweetening plant
11	11	Testing & commissioning of gas processing plant
12	12	48MW power plant rehabilitation
13	13	Northern fertilizer plant rehabilitation
14	14	Testing & commissioning of 48MW power plant
15	15	Testing & commissioning of fertilizer plant



The list of major activities along with the estimated budget, funding source, committed amount, and funding shortfall is given in the table below. The activities shaded in red are related to rehabilitation of the NFPP and the activities in blue are related to the construction of the IPP.

Major Activities	Estimated Budget	Funding Source	Committed Amount	Funding Shortfall
Sheberghan to Mazar gas transmission pipeline	$20,022,000	TFBSO	$20,022,000	0
Gerquduq to Khoja Gogerdak gas pipeline	$6,000,000	USAID (on-budget)	$6,000,000	0
Well #21 flow test for the NFPP	$2,400,000	ADB	$2,400,000	0
Gas sweetening plant for the NFPP	$ 23,000,000	ADB	$23,000,000	0
Rehabilitation of compressor station at Khoja Gogerdak for NFPP	$4,500,000	CERP/ISAF	$4,500,000	0
48MW power plant rehabilitation (NFPP)	$30,241,700	USAID (on-budget)	$23,000,000	($7,241,700)
Northern Fertilizer Plant rehabilitation	$14,625,200	MoM	$4,500,000	($10,125,200)
Drilling of exploitation well(s) (twinning)	$31,000,000	USAID (on-budget)	$31,000,000	($1,000,000)
Gas sweetening plant for IPP	$50,000,000	?	$ -	($50,000,000)
Construction of a 200 MW gas-fired power plant by an IPP	$300,000,000	OPIC/IPP	$300,000,000	0
Construction of a 220kv transmission line from Sheberghan to Mazar	$75,000,000	ADB	$75,000,000	0
Construction of NEPS II (Pul-e-Khumri to Kabul)	$75,000,000	ADB	$75,000,000	0
Compressor station for the IPP	$16,000,000	?	$ -	($16,000,000)
Gas pressure regulation & metering station at Gerquduq for the IPP	$4,000,000	?	$ -	($4,000,000)

The purpose of the Critical Path Report is to identify projects being implemented and studied by donors and to assist in coordination of those efforts. Prior to the CPR and the establishment of the PMU, many of these projects were proceeding independently of one another, despite the obvious overlap in activities. In creating the CPR, the SGFDP team, working as the PMU, was able to bring the various projects that utilize the Sheberghan gas reserves together and begin the process of coordinating funding and timing so that the various projects would support each other. The aggressive coordination strategy implemented by the Ministry of Mines through the PMU, including development of the critical path report and weekly Sheberghan Working Group meetings, has succeeded in bringing these projects together and has accelerated the planning and implementation efforts for Sheberghan gas field development.

The end result of this process has been the identification of a few major funding gaps in the activities supporting the development of the Sheberghan gas fields. These gaps, principally

the gas sweetening plant for the power plant and rehabilitation of the captive power plant at the Kude Barq facility in Mazar-e-Sharif, were known by donors and Ministry officials, but had not been specifically identified and displayed until the CPR was developed. The process of developing the CPR, including working with MoM officials and donors, has led to significant progress and, in the case of the captive power plant, expressions of interest from parties who were not part of the original proposals, but have become interested as a clear picture of the entire Sheberghan gas development strategy makes it much easier for donors to identify specific needs.

Overall, the process in developing the CPR has been as valuable as the report itself. Working together, MoM officials and donors have been able to coordinate almost $570 million in energy infrastructure projects for Northern Afghanistan. The CPR's function as a blueprint for these projects has reinvigorated interest and support for Sheberghan gas field development efforts, and promises to guide the process going forward.

III. ACTIVITIES RELATED TO THE REHABILITATION OF THE NORTHERN FERTILIZER AND POWER PLANT (NFPP)

This section describes the individual activities that are required to rehabilitate the NFPP. These activities have been sequenced in the order that is required for the project to move forward taking into account the dependencies and the critical path.

SHEBERGHAN TO MAZAR-E-SHARIF GAS TRANSMISSION PIPELINE

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$20,022,000	***TFBSO***	***$20,022,000***	***0***

The 12-inch gas transmission pipeline between the Khoja Gogerdak gas field and Mazar-e-Sharif is the only method of providing natural gas to the Northern Fertilizer and Power Plant. This pipeline is currently receiving gas at eight atmospheres of pressure (118 pounds per square inch) in the Khoja Gogerdak field and delivering gas to the NFPP at approximately two and one half atmospheres (36.86 pounds per square inch), and sometimes even less. The loss of roughly 70% of the gas pressure in 89.1 kilometers demonstrates a clear need to replace the pipeline. Replacement of the pipeline should provide sufficient quantities of gas to the NFPP to support urea and power production, with the added potential of supporting industrial development in Mazar-e-Sharif.

TFBSO has proposed an aggressive schedule for pipeline replacement and is anticipating commissioning the new pipeline on or about October 1, 2011. In discussions with the Sheberghan Working Group, TFBSO is reviewing options to increase the pipe diameter to 16 inches to allow for anticipated demand growth in Mazar-e-Sharif, particularly in the industrial zones. TFBSO has committed funding for the replacement of the transmission pipeline, which is expected to cost approximately $20 million. The $20 million figure supports only the replacement of the 12-inch pipeline, and does not include the increased cost associated with a 16-inch pipeline.

