Chapter 3

Project Description

The Chad Export Project is a proposed US $3.5 billion (2,100 billion FCFA) effort to produce and transport oil from southern Chad through neighboring Cameroon to the Atlantic coast for export to world markets. The project will produce approximately 160 million cubic meters (as much as 1 billion barrels) of crude oil over a 25- to 30-year period. The peak annual average production rate is estimated to be approximately 36,000 cubic meters (225,000 barrels) of oil per day. The project consists of two main components:

- **Oilfield:** Development of three oilfields in the Doba Basin of southern Chad with approximately 300 oil production wells, 25 produced water injection wells, a system of flowlines and gathering pipelines, produced fluids treating facilities, a power plant, cargo airport and operations control center.*
- **Transportation System:** An approximately 1,070-kilometer (663 mile) pipeline to transport crude oil from the oilfields in southern Chad through Cameroon to the Atlantic Ocean near Kribi, associated pump and pressure reducing stations, and an offshore marine terminal consisting of a moored Floating Storage and Offloading (FSO) vessel.

To support these two main components, the project will also include numerous infrastructure additions and improvements. These will include some new road and bridge construction as well as improvements in existing road and railroad infrastructure.

* A separate Environmental Assessment has been prepared and an Environmental Management Plan is being finalized for a small oilfield development at Sedigui, in West Central Chad. The Sedigui/SEERAT Project , which includes a refinery, will supply enough energy for an expanded and modernized power generating station for N'Djaména, the capital city of Chad.

For details on the environmental analysis and other considerations that have lead to the project design described here, see Identification and Analysis of Alternatives (page 5-1). For a description of environmental and social impacts of the design and the project's approach to mitigating these impacts, see Impacts and Mitigation Measures (page 7-1).

Standards and Guidelines

The project will be constructed and operated in accordance with internationally accepted standards and guidelines which specify a variety of measures for safety and environmental protection.

Some of the standards and guidelines applied to various aspects of the design, construction and operation of the project include:

- Applicable Environmental and Social Safeguard Policies adopted by the World Bank Group.
- Environment, Health and Safety Guidelines — Onshore Oil and Gas Development, May 31, 1995, published by the World Bank Group and covering issues relating to:
  - Liquid effluents.
  - Air quality.
  - Oil pipeline corrosion control and leak detection.
  - Noise.
  - Hazardous materials.
  - Health.
  - Safety.
  - Training.
- Applicable provisions of the Pollution Prevention and Abatement Handbook, published by the World Bank Group, July 1998.
- Applicable engineering standards and specifications promulgated by the:
  - American National Standards Institute (ANSI).
  - American Society of Mechanical Engineers (ASME).
  - American Petroleum Institute (API).
  - American Society for Testing and Materials (ASTM).

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal - Final Act, March 22, 1989.
- Applicable provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) published by the International Maritime Organization.
- Applicable provisions of the International Convention for the Safety of Life at Sea (SOLAS) published by the International Maritime Organization.
- Decommissioning, Remediation and Reclamation Guidelines for Onshore Exploration and Production Sites, Exploration and Production Forum report, No. 2.70/242, October 1996.

Oilfield Area

Development and production operations of the project oilfields will be performed by the Esso affiliate, the Consortium's designated operator. Current plans call for drilling approximately 300 wells in the Chadian oilfields. Approximately two-thirds of these wells will be in the Komé field — the largest of the three oilfields. The remainder of the wells will be divided between the Miandoum and Bolobo oilfields.

For a description of some of the alternatives considered during the design of the oilfield facilities, see the Chapter 5 sections on Scale of Oil Development Alternatives and Oilfield Design Alternatives, beginning on page 5-4.

Because the natural pressures of the reservoirs are not sufficient to push the viscous oil to the surface, each well will be equipped with an electric submersible pump located at a depth of approximately 1.6 kilometers (1 mile).

