Feasibility Study

Sédigi

Development Project

BACKGROUND

The previous plan for the exploitation of the Sédigi field was developed per the terms agreed to in the 1988 SEERAT Convention between the Republic of Chad and the Consortium (Exxon 40%, Shell 40%, Elf 20%). The Convention required that the Sédigi field facilities would be owned 100% by the Consortium, and that the pipeline and refinery would be owned and operated by "Societe d'Etude et d'Exploitation de la Raffinerie Tchadienne" (SEERAT), a company owned 51 % by the Consortium, and 49% by the Chad government. The objective of the SEERAT project was to pipeline the Sédigi crude to a newly constructed refinery to be located at Farcha in N'Djamena, the Countries capital which would meet the energy demands of "Societe Tchadienne D'Eau et d'Electricitie" (STEE) as well as meet the potential available petroleum market. As well, the project would have to meet the profitability criteria necessary for the government of Chad to secure financial support from the Consortium members, and/or other lending institutions to allow it to meet its cost obligation to the project.

STATE PETROLEUM OVERSEAS INC, PROPOSAL

The State, proposal for the exploitation of the Sédigi pool involves the construction of a 320 km pipeline, and associated gathering and pumping facilities from the field to N'Djamena, where a 3500 BOPD refinery would be located, designed to supply the national requirements for hydrocarbon byproducts as well as the fuel requirements for an upgraded 8 megawatt power generation facility located at the same site. The cost of the project would be borne 100% by State, with production sharing and cost recovery, to be negotiated. Ownership of all upstream facilities, which would include the Sédigi field production and gathering facilities, would be 100% State Petroleum Overseas Inc. Ownership of all downstream facilities, which would include the field evaporation system, crude oil pipeline and pumping station, the refinery' arid the power generation station would be 100% the Republic of Chad. State would commence construction of the development plan immediately upon the signing of an Exploration Agreement for the Lake Chad Basin, and a Production Sharing Agreement for the Sédigi field. Completion of the project is estimated to be 18 months from commencement.

The purpose of this report is to determine the feasibility of the exploitation of the Sédigi pool by State Petroleum Overseas Inc., prior to entering into an agreement with the Republic of Chad defining the respective rights and obligations of the parties regarding the conduct of petroleum activities by State within Chad. Fundamental to States determination of the economic feasibility of developing the Sédigi field, remains the unrestricted access to all technical data acquired on the Lake Chad Basin portion of the Permit H to date, to determine the remaining exploration potential of the basin, as well as confirmation of the availability of this portion of the Permit held-by-the Consortium, for further exploration and development by State,

TECHNICAL DATA

Since 1989, there has been extensive technical work done on the Sédigi project with respect to reservoir description, reserve determination, production capabilities and hydrocarbon properties by Exxon International and SNC Lavalin International. In addition, extensive research has been done on the petroleum byproduct requirements, and electrical energy requirements for the Republic of Chad, and reported on by these same companies. Haskoning Societe Royale d'Ingenieurs was commissioned by the Government of Chad to do a study on the impact of the proposed SEERAT pipeline and refinery on the environment. All of this information was made available to State by the Chad government, and was evaluated in detail by State's technical staff. The technical information contained in these various reports was determined to be reasonable and adequate to allow State to develop the alternative plan to the SEERAT project to exploit the Sédigi field.

GEOLOGY

The Sédigi Field is located about 300 km north northwest of N'Djamena, the capital city of Chad. The field was discovered by Conoco in 1975 with the drilling of the Sédigi 1 well, which tested hydrocarbons from eight of fourteen drill stem tests conducted on the well. Exxon further delineated the discovery in 1989 with the drilling of the Sédigi 2 well, and sidetracking of the original Sédigi 1 well as Sédigi 1A. Four production tests were performed in the Sédigi 2 well, and three production tests were performed in the Sédigi 1A well, all of which produced hydrocarbons.

