

## **OIL AND GAS PIPELINES**

### **Generality**

1. Projects related to oil and gas pipelines include the construction and development activities conducted at sea, near the coast or on land. Their diameter can reach two meters in length and extend as well as several hundreds of kilometers. Pipelines built near the coast or by land are generally buried. Offshore pipelines are often built on the seabed at a depth varying between 350 and 450 meters and in some cases, to 1500 meters.
2. The main facilities that relate to oil and gas pipelines have the pipes themselves, access roads and maintenance, the receiving station, the control room and transmission, central pumping and compression. Due to internal friction and elevation encountered along the pipeline, pumping stations installed at regular intervals changes are necessary when it comes to pipelines transporting over long distances, crude oil or derivatives (approximately 70 km). Compressor stations are installed along the pipeline transmission intervals that maintain line pressure. These can carry oil or raw gas wellbore transshipment facilities or refineries. Refined oil and gas can be transported in a pipeline to the end user, a petrochemical plant or a plant, for example.

### **Potential impacts on the environment**

3. The installation of pipelines on land involves a number of operations that are to develop a topographic map, to make the clearing of the right-digging trenches, climb, bend, weld, cover and coating lines to protect the corrosive action by a cathode coating to deposit them in the trenches (buried pipelines) to finally make backfilling and cleaning. The same kind of

work is done in wetlands, except that it must, in addition, carry out dredging and sediment transport before installing the pipes.

4. Laying pipelines offshore is to place the bottom of the sea sometimes anchoring using blocks or collection of concrete. If the pipe is not buried, it is then necessary that the trenches are dug. The pipeline is installed by means of a barge. Trenching is carried out by shovel underwater. The burial of offshore pipelines is mostly undertaken taking into account the natural currents and wave action, but sometimes it is done by artificial means. Pipelines that are installed near the coast or by land should be buried.
5. A judicious development activity attaches great importance to the maintenance and testing of equipment. Periodic inspection by land or air, must be done throughout the course of conduct in order to detect leaks might occur. Waste that can generate scrubbing equipment, removal of paraffin and limestone deposited on the walls of the pipeline (known as scrapers or scrapers), separation of the pumped material, removal of liquids and condensate (in the pipeline) must be removed. The life of a pipeline depends on the rate of corrosion and internal wear. Corrosion protection of pipes is necessary for most soils. The scope of the consequences engendered leaks and ruptures of oil and gas pipeline spreads far beyond the environment.

### **Positive impacts**

6. The oil and gas pipelines can contribute to the quality of the environment to the extent that they provide cleaner fuels for energy production and industrial (eg. Gas, low-sulfur coal compared with high sulfur content). Offshore pipelines that have not been buried can offer new habitats attracted by these new "artificial reefs" marine organisms.

### **Negative impacts**

7. The negative impacts of oil and gas pipelines installed at sea near the coast or on land vary depending on the type of installation, as specified in the following paragraphs (see table below gives further details) . The significance of impacts depends on the type and size of the pipeline and the degree to which natural and social resources are affected.
8. **Direct impacts: offshore pipelines**
- (a) The installation of offshore pipelines and coastal risk due to trenching and phenomena turbidity caused by the installation of pipes, result in the loss of benthic organisms. The magnitude of these impacts will depend on the nature and extent of aquatic resources.
  - (b) The construction of the pipeline could lead to the restoration temporary suspension of bottom sediments, which in turn may alter the characteristics of aquatic habitats and species composition change. The severity of these changes depends on the type and extent of the affected organizations. The alteration, for example, seagrass beds or coral reefs that shelter, feed and serve as breeding grounds for fish and other species is considered more serious than the change in the benthic habitats of the deep sea.
  - (c) If the trenching takes place near the coast or at sea where toxic chemicals have accumulated in the sediments (eg . at ports near outfalls receiving toxic chemicals such as mercury and polychlorinated biphenyls [ PCBs ] ) , pipeline installation may cause resuspension of these toxic sediments and temporarily lower the quality of the water just above the line. Aquatic organisms (such as fish and crustaceans) may suffer a process of bio- accumulation of these toxic elements.
  - (d) Pipelines installed in areas where fishing is carried to the bottom line , it takes place near the coast or at sea, can impede the movement of trawls and be the cause of both loss or damage fishing equipment

and accidental breakage of pipes. The slippage of an anchor may also be responsible for damage to the pipeline and oil spills.

## 9. Direct impacts on land pipelines

- (a) The installation of pipelines can cause erosion near work. In areas with steep slopes, it can make unstable slopes and cause landslides. Runoff and sediment transport can affect the water quality of watercourses during construction.
- (b) The installation of pipelines and roads maintenance may disrupt the runoff, prevent water runoff, retain some of these upstream pipeline and lead to asphyxiation of the vegetation and trees. A pipeline through a large forest area can cause real problems. In the case of wetlands, water flow be disrupted.
- (c) The creation of rights of way may lead to the invasion of exotic plants which dominate the natural vegetation, a phenomenon which, if left unchecked, can have serious long-term implications. The installation of pipelines can also lead to fragmentation of natural areas (wilderness areas, for example) whose consequences will result in the loss of animal and plant species and a decline in biodiversity.
- (d) The installation of oil and gas pipelines in developed areas can lead to the loss of use of land and displacement. It may be that certain types of agricultural activities are temporarily affected by construction.
- (e) Pipelines surface may impede the movement of people and migration of animals, the severity of this problem increases depending on the location and length of the pipeline.
- (f) The construction can result in damage to or destruction of archaeological sites.
- (g) The construction of the pipeline may cause temporary interruption of transport networks, this aspect could be particularly significant in the

case of a developed region and the pipeline crosses major transportation routes.