Timeline:

The construction work will begin sometime in March of 2011 and TFBSO expects to complete the pipeline in October of 2011.

Major Risks/Issues/Recommendations:

- With proper compression, the 12” pipeline can deliver about 3.6MCM per day. However, without compression it can only deliver about 850,000 cubic meters per day, which would not be enough for Mazar industrial use. A 16” pipeline without compression can deliver 1.6MCM per day, which can supply some gas to anticipated future industrial customers. We strongly suggest the use of 16” pipeline for the long-term, particularly because Afghanistan will probably not be building new pipelines every few years. The other

option is to build another 12” pipeline for the industrial customers. Currently, there is a lack of funding for the second line. According to TFBSO, going from 12” to 16” on this pipeline would add as much as 60% to the cost.

- Gas delivery to the Mazar industrial customers will depend on the size of the sweetening plant as well. If the sweetening plant can only process about 900,000 cubic meters per day then the volume of gas that will be travelling through the pipeline will be limited to about 1.3MCM per day (900,000 plus 400,000 of current production of sweet gas). This amount will probably not be able to sustain the industrial zone demand in Mazar.

GERQUDUQ TO KHOJA GOGERDAK GAS PIPELINE

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$6,000,000	*USAID (on-budget)*	*$6,000,000*	*0*

There is a 28.6 kilometer pipeline between Gerquduq and Khoja Gogerdak that is transporting sour gas produced in the Gerquduq gas field to residential customers in Aqcha and beyond. The pipeline has an outer diameter of 28 inches and was constructed in 1979. The pipeline appears to be oversized, and no maintenance work has been done since it was commissioned. Since it is, and has been, carrying sour gas, it will definitely need to be replaced by a new pipeline to support the transportation of gas from the sweetening plant in Gerquduq to the head of the new pipeline from Khoja Gogerdak to Mazar-e-Sharif.

There is another pipeline (28 kilometers long and 16" in outer diameter) that carries sweet gas from Gerquduq to Yatimtaq and then on to Khoja Gogerdak via a temporary 1.2 kilometer pipeline with an outer diameter of 8.8". This suggests that the Gerquduq to Khoja Gogerdak pipeline will not be usable once the processing plant is built. Therefore, we suggest building a new 12” pipeline from Gerquduq to Khoja Gogerdak, consistent with the pipeline size from Khoja Gogerdak to Mazar-e-Sharif. This pipeline would carry sweetened gas from the Gerquduq gas field (primarily Well 21 and Well 27) to Khoja Gogerdak for transportation to Mazar-e-Sharif.

Timeline:

The construction of this pipeline can begin in parallel with the construction of the Sheberghan to Mazar pipeline—starting in March 2011 and will be completed in October 2011.

Major Risks/Issues/Recommendations:

- Some Sheberghan Working Group members have suggested that the pipeline from Gerquduq to Yatimtaq may not need replacement and have suggested testing this pipeline before a final decision is made. Their suggestion is to replace only the 1.2 kilometer pipeline from Yatimtaq to Khoja Gogerdak. However, even if the Gerquduq-Khoja Gogerdak pipeline is operational now, it will likely need to be replaced very soon. Further, since we are replacing the 90 kilometer pipeline from Sheberghan to Mazar, it would be more cost effective to build a new pipeline from Gerquduq to Khoja Gogerdak.

- There are also risks associated with testing the pipeline. First, new water wells would need to be drilled to supply enough water to pressure test the pipeline. Second, specialized equipment is needed to conduct this type of test, and this equipment is not currently available in Sheberghan. Third, if the pipeline does not withstand the pressure and fails, emergency measures will be required to repair the pipeline, dealing an economic blow, as well as lost gas supplies to the NFPP for the period that the pipeline is shut down for repairs. Finally, if the test shows either substantial weakness or complete failure of the pipeline, it will have to be replaced. Given the current state of the pipeline and the circumstances of its use, a testing program would likely confirm the view that the pipeline would not be able to handle the increased pressures of the new system, meaning that the money spent testing the line would probably be better allocated towards other needs.

WELL #21 FLOW TESTING (GAS SUPPLY TO NFPP)

Gerquduq Well No. 21 is anticipated to be a major source of supply for the NFPP project. The gas produced from Well 21 is sour, and will require sweetening at the proposed sweetening plant prior to transmission to Mazar-e-Sharif. Well No. 21 is ready to begin production after a flow test has been completed and once the sweetening plant is operational. The flow test will be conducted by Gustavson Associates in the spring of 2011. ADB has a budget of $25.4 for the construction of the gas sweetening plant and this activity will be carried out under that budget. The engineering design of the gas sweetening plant will depend on the results of well No. 21 flow test.

REHABILITATION OF COMPRESSOR STATION AT KHOJA GOGERDAK FOR NFPP

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$4,500,000	*ISAF/CERP*	*$4,500,000*	*0*

There is a compressor station at Khoja Gogerdak that was used to increase the gas pressure during gas transmission to Mazar-e-Sharif. This compressor station was decommissioned, but is now needed to boost gas pressure for the new pipeline between Khoja Gogerdak and Mazar-e-Sharif. The increased pressure will restore the efficiency of the Fertilizer Plant and it will enable more gas to be supplied through the pipeline to the NFPP.

Timeline:

The rehabilitation work will begin in June and should be completed by September of 2011.