The Sédigi pool occurs in the Termit Graben portion of the West African Rift System, which is continuous from Niger into Chad. The Termit basin is an extensional asymmetric rift, 575 km long, and 150-200 km wide. The basin is estimated to contain maximum sediment thicknesses, of approximately 14,000 m consisting of 1000-3000 m of Early Cretaceous fluvial-lacustrine clastics, 5000-7000 m of Late Cretaceous shallow marine clastics and minor carbonates, and up to 4000-5000 m of Cenozoic continental sands and shaly sediments.

Reservoirs in the Termit Basin are generally about 30 m thick, and occur in the Late Cretaceous fine grained tidal marine sandstones, and fluvial Tertiary sandstones. Two main structural styles are reflected over the majority of the Termit Basin. Basin extension resulted in a complex of tilted and rotated Cretaceous fault blocks, followed by sinistral wrench tectonics resulting in more gentle Tertiary anticlinal structures.

The Sédigi field is a faulted domal structure located at a drilled depth of approximately 2750m. The field contains multiple stacked reservoirs 6 m - 10 m thick, containing two gas/condensate zones and four high shrinkage volatile oil zones with varying hydrocarbon-water contacts. Volatile oil gravity is approximately 48° API while condensate gravity ranges from 50° to 52° API. The reservoir rock is good quality sandstone with porosities ranging from 15% to 21 % and permeability's ranging from 20 md to 500 md. The current average reservoir pressure is 27,570 kPag (4000 psig) at an estimated depth of 2800m with an average reservoir temperature, based on drill stem-test data, of 129°C.

RESERVES

The original oil in place for the field, based on geophysical mapping and reservoir parameters established by Esso Exploration and Production Chad Inc, is 30.9 MMSTB, and 11 Bcf gas. Based on simulation work done on the reservoir model by the same group, recoverable reserves for the field are 13.9 MMSTB oil, 1.4 MMSTB condensate and 5 to 10 Bcf of gas. This represents recovery factors in the oil zones ranging from 31% to 52%, and condensate recoveries ranging from 25% to 29%. The assumption used in these recovery factors was that the reservoir was aquifer supported, with water in place in the model about 1800 times the oil in place. If the reservoirs are not in fact aquifer supported, recovery factors would be cut at least, in half, without the implementation of an injection scheme.

PETROLEUM PRODUCT DEMAND

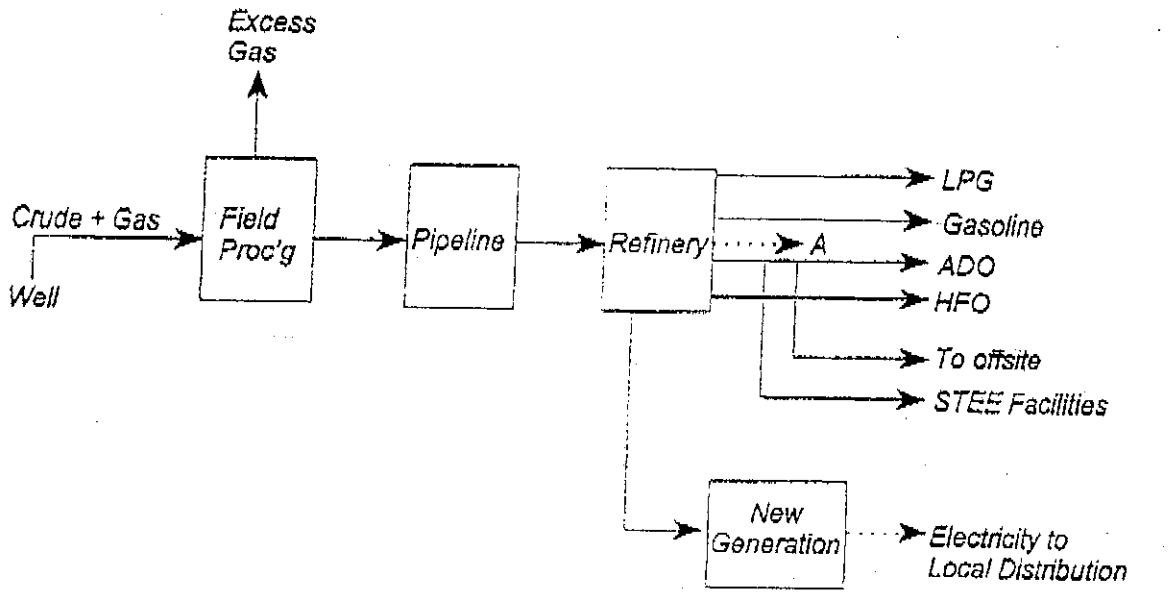
Whether the field has strong aquifer support, or weak aquifer support (which can be mitigated at significant: cost by water injection), the deliverability of the two existing wells appears sufficient to provide feedstock to the refinery to meet the expected product demand as defined by the Societe d'Etude et d'Exploitation de la Raffmerie Tchadienne (SEERAT), and the fuel requirements for the energy demands as required by the Societe Tchadienne d'Eau et d'Electricitie (STEE). The total SEERAT product demand is based on the following percentages of the individual markets:

Product	STEE Demand	Local Market
Liquified Petroleum Gas (LPG)	Nil	100%
Motor Gasoline (MOGAS)	Nil	40%
Jet Fuel (JET-A)	Nil	100%
Automotive Diesel Oil (ADO)	100%	29%
Heavy Fuel Oil (HFO)	100%	100%

The yearly total SEERAT petroleum product demand for the year 2000 is estimated to be 1516 BOPD, and by 2005 the demand is estimated to increase to 1848 BOPD. The STEE fuel requirements for the generation of 8 MW of electrical power in the year 2000 are estimated to be 530 BOPD, escalating to 659 BOPD by the year 2005. The total product requirement for the year 2000 is then approximately 2050 BOPD, increasing to approximately 2500 BOPD by the year 2005.

State's exploitation proposal for the Sédigi field is based upon meeting these initial requirements, and designing for the additional demand as anticipated, to a maximum output of 3500 BOPD of refined product.

GENERALIZED DESIGN

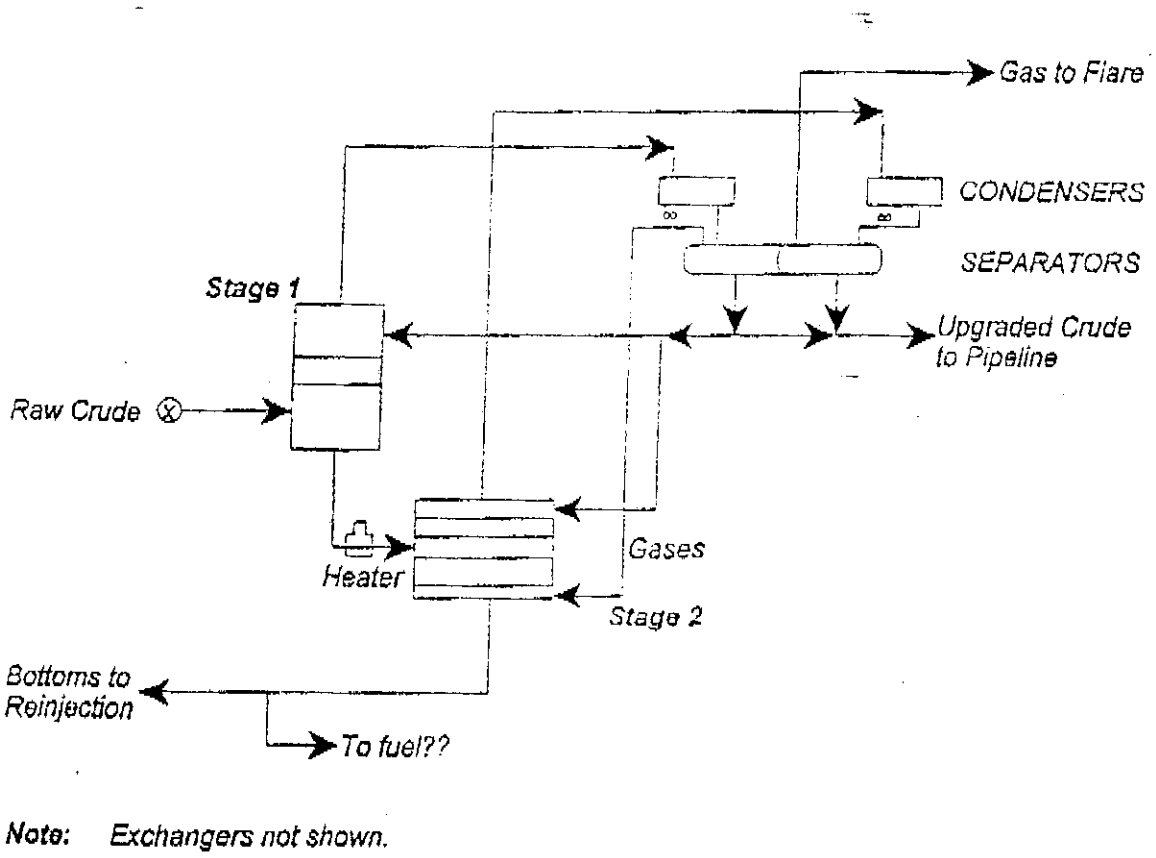


Note: A. *Petrole Lampant/Jet Fuel to be considered in future.*

SEDIGI PRODUCTION FACILITIES

The Sédigi production facilities will consist of the producing wellsites (Sédigi 1A and Sédigi 2) a gathering system from the producing well sites, which will take the produced crude to the Field Evaporation system. The upgraded crude will be held in storage tanks, from which a booster pump will pump the crude through a metering skid (considered the beginning of the pipeline), to the shipping pumps. The upgraded crude will be dry, and not contain the previously allowed 0.5% water (and salt not previously considered but which would be present if there is any water), and will have a reduced residual content about 50% of the original crude. Power will be generated at the Production Facilities by diesel engine powered electrical generators. The generators will supply power to the Production Facility as well as the Pipeline Facility, which will include power to the shipping pumps, lighting and control systems and communications systems. There will be sufficient fuel for the diesel generators resulting from the removal of a portion of the heavy ends of the crude by the Field Evaporation system. Any excess heavy ends would be re-injected if sufficient at site used did not develop.