The crude oil and water produced by these wells will be transported through flowlines, manifolds, and gathering stations to processing facilities for collection and separation of oil, water and a small amount of associated natural gas. As with the main oil transportation pipeline, these flowlines will be buried for protection to a depth sufficient to avoid damage.

Following separation of the oil, natural gas, and produced water, special wells (injection wells) will be used to re-inject the separated water back into the original stratum from which it was produced.

In addition to the oil well locations, an Operations Center including the following facilities will be located in the oilfield area:

- A central treating facility to prepare the crude oil for insertion into the pipeline.
- Pump Station #1 of the pipeline system.
- Warehouses and a maintenance center.
- A training center for the workforce.
- Offices and accommodations for a portion of the workforce.

Although the oilfields will produce little natural gas, the natural gas that is produced will be recovered and utilized in combination with crude oil as fuel for the oilfield-area facilities. No gas will be routinely flared.

To supply power to the Operations Center and the field facilities, an approximately 120 megawatt electric power generation plant will be constructed. The combustion turbines for the generators are capable of burning gas, crude oil or a combination of both. Both crude oil and the small amount of produced natural gas will be used to fuel the power plant. (The available amount of produced natural gas will not be sufficient to run the entire power plant.) Waste heat from the plant exhaust will be recovered and used to assist in the oil separation process.

Pipeline

A key element in the proposed Chad Export Project is the construction of a pipeline to carry crude oil from the oilfield area of southern Chad across Cameroon to the offshore marine terminal.

The pipeline itself will be 760 millimeters (30 inches) in diameter, approximately 1,070 kilometers (663 miles) in length, and buried about 1 meter (3 feet) underground. The pipe will be made of carbon steel. The wall of the pipe will vary according to need, with heavy, thick wall piped used in locations such as river crossings where extra strength may be needed.

Two main types of corrosion protection will be utilized to prevent oil leaks:

- Cathodic protection will be used to prevent electrolysis, a primary cause of corrosion.
- Corrosion-resistant coatings will be applied. The pipeline will be covered with a polyethylene external coating. Buried valves, fittings, and other components will be protected by a field

applied epoxy or coal tar urethane coating. Above ground piping and valves will be protected by painting.

About 15% of the pipeline will be located in Chad and 85% of the pipeline will traverse Cameroon. A number of alternative pipeline routes were studied from an environmental, social and engineering point of view. The route selection process and the various alternatives, including the chosen preferred route, are described in Chapter 5, Identification and Analysis of Alternatives, page 5-1.

Construction activities associated with the pipeline will be restricted to an easement that will usually be 30 meters wide. This width will be varied in certain situations to aid construction and to meet specifications such as maintenance of anti-erosion grading requirements. At river crossings the construction easement will be 60 meters and it will be 50 meters at road crossings, areas with sloping terrain and areas where natural obstacles exist.

After construction activities have been completed, the transportation pipeline land easement will be reduced to about 15 meters and made available for use, including agriculture use subject to certain restrictions. For example, annual crops will be permitted in the easement, although houses or trees will not be allowed. Tree foliage or buildings could hinder the project's periodic aerial inspections. Tree roots could affect the buried pipeline's anticorrosion, protective coating.

The pipeline route has been adjusted to reduce the number of streams and rivers that need to be crossed, although a number of stream and river crossings are inevitable when traversing a distance of 1,070 kilometers. At crossing locations, trenching and pipelaying activities will be scheduled to take place during periods of low- or no-water flow, to the extent practical. As an added precaution, the pipeline will be laid deeper than normal (at least 1.5 meters or 5 feet) below stream/river channel bottoms to protect it from the potential effects of scour and changing bottom profiles.

Valves will be installed along the length of the pipeline at approximately 35 kilometer (22 mile) intervals and near each side of major river crossings to facilitate system operation and maintenance as well as to limit potential environmental impacts in case of a leak or spill.

