

TA 6066 - REG
**Turkmenistan - Afghanistan -
Pakistan**
Natural Gas Pipeline Project

**Techno-Economic
Feasibility Study
Final Report**

P E N S P E NTM

April 2005

Summary: Introduction



- **TAP Project Techno Economic Feasibility Study**
 - Objectives
 - Status
- **Sixth Steering Committee Meeting in Ashgabat**
 - Eliminated LNG at Gawadar
 - Selected Southern Route
 - Basis for project analysis
 - Preparation of Draft Final Report
- **Seventh Steering Committee Meeting in Islamabad**
 - Presentation of Draft Final Report
- **Eighth Steering Committee Meeting in Islamabad**
 - Presentation of Final Report
 - Next Actions

Summary: Techno-Economic Feasibility Study Objectives



- **Phase 1: Inception report**
 - Relate gas market data to project for development
 - Identify showstoppers
 - Develop two route corridors: select one
 - Evaluate LNG at Gawadar: discarded
 - Southern Route selected

- **Phase 2: Draft Final Report**
 - Purchase satellite data
 - Develop engineering done in Phase 1
 - Conduct field visits
 - Refine cost estimates
 - Perform economic and financial analysis
 - Discuss project viability

- **Phase 3: Final Report**

Summary: Final Report Objectives



- **Address and develop study terms of reference as applied to the project defined in the Inception Report.**
- **Provide a clear indication of overall project viability.**
- **Elaborate recommended pipeline corridor for Southern Route**
 - **Optimal route for development**
 - **Further development in FEED study**
- **Use Framework Agreement as basis for economic and financial analysis**

Site Visit



- **Team of 4 experts**
 - **Route Survey and Planning Engineer**
 - **Pipeline Construction Engineer**
 - **Environmental Expert**
 - **Social Resettlement Expert**
- **Visits to Pakistan, Afghanistan, Turkmenistan**
- **Meetings with Ministries, ADB, NGOs**
- **4WD and helicopter survey of Pakistan and Baluchistan**
- **Discussed with Ministries, NGOs in Afghanistan**
- **4WD survey in Turkmenistan**
- **No perceived impediment to pipeline construction or operation**

Pipeline Route



- **No insurmountable geo-technical constraints**
 - Enhanced satellite imagery used
 - Khojak pass
 - Sulaiman range
 - Seismicity and fault lines
- **No identified environmental or social constraints**
 - Further work required at FEED stage
 - Narrowing of the route corridor will focus attention
- **Problems with security**
 - Landmines
 - Insurrection
 - Risk to construction contractors
 - Risk of sabotage to completed pipeline
 - Perception of potential investors