Major Risks/Issues/Recommendations:

- We need to think about redundancy in the system if we only have one compressor station. This becomes especially important if we rely on this compressor station to increase the volume of gas delivered to Mazar from 850,000 cubic meters per day (without the compressor station) to about 3.6 million cubic meters per day. Further, the reliability of the compressor station is a critical issue once industrial customers are depending on the gas for their operations. Our recommendation is to increase the size of the pipeline from 12" to 16" to avoid dependency on the compressor station to deliver sufficient gas to Mazar and also to plan for building another compressor station, or some other type of redundancy, as a backup to this one.

CONSTRUCTION OF THE GAS SWEETENING PLANT FOR THE NFPP

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$23,000,000	***ADB***	***$23,000,000***	***0***

Increasing the capacity of the Northern Fertilizer and Power Plant will require a significant increase in gas supplies. The NFPP is currently being supplied with mostly sweet gas from the Khoja Gogerdak and Gerquduq gas fields. In order to increase gas supplies, the MoM has decided to utilize Gerquduq Well No. 21 and Gerquduq Well No. 29. These wells have penetrated the Jurassic formations and can flow at high rates but contain hydrogen sulfide and carbon dioxide and must be processed prior to transportation through the pipelines. Since the existing processing plant at Gerquduq cannot be rehabilitated, a new sweetening plant will have to be built to process the gas from these two wells. ADB has committed funding for a sweetening plant that will process between 850,000 and 900,000 cubic meters per day. The total cost is estimated by ADB to be $23 million, so there should be no budget shortfall on this item. Gustavson Associates has been tasked with the preliminary engineering work for the processing plant and it is expected to be operational by the second quarter of 2013.

Timeline:

As soon as the engineering design is completed the construction can begin. According to critical path diagram (section IV), the gas sweetening plant can be operational by April of 2013. As discussed earlier, the NFPP cannot be fully operational unless the sweetening plant has been commissioned and is fully operational.

Major Risks/Issues/Recommendations:

- According to ADB/Gustavson, the sweetening plant for the NFPP will be designed to process about 850,000 to 900,000 cubic meters of gas per day, which will be sufficient for the operation of the 48MW power plant, full-capacity production at the fertilizer plant, and some remaining gas for the Mazar gas distribution network for residential use. We strongly recommend that the capacity of the processing plant be increased so that there would be enough processed gas to support the Mazar industrial zone. We anticipate that

there will be at least five industrial customers that will use gas as fuel in the next five to seven years, perhaps similar to the fertilizer plant. Therefore, there could be a requirement for an additional two million cubic meters of gas per day. If the decision to go forward with the existing plant capacity is made, then planning for another sweetening plant for the industrial customers in Mazar should begin so gas supplies can be made available in the next two to three years.

48MW-POWER PLANT REHABILITATION (NFPP)

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$30,241,700	*USAID (on-budget)*	*$23,000,000*	*$7,241,700*

In addition to the rehabilitation work on the Northern Fertilizer Plant, TFBSO is also evaluating rehabilitation and expansion options for the captive power plant at the Northern Fertilizer Plant site in Mazar-e-Sharif. The current proposal is to rehabilitate the existing steam boiler generators and possibly add a fifth turbine unit to provide an additional 25 MW of power for a total of 73 MW of generating capacity for an additional amount of $15M. USAID has decided to fund the rehabilitation of the captive power plant through an on-budget grant of $23 million. TFBSO has estimated the total rehabilitation cost would be $30.2 million dollars, leaving a budget shortfall of $7.2 million dollars. KfW has expressed interest in participating in the rehabilitation of the power plant, but has not made a firm commitment on funding. Also, the World Bank has shown interest in funding some of the Sheberghan activities related to power. These discussions are on-going and no firm commitments have been made by either the World Bank or KfW.

Timeline:

The rehabilitation of the power plant can start in parallel with other activities and it will take about a year. However, in order to be able to generate the full nameplate capacity of 48MW, or more if additional turbines are installed, the gas sweetening plant has to be fully operational. According to critical path diagram (section IV) , the earliest that the commissioning of the power plant could take place is May 2013.

Major Risks/Issues/Recommendations:

- The rehabilitation of the 48MW power plant may cost more than $31M. Some estimates have placed the total cost at up to $40M. Since about 20MW of power will be used by the fertilizer plant and the residential area associated with the factory, the maximum output to the Mazar grid will be between 25MW-28MW. Spending $40M on a net gain of only 25MW to 28MW does not seem to be economically or financially prudent, particularly in light of other potential investments in the energy sector in the region. In our opinion, rehabilitation may not be worth the investment, as the existing equipment is old and parts may not even be available. It may be better to build a new power plant with higher capacity, perhaps 80-100MW to connect to the Mazar grid and then on to the NEPS.

NORTHERN FERTILIZER PLANT REHABILITATION

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$14,625,200	*MoM*	*$4,500,000*	*$10,125,200*

TFBSO and MoM have proposed an aggressive rehabilitation strategy for the Northern Fertilizer Plant in Mazar-e-Sharif. The MoM is contributing $4.5 million to the rehabilitation of the Northern Fertilizer Plant. There are a number of repairs to various units including the air separation units and catalysts that are necessary for the plant to increase the production of urea. Further, the replacement of the natural gas pipeline to increase in both the pressure and quality of the incoming natural gas is critical to boosting urea production. TFBSO has estimated the total cost of rehabilitation work to be $14.6 million, meaning there is currently a funding gap of just over $10 million. TFBSO had anticipated paying for the rehabilitation work in phases, with the increased plant revenues from the immediate rehabilitation work in phase one paying for the necessary work in phases two and three. USAID has expressed some interest in contributing funds to the rehabilitation work, but has made no firm commitments on funding.