Access to the permanent land easement will be on an as-needed basis and will be restricted to authorized vehicles and personnel involved in

maintenance, system monitoring, and (if necessary) emergency response. An induced access management plan has been developed so that public vehicular access to the land easement can be controlled in environmentally sensitive areas. (For a summary of the Induced Access Management Plan, see page 7-24. The full text of the plan is available in Volume 1 of the Environmental Management Plan for Cameroon.)

During the operations phase of the project, the transportation system will be monitored 24 hours a day by electronic instruments and leak detection systems. In addition, the system will be inspected regularly on the ground and from the air for signs of leakage or unauthorized activities that might affect overall system integrity. Other items that may require monitoring include soil erosion; changes in the flow rate in water courses; pipeline crossings of railroads, roads and streams; and the regrowth of brush and trees over the pipeline.

Pump and Pressure Reducing Stations

The project design of the pipeline system calls for three pump stations and a pressure reducing station. Pump Station #1 will be located at the main Operations Center in the oilfield area of southern Chad. Pump Stations #2 and #3 will be located in Cameroon and will be manned and completely self-supporting (i.e., each will have power generation capabilities and worker accommodations). The pressure reducing station will normally be unmanned and will be located in Cameroon, one kilometer inland at the terminus of the pipeline as it transitions to the undersea pipeline.

Heaters, fueled by crude oil drawn from the pipeline and upgraded using a local topping plant, will rewarm the crude oil flowing through Pump Stations #2 and #3 to approximately 71 ºC (160 ºF). (The oil entering the pipeline at Pump Station 1 will already be heated as a result of the treating process.) Heating the oil lowers its viscosity, or thickness, and improves its flow characteristics. As the pipeline exits each pump station, it will be buried at a 30% greater than normal depth (approximately 1.3 meters) for a distance of approximately 20 kilometers. This greater depth will safeguard soil structure and soil organisms from undesirable heat effects. A short distance after the heated oil leaves a pump station, its temperature is reduced to a point where it will not have a negative impact on the surrounding soil and vegetations.

The pressure reducing station will regulate the pressure of the crude oil that is delivered to the offshore marine terminal. This station, which will be located on 2.5 hectares of land near Kribi, Cameroon, approximately 1

kilometer (0.6 mile) inland from the coast, will be fully automated and equipped with tanks to handle emergency pressure relief situations.

Marine Terminal

The marine terminal is comprised of the marine portion of the pipeline, a Floating Storage and Offloading (FSO) vessel and its single point mooring system. One of the reasons for choosing the ocean-based FSO approach was its potential for reducing land usage in the coastal area. A land-based approach would have required extensive tank farms and other facilities that would have caused unnecessary disturbance to the beach and coastal area near Kribi.

For a description of other factors involved in the FSO decision and some of the alternatives considered during the design of the marine terminal, see the Chapter 5 sections on Marine Terminal Location Alternatives, page 5-8, and Marine Terminal Design Alternatives, page 5-21.

FSO systems are commonly used throughout the world and more than twenty such facilities are in operation off the coast of West Africa. FSOs have a very good operational and safety record off West Africa and elsewhere in the world, including the North Sea, the South China Sea and offshore Brazil.

Current plans call for a single hull crude oil tanker converted to stationary duty to be used as the FSO vessel. This tanker is targeted to have a crude oil storage capacity of 318,000 cubic meters (2 million barrels), roughly one week of pipeline output at peak capacity.

All tankers considered for acquisition and FSO conversion will be built in accordance with the conventions and codes of the International Maritime Organization in effect at the time of vessel construction. Considered tankers will have been maintained in compliance with current IMO standards, including the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for Prevention of Pollution from Ships (MARPOL).

The FSO vessel will be capable of operating at least 10 years without shipyard repairs with the potential of 15 years without a vessel drydocking. To achieve this 10 year serviceable life, the vessel will undergo extensive repair and life extension work prior to use.

The FSO will have segregated ballasts to ensure that seawater and oil are not intermixed, eliminating the need for oily water ballast treatment and disposal.