Pipeline Design

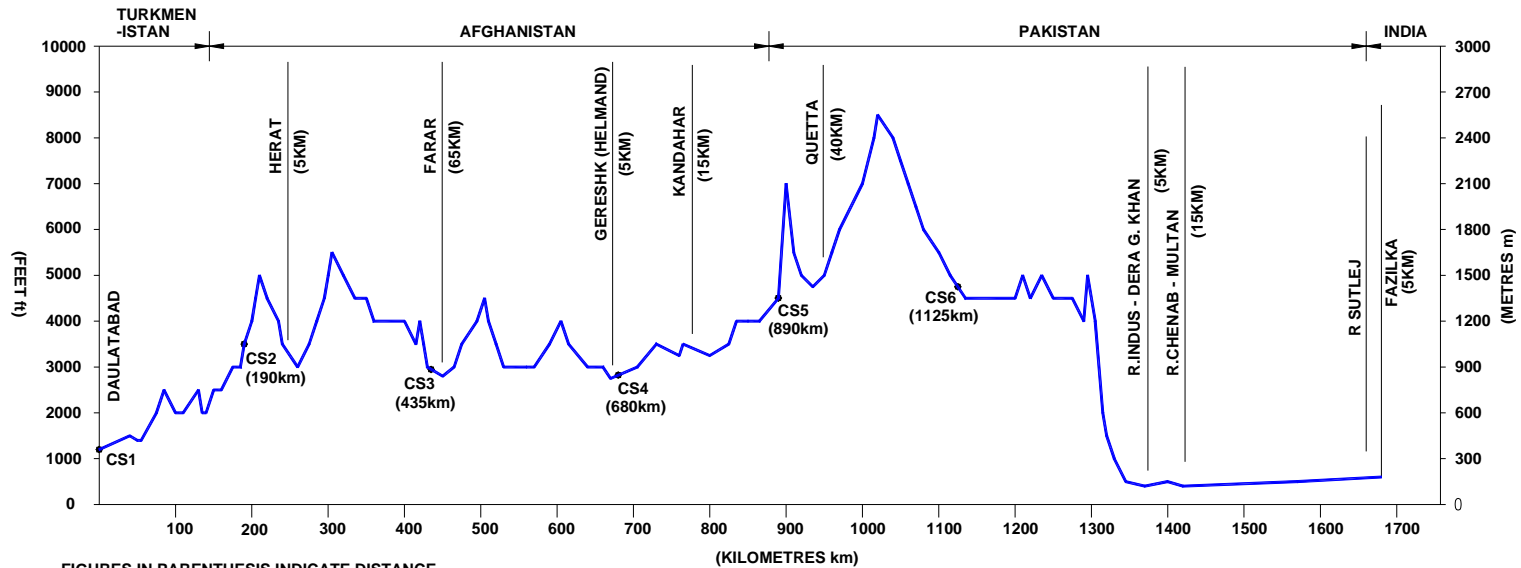


- **Design code ASME B31.8**
- **Single 56" pipeline for 2010 high rate flow (31.4 bcm / y)**
- **Length 1,680km**
- **API grade 5L X70: 20.6mm wall thickness**
- **Design pressure 100 barg**
- **Normal operating pressure 95 barg**
- **6 compressor stations: 3 x 30 MW each**
- **Capital cost \$3.3 billion**
- **Operating cost \$28.4 million/year**

Pipeline Route



Pipeline Route Profile



FIGURES IN PARENTHESIS INDICATE DISTANCE TO THE TOWN FROM OFFTAKE LOCATION.

T.A.P. ROUTE PROFILE: TOTAL LENGTH 1680KM

- = Compressor Station Locations

Supporting Information



- **Pipeline crossings, facilities**
- **Pipeline construction**
- **Pipeline operations and maintenance**
- **Pipeline communications system**
- **Medical requirements**
- **Insurance requirements, customs issues**
- **Environmental impact assessment**
- **Social impact assessment**

Environmental Mitigation

- **Route**
 - Kyzyljarsky Zakaznik
 - Avoidance of sensitive or valuable land
- **Land acquisition**
 - Minimise land take
 - Effective reinstatement
- **Construction**
 - Minimise nuisance and disruption
 - Minimise impact of workforce on communities
- **Operation**
 - Emissions
 - Health and safety
 - Environmental management

Social Impact Policy

- **Detailed socio-economic study**
- **Information programme**
 - Entitlements
- **Eligibility**
- **Consultation and participation**
- **Valuation and compensation**
- **Mechanisms for dispute resolution**
- **Mitigation of negative aspects**

Project Management



- **Implementation schedule**
 - Starts 2005
 - Operational in 2010

- **Basis for Cost Estimates**

Item	Southern Route
Size / dia inches	56"
Wall thickness / mm	20.6
Length / km	1,680
No. of compressor stations (3 x 30MW)	6
No. of Border Metering Stations	3
No. of Meter offtakes	0 ⁽¹⁾
No. of scraper receiver / launcher stations	10
No. of Block valves	53
No. of Bridges for Major River Crossings	3

⁽¹⁾ Offtakes assumed to be by others although tie-in at Multan is included.

Project Management



- **Capital Cost Estimates**

Item	Total	Total Local Costs		Total Foreign Costs	
	\$ Millions	\$ Millions	Percent	\$ Millions	Percent
Line Pipe	1,238	0	0%	1,238	100%
Construction incl ROW & land purchase	661	661	100%	0	0%
Compressor stations	593	161	27%	432	73%
Metering facilities	57	16	28%	41	72%
Block Valve / Launcher Receiver stations	49	11	22%	38	78%
Associated Infrastructure	128	128	100%	0	0%
Engineering & Project Management	179	32	18%	147	82%
Insurance	30	0	0%	30	100%
Contingency (@ 12.5%)	367	127	35%	240	65%
Totals	3,302	1,135	34%	2,167	66%
Length /km	1,680				
Equivalent Rate per inch dia./metre	\$22.71				

Project Management



- **Operating Cost Estimates**

	Total	Total Local Costs		Total Foreign Costs	
Item	\$ Millions	\$ Millions	Percent	\$ Millions	Percent
Spares/Equipment	0.14	0.07	50%	0.07	50%
Maintenance	0.51	0.08	16%	0.43	84%
Utilities	20.41	20.41	100%	0.00	0%
Manpower	2.75	2.59	94%	0.16	6%
Insurance	0.50	0.00	0%	0.50	100%
Overheads	4.07	4.07	100%	0.00	0%
Total	28.38	27.22	96%	1.16	4%

Economic Analysis - 1



- **ADB guidelines**
- **Framework Agreement**
- **Basis for analysis**
 - **Is a commercially financed project viable?**
 - **Establish minimum rate of return (ROR)**
 - **Establish minimum revenue flows from ROR**
 - **Test for sensitivity – India? – Entry price?**
 - **Include environmental costs**

Economic Analysis - 2



- **Market entry price \$2/MMBTU (\$71/MCM)**
- **Gas purchase price in Dauletabad – unknown**
- **Assumptions made: zero cost - \$20/MCM - \$40/MCM**
- **Transit fee – treated as a tax**
- **Discount rate – 17.5% - commercial finance**
- **Start-up date – 2010**
- **Share of TAP throughput for India?**

Economic Analysis - 3

- **6 market cases**
 - Moderate Pakistan
 - High Pakistan
 - Moderate Pakistan + Moderate India
 - High Pakistan + Moderate India
 - Moderate Pakistan + High India
 - High Pakistan + High India
- **All cases reported**
- **We will look at**
 - Moderate Pakistan
 - High Pakistan