Timeline:

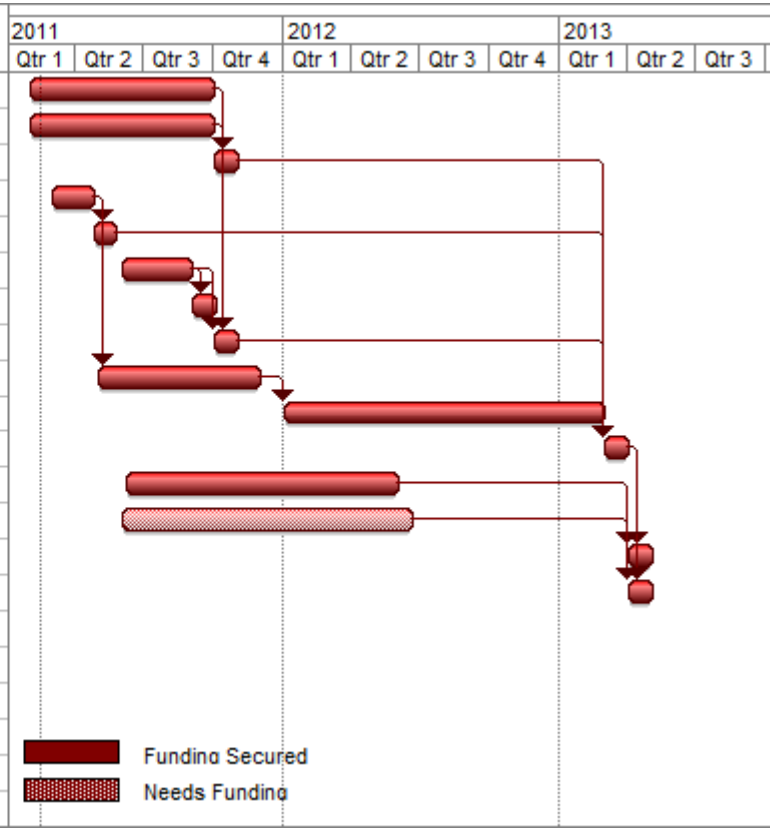
The rehabilitation of the fertilizer plant can start in parallel with other activities and it will take about a year. However, in order to be able to use the fertilizer plant to maximum capacity, the gas sweetening plant has to be fully operational. According to critical path diagram (section IV), the earliest that the commissioning of the fertilizer plant can begin is May 2013.

Major Risks/Issues/Recommendations:

- The flow lines in the fertilizer plant need to be tested before commissioning of the plant. We recommend replacing most of the flow lines as these are as old as the factory itself and may not be able to withstand the pressure that gas will be entering the fertilizer plant.
- Since the TFBSO report states that the fertilizer plant will be profitable in the first year, it might be possible to conduct the rehabilitation in phases as proposed by TFBSO. This way, the $4.5 million contribution from the MoM can be spent on phase I and the fertilizer plant can pay for the remainder of the rehabilitation work in phases II and III out of its profits from phase I.

IV. THE CRITICAL PATH FOR THE REHABILITATION OF THE NFPP

ID	Task Name
1	Sheberghan to Mazar gas transmission pipeline
2	Gerquduq to Khowja Gogerdak gas transmission pipeline
3	Testing & commissioning of Gerquduq to Khoja Gogerdak gas pipeline
4	Flow Testing of Well #21
5	Production begins from Well #21
6	Rehabilitation of compressor station at Khowja Gogerdak
7	Testing & commissioning of compressor station
8	Testing & commissioning of gas pipeline from Sheberghan to Mazar
9	Engineering study of gas sweetening plant & bidding process
10	Construction of gas sweetening plant
11	Testing & commissioning of gas processing plant
12	48MW power plant rehabilitation
13	Northern fertilizer plant rehabilitation
14	Testing & commissioning of 48MW power plant
15	Testing & commissioning of fertilizer plant



V. ACTIVITIES RELATED TO THE CONSTRUCTION OF A 200MW GAS-FIRED POWER PLANT IN THE FORM OF AN IPP

This section describes the individual activities that are required to construct and operate a 200MW gas fired power plant. These activities have been sequenced in the order that is required for the project to move forward taking into account the dependencies and the critical path.

PROVING GAS RESERVES FOR THE IPP -- DRILLING OF EXPLOITATION WELL(S)--TWINNING

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$31,000,000	*USAID (on-budget)*	*$31,000,000*	*0*

The natural gas reserves around Sheberghan in Northern Afghanistan were first explored by Soviet oil and gas engineers in the early 1950's. Soviet engineers drilled a total of 177 exploration and exploitation gas wells in seven different gas fields and produced gas for a variety of applications, including the Kude Barq facility in Mazar-e-Sharif, domestic consumption in Jawzjan and surrounding provinces, and some export back to the Soviet Union. The gas produced from the Sheberghan gas fields was processed at two facilities: a sweetening plant south of the city of Sheberghan and a glycol dehydration plant east of Sheberghan. Natural gas exploration and exploitation ended abruptly in 1989 when the Soviet Union withdrew its military forces from Afghanistan. During the Afghan civil war, very little natural gas exploration work was conducted and natural gas production was drastically reduced. These circumstances have resulted in a substantial amount of uncertainty regarding the remaining gas reserves and the composition of the available remaining natural gas.