FIELD EVAPORATION SYSTEM



Note: *Exchangers not shown.*

PIPELINE

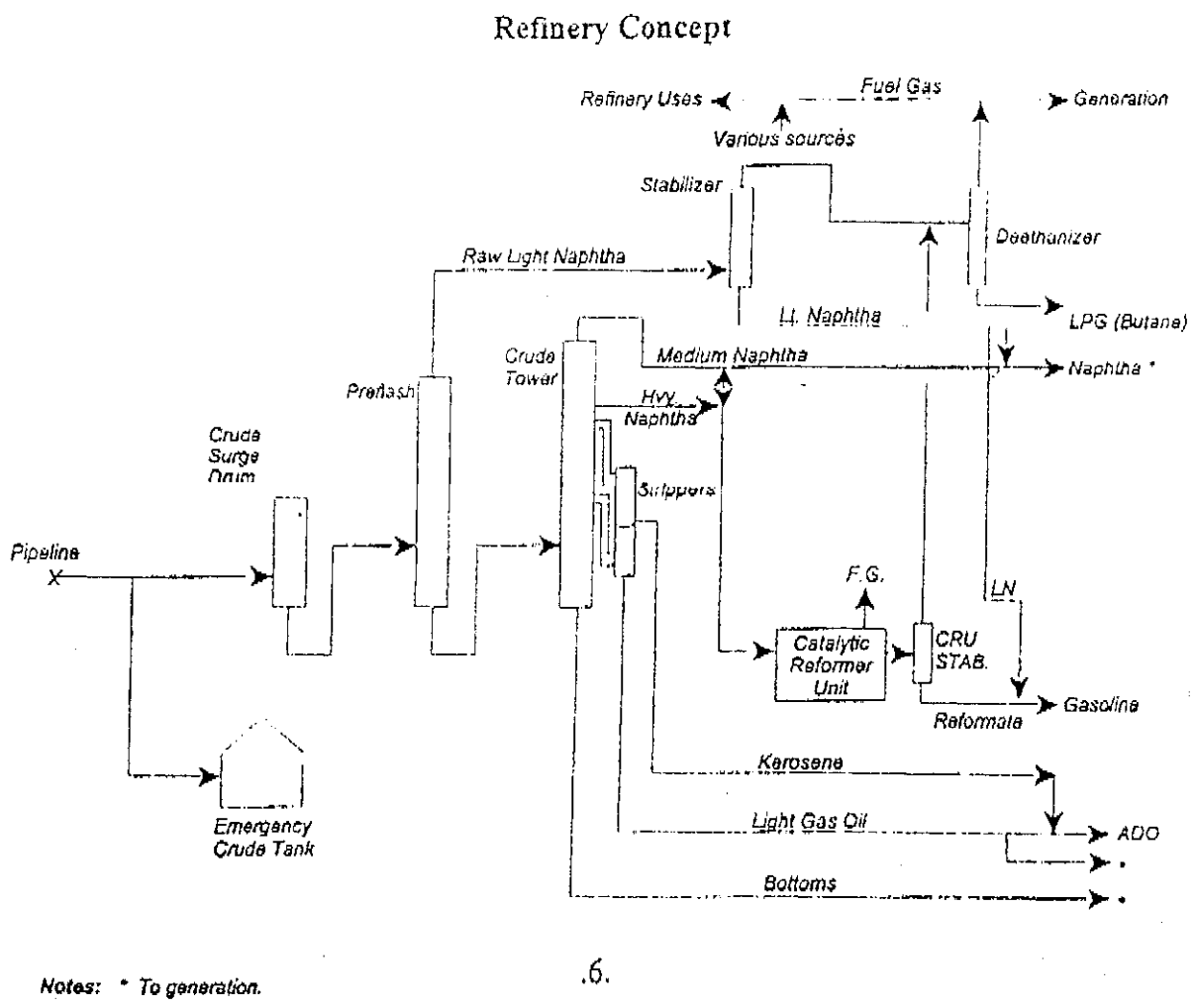
The proposed route for the pipeline would follow the "revised Hastening" route, as per the recommendations of the Esso Exploration and Production Chad Inc. SEERAT Project Design Basis Memorandum dated December 12,1996. This route is approximately 319 km long, and commences at the pump station, located in the Sédigi oil field near the town of Rig Rig to the north of Lake Chad, travels southeast to Bolosidi and Diarkouloula, rums southwest to Tourba, and on to the Farcha site near N'Djamena.

A 4" diameter carbon steel pipeline rated at ANSI 900 Class is proposed to transport the base case flow rate of 2500 BOPD, with a maximum flow capacity of 3500 BOPD. Pipe steel (grade X52) will be corrosion protected by applying an extruded polyethylene yellow jacket external coating, and cathodically protected using an impressed-current type of system, which will include facilities at both the Sédigi pump station, and at the refinery end of the pipeline. The Sédigi pipeline pump station will consist of a reciprocating plunger pump rated for ANSI 900 Class, with a second pump on standby.

The pour point for the Sédigi crude to be transported in the pipeline is 20° C, while ground temperatures at the 1 m depth of burial range from 19° C to 28° C Previous pipeline design proposals provided for isolation of pipeline sections at intervals of approximately 25 km to allow purging of a pipeline segment where line containing crude oil had gelled, resulting from ground temperatures at or below it's pour point. State plans to better resolve the pipeline hydraulic concern regarding a waxy fluid flowing below it's pour point by adding a "field evaporation" system. This unit would remove the heavy ends at the Sédigi site, with the resulting crude to be pipelined having a much reduced viscosity, and a pour point well below the lowest ground temperatures. In addition to alleviating the pipeline fluid gelling concern, this system would allow for the maximum design flow of 3500 BOPD without having to inject costly drag reducing agents at Sédigi.