Supporting Infrastructure

During construction, most material will arrive on freighters at the Port of Douala (in Cameroon) and will be transferred to a project storage yard located near the port. Approximately 340,000 metric tons of materials will be moved through or within Cameroon during construction, of which 160,000 metric tons will be transported into Chad.

To transport supplies and equipment to the oilfield development area and along the crude oil pipeline route land easement during the construction phase of the project, upgrades to sections of the road systems in Chad and Cameroon are required. This will involve repairing 135 kilometers (84 miles) of existing paved road, repairing and improving approximately 475 kilometers (295 miles) of existing laterite road surfaces, and the construction of 35 kilometers (22 miles) of new road and one new bridge crossing the Mbéré River at the Chad/Cameroon border. In addition, many existing small bridges will require modifications and strengthening to handle the material transport traffic.

The existing Cameroon rail system between the port of Douala at the coast and Ngaoundal in the northern part of the country will be utilized to move equipment and supplies. Upgrades will be made to this rail system so that the freight movement requirements of the project can be satisfied without disrupting local rail services.

In addition to land transportation, key items of the large equipment destined for the oilfield facilities will be shipped by aircraft from Douala in Cameroon to Kome in Chad, thus reducing local impacts by reducing infrastructure construction needs.

In addition to transportation system offices in N'Djaména and Komé, Chad, and in Douala, Cameroon, the supporting infrastructure-related facilities required by the project include:

- Storage yards at the port of Douala and at 11 other locations along the pipeline.
- A satellite-based communications system to facilitate construction and operations as well as emergency response.

Two-way radio transmitter stations will provide continuous coverage over the length of the project area.

- A cargo airstrip located in the oilfield area that is capable of handling large cargo aircraft as well as smaller airstrips at Pump Stations #2 and #3.

Management of Waste and Hazardous Materials

Few pre-existing facilities are available in the project area for the management of waste. Therefore, the project will be responsible for constructing and operating many of the needed facilities. Waste management and disposal of hazardous materials will be conducted according to the applicable regulations of Chad and Cameroon, World Bank and IFC guidelines (Environment, Health and Safety Guidelines — Onshore Oil and Gas Development, May 31, 1995), and other internationally accepted standards such as the E & P Forum Exploration and Production Waste Management Guidelines, 1993 (also see Standards and Guidelines, page 3-2).

- Landfills will be constructed utilizing the widely accepted cell technique for covering and isolating waste as it is deposited.
- Incinerators will be constructed suitable for destruction of medical wastes, oily debris, domestic waste, combustible chemicals and oily process sludge.
- Landfills and incinerators, designed using U.S. Environmental Protection Agency engineering standards, will be put in place early in the construction phase to accommodate construction wastes.
- During decommissioning, landfills will be capped and sealed according to internationally accepted standards. As with all project structures, at decommissioning the incinerators will either be turned over for continuing local usage or will be dismantled and scrapped and their sites decontaminated as needed.
- At temporary construction sites, packaged sewage treatment plants or septic systems will be used to process wastewater.
- At permanent project facilities, wastewater will be processed by constructed facilities or, in some cases, through septic systems.
- One of two methods will be used to manage soil if it becomes contaminated with hydrocarbons. Soil may be removed and disposed of in accordance with the project waste management

plan. Alternatively, the contaminated soils may be remediated in place, utilizing technologies such as the application of nutrients that accelerate biological biodegradation of hydrocarbons.

- Containers used to hold or transport hydrocarbons used during operations, such as motor oil or other lubricants, will be cleaned and recycled for reuse by industrial suppliers, or cleaned and crushed before being landfilled.
- Fluids and sludge from processing vessels, storage tanks and the pipeline (including the hydrocarbon removed during decommissioning) will be recovered and disposed of in accordance with the waste disposal plan, generally through biodegradation, incineration or landfilling.
- Wells will generally be drilled using low toxicity freshwater-based muds to the extent that is feasible.
- As previously indicated, water separated from the crude oil prior to transportation via pipeline will be reinjected back to its originating producing stratum (depth).
- Low level radioactive sources are commonly used by the petroleum industry to test pipe integrity and for quality assurance purposes. This technology is a primary tool, especially during construction, to prevent future oil leaks. However, these products will be returned to their country of origin for disposal at a licensed facility specializing in this type of waste.