While the data collected by the Soviet engineers appears sound, the vast majority of their data is between 20 and 30 years old and needs to be independently verified before a certification of reserves sufficient to support the proposed power plant can be issued. In order to verify the Soviet-era data on the gas fields, USAID has proposed drilling new exploitation wells to supply fuel to the proposed power plant. In order to reduce the risk associated with drilling new wells, AEAI, through its subcontractor Gustavson Associates, has reviewed the Soviet data and developed a ranking of well candidates for "twinning," a process of drilling a new exploitation well near an existing exploitation well. This process substantially reduces the risk of drilling a "dry hole," or finding no gas and would provide immediate and substantial gas supplies to the proposed power plant.

Currently, the top two well candidates are Bashikurd No. 2 and Juma No. 7. AEAI has consulted with officials from the MoM regarding the potential development of these two fields and the parties appear to be in agreement on the recommendations. AEAI, through Gustavson Associates, will prepare the tender documents necessary for USAID to engage a

contractor to drill one to two new exploitation wells in the Bashikurd and Juma gas fields. It is anticipated by the MoM and USAID that these wells will be drilled through an on-budget financing mechanism. The timing for completion and production testing of the wells will depend on the results of the tendering process and the availability of funds from USAID.

Timeline:

The wells to be twinned have already been identified by AEAI in a deliverable entitled "Preliminary Recommendations and Cost Estimates for Well Development Efforts," submitted to USAID on February 3, 2011. The bidding documents will be prepared by the end of March 2011. We expect the award of the drilling contract by July 2011 and actual drilling work to be completed by March 2012.

Major Risks/Issues/Recommendations:

- Additional gas supplies will be needed to meet the daily fuel requirement of the power plant. With these two wells, the expectation is that, together, they will provide between 600,000 and 1 million cubic meters per day. Since the power plant is estimated to require 1.2MCM per day, more wells will need to be drilled to support the power plant.
- The actual cost of drilling may be higher. It is important to point out that the drilling contractors do not generally charge a fixed price per well—it is based on a daily rate.
- Furthermore, there has to be a contingency plan in place for utilizing these two wells in case the IPP transaction does not come to fruition.

CONSTRUCTION OF THE GAS SWEETENING PLANT FOR THE IPP

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$50,000,000	***None***	***0***	***$50,000,000***

The gas produced from Juma and Bashikurd gas fields will be "sour gas," meaning it will have a concentration of hydrogen sulfide (H2S) greater than 5.7 milligrams per cubic meter.[1] In addition to hydrogen sulfide, Soviet-era data on the Jurassic reserves suggest that the gas contains a high concentration of carbon dioxide (greater that eight percent). In order to be used as a fuel supply for the power plant, the gas must be processed to remove hydrogen sulfide, carbon dioxide and other impurities. This is generally accomplished through the use of an amine sweetening plant, where a liquid desiccant (monoethanolamine or diethanolamine) is circulated through the raw natural gas to remove the "acid gas," or the compounds of hydrogen sulfide and carbon dioxide. The resulting natural gas stream is then dehydrated and cleaned of further impurities before being compressed and fed into the pipeline for the power plant. The "acid gas" stream can be further treated to recover the

[1] http://www.naturalgas.org/naturalgas/processing_ng.asp. Last accessed: 05 February 2011.

elemental sulfur or disposed of through either flaring (incineration) or reinjection into underground formations for long-term storage.

The gas processing plant that will supply pipeline quality gas to the power plant will require a significant capital investment. The existing gas processing plant at Gerquduq has not been operational since 1989 and twenty years of idle operation has resulted in significant deterioration of the facility. In several reports written by different consultants, there was unanimous agreement that rehabilitation of the existing gas processing facility would not be economically feasible.

The power plant is expected to need 1.2 million cubic meters of gas per day, or 13.1 billion cubic meters over its anticipated 30 year operational life. AEAI's 2006 Feasibility Study found that the capital cost for the gas processing plant would be $34,980,000.[2] However, the gas processing plant in the study was designed to fuel a 100MW gas-fired, thermal power plant that would operate for 20 years. The expected nameplate capacity of the power plant has since been increased to 200MW, effectively doubling the amount of gas that would be required. Further, the capital cost estimated by AEAI in the 2006 Feasibility Study relied on a blend of sweet gas from Yatimtaq Cretaceous reservoirs and sour gas from Gerquduq and Khoja Gogerdak Jurassic reservoirs. Gas processing plants are designed to process a specific blend of natural gas, so with the change in fields and reliance on Juma and Bashikurd Jurassic reservoirs, the estimated cost may increase to cover the additional processing requirements including the increased quantity of gas, extended operating life, waste disposal options and different composition of the raw gas being processed. While the capital costs for gas processing do not increase linearly with the amount of gas processed, the changed circumstances from the 2006 Feasibility Study suggest that a rough 40% increase in cost would be reasonable. Based on that assumption, the capital cost for the gas processing facility would increase to approximately $50,000,000, with no inclusion of contingency costs and premiums for security and other factors. At this point, the gas processing plant is unfunded, but must be constructed and operational prior to commissioning the power plant.

Timeline:

No funding commitments have been made, so we do not know the timeline. We believe that if we had the commitment for funding, then the construction could begin as early as the first quarter of 2012.