Pipeline pigging facilities will be provided at the Sédigi pump station, with an intermediate receiver and launcher located near Bolosidi. A second receiver only unit will be located at the refinery. The scrapper traps should be of sufficient size to allow launching and receiving of instrumental pigs for pipeline inspection.

REFINERY



The refinery will take crude direct from the pipeline via a surge vessel with a standby crude tank only for emergency use. The crude will be separated into three naptha fractions, kerosene, light gas oil and a bottoms fraction. The heaviest naptha fraction will form the bulk of the feed to the 500 BPD catalytic reforming unit for conversion to 98 to 100 octane reformats The catalytic reformer will have special feed driers and sulphur adsorbers to protect the precious metal catalysts in the three reactors. LPG (butane rich) will be produced from the light fractions in the crude and possibly from C3C4's produced in the reforming.

Products for transfer to oil company tankage will be:

LPG	Primarily Butane	-up to 200 BPD-
MOGAS	*91 Octane Unleaded Gasoline	-up to 600 BPD-
ADO	Single all season product	-up to 900 BPD-
HFO	Minor product, but very pure	-up to 100 BPD-

*The gasoline will be composed of a blend of light naptha (75 octane) and the high octane reformate.

The STEE facilities will receive ADO and HFO, with excess fuel gas, LPG, HFO and all excess naptha going to the onsite electrical generation facilities.

Added crude capacity or less ADO could make available up to 500 BPD of feed for jet fuel to a kerosene hydrotreater using hydrogen available from the catalytic reformer to lower the napthalene and aromatics content of the raw kerosene and increase the smoke point. This unit will, operate at about 4500 kPa and would not be recommended for startup until 9 to 12 months after refinery startup due to the very close process control required, and almost doubling the laboratory workload required with jet fuel testing. In addition, several additives are required for the production of jet fuel.

ELECTRICAL POWER GENERATION

The refinery and new power generation facilities are assumed to be fully integral, recognizing the need for adequate spacing in case of fire or other emergencies, and only common utility systems have been considered.

There will be varying availability of excess fuel gas and LPG light, medium and heavy napthas; perhaps ADO; and excess heavy fuel oil from the refinery. The simplest means of converting such materials to electricity has been selected using steam. The upgraded Electrical Generation Facilities will initially consist of three to four Boilers generating a minimum of 4:500 kPa with 100+°C of superheat (the boilers would also provide steam for refinery stripping and reboiling), two Condensing Steam Turbine Generators (3-6 MW, to be determined at the next stage of development), Exhaust Steam Condensers (air, air/water, or water cooled) complete with vacuum systems, and one 1 MW Diesel capable of using ADO/HFO blend. The diesel will be largely for startup and shutdown of the refinery and boiler systems.

The Power Generation Facilities will be laid out to permit the relocation of selected reconditioned diesels from the present site, as well as the ability to expand to a total capacity of 30+ MW (peak with the largest generator off-line).

The following utility systems will be common to the Refinery, and the Electrical Power Generation facility:

Water:
- fire water
- cooling water (complete with cooling tower)
- boiler feed water
- service water

Steam distribution:
- note, all steam from generation boilers includes condensate return

Air:
- instrument air
- plant air

The following water and chemical facilities will be common to the Refinery, and the Electrical Power Generation facility:
- Flare
- Oily water treating
- Potentially oily water treatment
- Caustic and chemical handling
- Laboratory waste collection

In addition, the following service facilities will be provided:

- Air conditioned Control room complete with washroom and one office
- Laboratory, air conditioned (two rooms plus store room and one office)
- Motor control center, air conditioned

The construction utilized a single project management and process design team for the field, pipeline, refinery, power generation and related facilities. State plans to prefabricate all equipment modules, with modularization to the maximum spread between several. Canadian shops, and all modules and material packages would be air freightable, with the exception of the boilers. State would permit the use of certain reconditioned equipment (e,g. steam turbines, catalytic reforming reactors) where such equipment would perform and have a residual life equivalent, to new equipment.