Economic Analysis - 4



Moderate Pakistan

Financial Rate of Return

		Gas input price, \$/MCM			
		\$0	\$20	\$30	\$40
Gas sales price, \$/MCM	60	18.7%	14.7%	12.2%	8.8%
	71.04	20.5%	17.0%	14.9%	12.3%
	80	21.7%	18.6%	16.7%	14.5%
	90	23.0%	20.2%	18.5%	16.6%
	100	24.2%	21.6%	20.1%	18.4%
	110	25.4%	22.9%	21.5%	20.0%

High Pakistan

Financial Rate of Return

		Gas input price, \$/MCM			
		\$0	\$20	\$30	\$40
Gas sales price, \$/MCM	0.211				
	60	23.4%	18.1%	14.7%	10.6%
	71.04	25.7%	21.1%	18.3%	15.0%
	80	27.5%	23.2%	20.7%	17.9%
	90	29.3%	25.4%	23.1%	20.6%
	100	31.0%	27.3%	25.3%	23.0%
	110	32.6%	29.2%	27.3%	25.2%

NPV at Discount Rate of 17.5%

		Gas input price, \$/MCM			
		\$0	\$20	\$30	\$40
Gas sales price, \$/MCM	-116				
	60	312	-594	-1,047	-1,502
	71.04	790	-116	-569	-1,023
	80	1,177	272	-181	-636
	90	1,610	704	252	-203
	100	2,043	1,137	684	230
	110	2,476	1,570	1,117	663

NPV at Discount Rate of 17.5%

		Gas input price, \$/MCM			
		\$0	\$20	\$30	\$40
Gas sales price, \$/MCM	801				
	60	1,398	118	-522	-1,164
	71.04	2,081	801	161	-481
	80	2,635	1,355	715	73
	90	3,254	1,973	1,333	692
	100	3,872	2,592	1,951	1,310
	110	4,491	3,210	2,570	1,929

Financial Analysis - 1

- In accordance with the Framework Agreement
- Risks – field, transport, market, political
- Transit fees - \$1 / 100km / MCM
- Rate of return = normal discount rate = 17.5%
- Tariff assumptions
 - Depreciation
 - Operating costs
 - Return on undepreciated assets
- Full-cost, capacity-offered principle
- Carbon emission v benefits
 - Direct and indirect

Financial Analysis - 2

- NPV of gas revenues to Turkmenistan: No gas sale price escalation

Pakistan Moderate

		Pipeline rate-of-return allowed for ('\$ million)			
		10.0%	17.5%	20.0%	25.0%
Afghan Transit Fee \$ per 1000cm per 100km	0.5	\$2,465	\$889	\$364	-\$688
	0.8	\$2,284	\$708	\$183	-\$869
	1.0	\$2,162	\$586	\$61	-\$991
	1.3	\$1,980	\$404	-\$121	-\$1,173
	1.5	\$1,859	\$283	-\$242	-\$1,294

Pakistan High

		Pipeline rate-of-return allowed for (\$ million)			
		10.0%	17.5%	20.0%	25.0%
Afghan Transit Fee \$ per 1000cm per 100km	0.5	\$4,880	\$3,322	\$2,803	\$1,763
	0.8	\$4,620	\$3,062	\$2,543	\$1,503
	1.0	\$4,448	\$2,890	\$2,371	\$1,331
	1.3	\$4,189	\$2,630	\$2,111	\$1,071
	1.5	\$4,016	\$2,457	\$1,938	\$898

Financial Analysis - 3



Conclusions

- **Project appears robust for all scenarios, except Pakistan Moderate.**
- **Trade-off for Afghanistan: lost tax revenue / transit fee**
- **Affordable gas purchase price from Dauletabad**
 - \$20, \$30, \$40 / MCM?
- **Gas entry price in Pakistan**
 - Now \$2 / MMBTU (\$71 / MCM)
 - But trend is upwards to match LNG imports

Financial Analysis – 4

Rates of return for various input and market prices



				Gas input price, \$/MCM			
Gas sales price	\$/MCM			\$40	\$58	\$70	\$80
			60	10.6%	negative	negative	negative
		FIRR	71	15.0%	6.5%	negative	negative
			80	17.9%	11.2%	4.0%	negative
		EIRR	88.8	20.3%	14.7%	9.5%	2.5%
			100	23.0%	18.3%	14.3%	10.0%
			110	25.2%	21.0%	17.5%	14.1%

Sensitivity Results

Input Price in Turkmenistan		Market Price in Pakistan		FIRR%
\$/MCM	\$/MMBtu	\$/MCM	\$/MMBtu	
58	1.63	77.5	2.18	10.1
51	1.44	71.04	2	10.4

Recommendations



- **Complete the audit of Dauletabad gas reserves**
- **Firm gas price and transit fee variables**
- **Address minefield clearance and security**
- **Move to the next stage of project development**

Conclusion



- Thank you
- Discussion