Major Risks/Issues/Recommendations:

- Without a funding commitment for the sweetening plant, the entire IPP transaction is at risk. Further, the sweetening plant will be required whether the IPP model is used or not. Soviet-era data suggests "acid gas" (hydrogen sulfide and carbon dioxide) concentrations of eight to ten percent, which is too high for almost all applications. Even if donors were to provide the estimated $300 million for the power plant, the gas would still require sweetening.

[2] The Technical and Economic Feasibility of Development of a Gas-Fired Thermal Power Facility in Sheberghan, Afghanistan. Appendix P: Cost Estimates. March 2006.

- One way to avoid the dependency on donor funding for the processing plant is to ask the IPP investors to build the processing plant. Since this will not be a grant to the Afghan government, the cost of the processing plant will be added to the price of electricity sold to the power purchaser, in this case DABS. However, the increased price of electricity may not be acceptable to DABS, also risking the entire IPP transaction.

WATER SYSTEM DEVELOPMENT FOR SUPPLY TO GAS TREATMENT PLANT AND POWER PLANT

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$2,000,000	***None***	***0***	***$2,000,000***

The additional industrial processes of gas processing and power generation will require additional water resources to be developed in the Sheberghan area. Fortunately, there are two rivers near the project site and an underground aquifer that can provide a ready supply of water to both the gas processing plant and power plant. During the Soviet era, the gas processing plants at Gerquduq and Khoja Gogerdak were supplied with water from 12 wells at Quarakent. These wells are not all in operation today. In order to meet the demands of both the processing plant and the power plant, additional water wells will need to be drilled near Quarakent and a water pipeline constructed between Quarakent and the site in Gerquduq. The cost of this work is estimated at approximately $2 million for the power plant alone, with some additional incremental costs coming from the water requirements of the proposed gas processing plant. At this time, the water system development is unfunded, but represents a comparatively small portion of the total project cost and can be constructed concurrently with the power plant and gas processing plant.

Timeline:

There are no funding commitments yet, so we do not know the timeline. However, since this activity only requires about $2,000,000 and can be done in approximately six months, there is no immediate issue in terms of timing, as long as the water development project is complete before the commissioning of the processing plant.

Major Risks/Issues/Recommendations:

- None.

COMPRESSOR STATION FOR THE IPP (OPTIONAL)

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$16,000,000	***None***	***0***	***$16,000,000***

Well head pressures of most of the operational gas wells need to match the higher pressure gas wells. In the future, booster compressors will likely be required for all gas wells for secondary recovery from the reservoir. At this stage, one compressor station downstream from the gas gathering manifold station can boost the pressure of feed gas to the gas processing plant.

Timeline:

There is no funding commitment yet, so we do not know the timeline. We do not believe this activity is a critical item and therefore, there are other ways to deal with this activity. Please see our recommendation for options below.

Major Risks/Issues/Recommendations:

- As mentioned above, the compressor station will be an increasingly important part of the gas development and utilization process. There are three options to dealing with this activity:
- Option I: Get a commitment from a donor to build the compressor station and provide gas to the end user, in this case the IPP, at a higher pressure.
- Option II: When designing the gas sweetening plant, take compression into account. This will eliminate the need to build a separate compressor station. However, this may raise the cost of the processing plant.
- Option III: Sell the gas to the IPP at a pre-determined pressure without compression and have the IPP compress it to its own specifications. This may raise the price of electricity as the IPP will have to include this cost in their capital cost calculations. We recommend this option as it gives the IPP the flexibility to match their specifications and since this will be part of the 200MW power plant construction, it will be much economical than building a separate compressor station.

GAS PRESSURE REGULATION & METERING STATION AT GERQUDUQ FOR THE IPP

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$4,000,000	*None*	*0*	*$4,000,000*

In order to accurately measure gas deliveries from the gas supplier to the IPP, a modern pressure regulating and metering station with meters of AGA#3 or equivalent standard, including an online calibration facility, gas chromatograph, odorizing facility, and fire safety system will be required. This will be an important medium-term investment, as disputes between gas suppliers and purchasers are often based on the amount of gas claimed by both sides. This system will ensure delivery of a quality gas supply and accurately measure the gas volume traded. This is a critical item as the regulating and metering station will determine how much gas and at what pressure, is sold to the IPP.

Timeline:

There has been no funding commitment yet, so we do not know the timeline. However, since this activity only requires about $4,000,000 and can be done in about six months, there is no issue in terms of timing. We just have to ensure completion before the commissioning of the 200MW power plant.

Major Risks/Issues/Recommendations:

- None.

CONSTRUCTION OF A 200 MW GAS-FIRED POWER PLANT IN SHEBERGHAN BY AN IPP

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$300,000,000	*OPIC/Investor*	*$300,000,000*	*0*

The construction of a 200MW gas-fired thermal power plant south of Sheberghan is the primary driving force behind the development of the Sheberghan gas fields and the reason for substantial investment in electrical infrastructure in Northern and Eastern Afghanistan. The power plant is expected to be constructed and operated under the Independent Power Producer (IPP) model, which means that a private company will build and operate the power plant. Under this model, the private company will purchase gas from a gas supplier under a Gas Supply and Purchase Agreement (GSPA), assumed in this case to be Afghan Gas, and

sell power to a power transmission and distribution company under a Power Purchase Agreement (PPA), assumed in this case to be Da Afghanistan Breshna Sherkat (DABS). The PPA will need to be structured to provide a certain minimum payment to the IPP to service debt and provide a reasonable rate of return, reflecting the investor's level of risk and other factors, for undertaking the project. The total project cost is anticipated to be $300 million, though costs will vary with the type of technology selected by the IPP.