State will supply, erect and connect all of the process and utility modules, as well as all equipment where it is not part of the modules. We will also supply the engineering for site development and building erection for control, laboratory, and generation buildings as well as supply all control room and laboratory equipment. In addition, State will supply plant Management for the first year of operation, with assistance in subsequent years available but not part of the current proposal.

It has been assumed that Chad-agencies would provide a clear level site, with all interface connections at the site limit for water supply, waste water disposal, product lines to the existing market terminals and electrical connections to the grid. In addition, Chad agencies would provide housing and relative facilities for expatriate staff during the project and the first year of operation to North American standards of quality. State requests the remission of any or-all taxes, duties etc. that might otherwise be-due resulting from the work done on this project by it's staff, or it's subcontracted staff, and the timely necessary approvals for all aspects of the project.

CAPITAL COST SUMMARY (MMSVS)

FIELD	
Evaporation Unit (3500 BPD of feed)	4
Gathering system, Booster pumps and Storage tanks	3
Sub total	7
PIPELINE	
4" Pipeline	25
Pumping Station	2
Subtotal	27
REFINERY	
Process units	16
- 3200 BPD upgraded crude	
- 500 BPD heavy naptha feed catalytic reformer	
Tankage with connecting piping and pumps	4
Pipe racks and onsite utility distribution	4
POWER GENERATION	15
-Steam generation system (8 MW total)	
-New diesel generation plus tie-ins for relocated units	
UTILITIES AND SERVICES	8
-only as specified to States account	
OVERALL (as specific to State's account)	
-Site development, roads, fences etc.	2
-Project management and related expenses	8
-Commissioning and training	3
-Plant management and Support (year 1 only)	2
-Subtotal	15
-Project total	**96**

CONCLUSION

From the preceding report, it is clear that the development of the Sédigi field will have a very significant capital cost associated with it. On a stand-alone basis, a project such as this would not generally be of interest to State.

The mandate of State is to explore for, and develop hydrocarbon reserves in basins of known hydrocarbon potential in underdeveloped areas.

We believe that the Lake Chad portion of the Termit Basin may be one such area. This report however, points out that State Petroleum Overseas Inc. proposal discussed at the beginning of this study is not economically feasible unless significantly more hydrocarbon reserves are proven within the basin to justify the construction of a larger pipeline from Sédigi, which may ultimately tie into the Doba pipeline to the south.

State is interested in pursuing alternatives to spend additional capital on future seismic and drilling programs in the basin that would develop the necessary reserve base to bring such reserves to market. Such development would bring with it added benefits to the citizens of the N'Djamena area, resulting from the construction of the refinery and power generation facility discussed in this report.

Before finalising our commitment to the further exploration of the Lake Chad area, and subsequent exploitation of the Sédigi field however, State requires that unrestricted access to all technical data acquired to date on the Lake Chad portion of the Termit Basin be made available to it, so that the Company's technical staff may better determine the additional hydrocarbon potential of the area, which is fundamentally important to the project's overall viability.

Sédigi Simulation Study

Results Summary

ISSUE

- Optimize recovery with two existing producers wells
- Investigate impact of a third well as an injector

RESULTS

- 2000 BOPD can be produced for 20 years

Sédigi Simulation Study

Conclusions

- We can product 2000 BOPD for more than 20 years with two existing wells if we have a good aquifer support
- More than 50% oil recovery is achievable in the case of active aquifer support
- 44% oil recovery seems achievable in case of a weak aquifer plus injection

SEDIGI SIMULATION RESULTS (ACTIVE AQUIFER)

OOIP = 30.9 MBO
OGIP = 0.9E + 11 SCF

CASES NAME	PRODUCTION (MBO)		(SCFE + 11)	RECOVERY Factor (%)	
	Cum. Oil	Cum. Water	Cum. Gas	OIL	GAS
JPSDGF	14.6	13.3	0.5	47.2	54
ASSDG3	13.4	12	0.5	43.2	47
ASSDGE	15.4	34.5	0.6	49.8	60
ASSDG7	15.8	20.5	0.6	51	59