Decommissioning and Reclamation

Interim decommissioning and reclamation plans have been developed for each country. These plans have been developed at the project's inception to clearly set in place the project's principles for action when the project comes to the end of its anticipated 25- to 30-year life or as individual facilities reach the end of their economic life. The interim plans will be updated and finalized as the project comes to a close.

As with all project activities, decommissioning and reclamation will be conducted in full compliance with applicable laws and regulations of Chad and Cameroon, including the Conventions of Establishment that have been enacted by the parliament of each country and signed by Esso Exploration and Production Chad, Inc., TOTCO and COTCO.

Future decommissioning procedures will also be in accordance with international petroleum industry standards in place at the time of decommissioning activity. For example, if decommissioning were to occur

today, standards would be based on the Exploration and Production Forum report titled *Decommissioning, Remediation and Reclamation Guidelines for Onshore Exploration and Production Sites, No. 2.70/242*, October 1996 and the E & P Forum report *Offshore Pipeline Decommissioning*, August 1997.

The project's monitoring and audit procedures will verify compliance with the Environmental Management Plans, the final decommissioning plans and all applicable laws and regulations.

Reclamation

As construction is completed in each area of the project, the project will apply one or more of the following reclamation procedures to each construction site:

- Where appropriate, topsoil removed during construction will be stockpiled and spread on disturbed surfaces when construction has been completed.
- Topsoil stockpiled for more than six months will be fortified with fertilizers, soil enhancers or other organic materials to maintain viability prior to use in restoration.
- Vegetation that must be removed during pipeline construction will be conserved and spread over the easement during reconstruction, where it is practical to do so, to help control erosion, provide mulch and serve as a source of seed for revegetation.
- Except in cases where a local community wishes to retain a project construction facility for continued use, construction sites, including easements and construction camp locations, will be returned to natural contours and grade at the same time that topsoil is spread over disturbed areas.
- Topsoil stripping and construction of new borrow pits will be limited through the reuse of laterite from old exploration infrastructure such as well pads and airstrips.
- Following removal of facilities, land surfaces will be recontoured. Revegetation will be facilitated through fertilization or other appropriate techniques.
- For revegetation, seeding and planting will be from native seeds and seedlings, compatible with local soil conditions and climate.

Decommissioning At Project End

Where feasible, facilities will be left in place for use by the host countries. Where that is not appropriate, facilities will be decontaminated before abandonment in place or removal for reuse or recycling as scrap. Project sites will be cleaned up and land will be reclaimed.

- Oil wells will be abandoned using methods that will protect groundwater resources. Wells will be permanently plugged with cement.
- Well pads will be removed and any hydrocarbon-contaminated soil disposed of in accordance with the project's Waste Management Plan.
- Pending governmental approval, buildings will be provided to local organizations for reuse. Otherwise, they will be demolished and properly disposed of according to the project's Waste Management Plan.
- The oilfield power plant could be turned over to the Republic of Chad, pending governmental approval. If that approach is not feasible, the power plant will be salvaged/dismantled for reuse, recycled, or disposed of as scrap.
- In most cases, project-improved roads and railroad sidings will be left in place for continued use unless deemed environmentally undesirable.
- Buried piping, such as the transportation system pipeline and oilfield area flowlines, will be purged, cleaned of hydrocarbons, filled with inert material, capped and abandoned in place.

  All buried piping is below the normal depth likely to be disturbed by agricultural activities. Abandonment in place is environmentally preferable to the disturbance associated with the alternative, which will involve excavation.
- The Floating Storage and Offloading vessel and associated buoys and moorings will be removed and reused or recycled as scrap.