In early 2011, the U.S. Overseas Private Investment Corporation (OPIC) brought a pair of potential investors in the IPP project to Kabul for a series of meetings with stakeholders. OPIC is prepared to finance and insure the transaction, but outstanding issues on the gas side, particularly the gas processing plant, and the cost of energy on the electric power side, need to be resolved before construction can begin on the power plant. DABS, as the power purchasing entity, will also require some credit support from donors or international financial institutions as part of the transaction. The SGFDP team and USAID are continuing to work with OPIC to address these concerns. Since the SGFDP project scope and workplan have been revised, many of the issues brought by OPIC should be resolved as part of the new deliverable schedule.

Timeline:

OPIC and the investors are ready to finalize the transaction and if everything falls in place, the construction of the power plant can begin sometime in early 2012. However, the processing plant, at this stage, is a critical item. Without the processing plant, the IPP will not have fuel for operations.

Major Risks/Issues/Recommendations:

In order to move forward with the IPP, we recommend the following steps:

- Lack of funding for the gas sweetening plant is a major issue. The funding either needs to come from the donors or it needs to be rolled into the cost of the IPP.
- The investors/OPIC need to come up with a realistic financial model for the price of electricity. DABS, as the power purchaser, needs to know what price to expect before moving forward.
- There has to be Memorandum of Understanding signed between all parties involved in order for each party to know what they are responsible for and what are the next steps in order to ensure a smooth transaction. This MoU will also allow ADB, for example, to move forward with the construction of the Sheberghan to Naibabad 220kv transmission line.

CONSTRUCTION OF A 220KV TRANSMISSION LINE FROM SHEBERGHAN TO MAZAR

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$75,000,000	*ADB*	*$75,000,000*	*0*

The 220 kV transmission line from Sheberghan to Mazar-e-Sharif is a critical part of the electrical infrastructure and must be built to evacuate the power produced from the proposed gas-fired power plant. The existing 110 kV line between Sheberghan and Mazar was completely destroyed and only the towers remain in a few points along the route. Constructing a 220 kV transmission line would allow the 200 MW produced from the power plant to be sent into the North East Power System (NEPS) for transmission to Kabul or to the South East Power System (SEPS). The 220 kV line from Sheberghan to Mazar-e-Sharif and on to Naibabad will connect Sheberghan to the NEPS system and is a priority project for ADB. The timing of this project depends on the outcome of the 500 kV import power transmission line from Turkmenistan or the construction of the power plant south of Sheberghan. The Asian Development Bank (ADB) has committed to funding and constructing the line associated with the proposed power plant, though the timeline for actual construction depends on a commitment by the parties to build the power plant.

Timeline:

In order for ADB to move ahead with the construction of this project, they need assurances from the IPP that the power plant will be built. This transmission line will only be built if the power plant is built. If there is an agreement with the IPP, ADB will start the procurement process early next year and the construction can begin sometime in the second or third quarter of 2012. It will take about nine months to build the transmission line.

Major Risks/Issues/Recommendations:

- The investors/OPIC need to convince ADB that the power plant will be constructed in order for ADB to start the procurement process for the construction of the transmission line. This could be accomplished by the Memorandum of Understanding described above.

CONSTRUCTION OF NEPS II (PUL-E-KHUMRI TO KABUL)

Estimated Budget	*Funding Source*	*Committed Amount*	*Funding Shortfall*
$85,000,000	*ADB*	*$85,000,000*	*0*

The NEPS II project involves the construction of a new double circuit, 220 kV line between Pul-e-Khumri and Kabul and would allow an additional 300 MW of imported or domestically produced power to flow to Kabul and potentially to the SEPS and some eastern provinces.

Currently there is a limitation on the transmission of electricity through the Salang Pass. Only about 130MW can be transmitted to Kabul via NEPS, due to technical issues. Both ADB and USAID are conducting feasibility studies to come up with mitigating strategies on how to expand the transmission from the North to Kabul and beyond. The feasibility study should be completed and available in March of 2011. The construction cost of this project is estimated at approximately $85 million and will be funded by ADB.

Timeline:

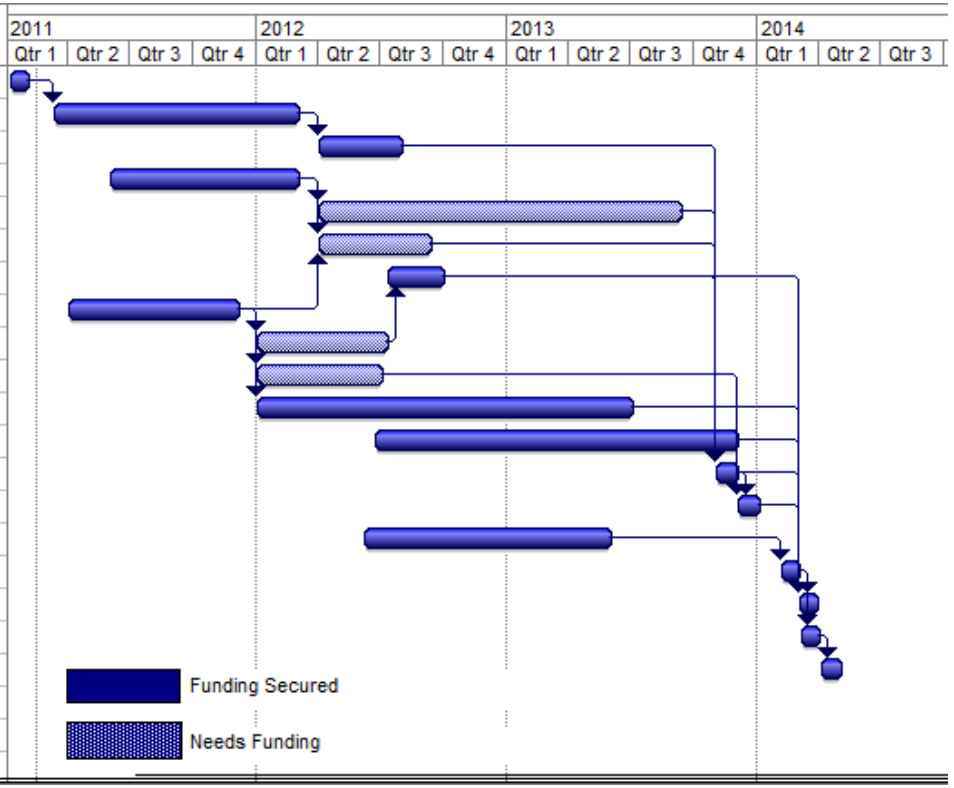
ADB will start the procurement process early next year and the construction can begin sometime in the second or third quarter of 2012. It will take about a year to build the transmission line.

Major Risks/Issues/Recommendations:

- None.

VI. THE CRITICAL PATH FOR THE IPP

ID	Task Name
1	Ranking of Exploitation wells for twinning (Twinning)
2	New Well Drilling to support gas supply to the IPP
3	Construction of gathering lines from the two new wells
4	Engineering Design and Bidding Process for Gas Sweetening Plant
5	Construction of gas sweetening plant
6	Water system for supply to gas sweetening plant and power plant
7	Testing & Commissioning of the compressor station
8	Engineering Design for the 200MW gas-fired power plant
9	Construction of the Compressor station
10	Construction of gas pressure reg. & metering station at Gerquduq
11	Construction of the 200 MW gas-fired power plant
12	Construction of NEPS II (Pul-e-Khumri to Kabul)
13	Commissioning of Gas Sweetening Plant for the IPP
14	Testing & commissiong of gas pressure reg. & metering station at Gerquduq
15	Construction of a 220kv transmission line from Sheberghan to Mazar
16	Commissioning of 220KV from Sheberghan to Mazar
17	Commissioning of 200MW gas-fired Power Plant
18	Commissioning of NEPS II
19	Synchronization of the system



VII. AFGHAN GAS CORPORATIZATION

MoM is anticipating a substantial future role for Afghan Gas. With the construction of the gas infrastructure in the coming years, it will be the responsibility of Afghan Gas to maintain and operate the assets that will be coming online. The goal should be to corporatize Afghan Gas, while retaining state ownership to protect Afghanistan's interest in its natural resources.

The SGFDP team has brought this issue up with both MoM and USAID, and both entities are supportive. Beginning the corporatization process will be critical to taking further steps with Afghan Gas, such as reorganization, negotiating a possible management contract, and coming up with a compensation plan that will retain and attract the required skilled workforce to carry out its responsibilities. This process will take years to complete, but the advantages of corporatization suggest that the MoM and USAID continue to engage in serious discussions on this issue in the coming months.

VIII. RECOMMENDED NEXT STEPS

On the NFPP…

- The goal should be to corporatize Afghan Gas. Beginning the corporatization process will be critical to taking further steps with Afghan Gas, such as reorganization, negotiating a possible management contract, and coming up with a compensation plan that will retain and attract the required skilled workforce to carry out its responsibilities.
- The size of the gas transmission pipeline from Sheberghan to Mazar should be 16" in order to plan for delivering gas to the industrial customers in Mazar in the next 5 years.
- It is important to point out that gas delivery to the Mazar industrial customers will depend on the size of the sweetening plant as well. If the sweetening plant can only process about 900,000 cubic meters per day then the volume of gas that will be travelling through the pipeline will be limited to about 1.3MCM per day (900,000 plus 400,000 of current production of sweet gas). This amount will not be able to sustain the industrial zone demand in Mazar. We estimate a demand of about two to two and a half MCM per day for use in the industrial zone in the next five to seven years.
- In our opinion, the rehabilitation of 48MW power plant may not be worth the $30M to $40M price tag, as the existing equipment is old and parts may not even be available. It may be better to build a new power plant with higher capacity, perhaps 60-80MW to connect to the Mazar grid and then on to the NEPS. Perhaps donors can pool their funds to get this done.
- We recommend rehabilitating the fertilizer plant in phases. The $4.5 million contribution from the Ministry of Mines can be spent on phase I and the fertilizer plant can pay for the remainder of the rehabilitation work in phases II and III out of its profits from phase I.

On the IPP…

- Lack of funding for the gas sweetening plant is a major issue. The funding either needs to come from the donors or it needs to be rolled into the cost of the IPP.
- There has to be Memorandum of Understanding signed between all parties involved in order for each party to know what they are responsible for and what are the next steps in order to ensure a smooth transaction. This MoU will also allow ADB, for example, to move forward with the construction of the Sheberghan to Naibabad 220kv transmission line.
- The investors/OPIC need to come up with a realistic financial model for the price of electricity. DABS, as the power purchaser, needs to know what price to expect before moving forward.