- (h) Pipe bursts and leaks as well as the waste generated at the pump and transfer points can be a source of pollution of soil, surface water and groundwater. The scope of this pollution depends on the nature and quantity of the substances discharged and the degree to which natural resources have been affected. Pipeline ruptures crossing bodies of water such as a river or wetland can have extremely adverse effects on the environment.
- (i) Rupture or leakage of pipelines can cause explosions or fire in and developed areas, such accidents are real dangers to the health of populations.

#### **10. Indirect impacts**

- (a) The construction of pipelines on land can lead to induced development (squatter settlement, for example) in the same grip and weigh heavily on the infrastructure of the region.
- (b) These pipelines can provide access to natural areas previously inaccessible (natural habitats) and lead to exploitation and degradation.

#### **Special issues**

##### **Natural resources**

- 11. Marine resources and estuaries are affected by the oil and gas pipelines installed in the sea or near the coast. Pipelines on land may have effects on freshwater resources. The location of the control is a key element when it comes to building a pipeline in a stream, river, lake or estuary, or near them, since the quality water could undergo serious changes caused by the phenomena of runoff and sedimentation. In addition, changes in

surface water runoff and construction of facilities within bodies of water may alter the functions of storing floodwater in these environments.

12. The construction of subsea pipelines can have significant impacts on coastal and marine resources and hamper fishing activities. The pipeline rupture or oil spill in the terminals can significantly degrade the water quality of streams, rivers, lakes, estuaries and other water bodies. It may also be groundwater polluted, depending on the nature and extent of the spill and the hydrogeological characteristics of the area.
13. Long pipelines can open up natural areas difficult to access, such as wilderness areas and give free rein to human activities (agriculture, hunting, recreation, etc.). These activities, against, may have adverse consequences, depending on the sensitivity of environmental resources and cultural characteristics of the population.

### **Sécurité des pipelines**

14. The transportation of natural gas in a pipeline involves a degree of risk to the public in case of accident and emissions that would ensue. A fire or explosions caused by the major pipeline rupture are the two greatest dangers to be feared.
15. External causes account for more than half of the accidents related to pipelines. Corrosion, faulty construction and equipment failures are among the other causes. Accidents as a result of the reckless operation of machinery, landslides due to compaction and leaching of soil, landslides to earthquakes, weather conditions (wind, thermal pressure) and to vandalism.

**Other specific aspects.**

16. Depending on their location and pipelines may impact on heritage assets, use and settlement of land, tribal populations, biodiversity, tropical forests, watersheds and natural habitats basins. Policy, procedure and guideline of the Bank on cultural heritage (or cultural) have been put in place to address these issues.

**Table: oil and gas pipelines**

Potential negatives impacts	Mitigation measures
<b>Direct impacts</b>	
<p><b>1</b> Resuspension of toxic sediments caused by the construction of offshore pipelines</p>	<ul style="list-style-type: none"> <li>• Choose another location for the pipeline.</li> <li>• Use of alternative construction techniques to avoid the possible resuspension of sediments (file line rather than burying it, for example).</li> <li>• Install the pipeline when the maritime traffic is lower.</li> </ul>
<p><b>2</b> Obstruction of fishing activities caused by pipelines installed near shore and offshore pipeline</p>	<ul style="list-style-type: none"> <li>• Establish a remote location known fishing areas.</li> <li>• Mark and indicate on maps the locations of pipes at sea</li> <li>• Burying pipelines through sensitive fishing areas.</li> </ul>
<p><b>3</b> Loss of habitats and organisms along the ROW at sea or on land near the pumping stations and compression facilitated access to natural habitats.</p>	<ul style="list-style-type: none"> <li>• Locate the right to avoid the significant natural areas.</li> <li>• Use appropriate clearing techniques (eg. Clearing manual rather than mechanical) along the height allowances established to preserve the natural vegetation adjacent to the pipeline.</li> <li>• Replant disturbed areas.</li> <li>• Use of alternative construction techniques (see paragraph 1).</li> </ul>

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| <b>4</b> Erosion, runoff and sedimentation caused by construction of the pipeline, roads and facilities | <ul style="list-style-type: none"><li>• Install the grip so as not to affect water bodies and slopes.</li><li>• Establish sediment traps or screens to control runoff and sedimentation.</li><li>• Use of alternative techniques for pipeline installation to minimize impacts.</li><li>• Conduct soil stabilization by mechanical or chemical techniques to reduce the risk of erosion.</li></ul> |
| <b>5</b> Alteration of hydrological regimes.  | <ul style="list-style-type: none"><li>• Locate the grip away from wetlands and floodplains.</li><li>• Avoid as much as possible the use of landfills.</li><li>• Design of drainage without consequences for surrounding land.</li></ul>  |
| <b>6</b> Invasion of exotic species and habitat fragmentation.  | <ul style="list-style-type: none"><li>• Place the grip in order to avoid important and sensitive natural habitats.</li><li>• Protect the natural ground cover (vegetation) above the pipeline.</li><li>• Take the necessary precautions in order not to obstruct the natural fire regimes.</li></ul>   |
| <b>7</b> Loss of enjoyment of land due to the location of pipelines and facilities on land.             | <ul style="list-style-type: none"><li>• Do not build in the right places that can hinder social and cultural land uses (the included agriculture).</li><li>• Develop construction plans to reduce the width of the control.</li><li>• Avoid as much as possible effects of construction on adjacent lands.</li><li>• Rehabilitate land along the ROW where the pipes were buried.</li></ul>        |
| <b>8</b> Barriers to movement of human populations and wildlife.  | <ul style="list-style-type: none"><li>• Place the grip in places that do not impede human movement and borrows wildlife corridors.</li></ul>   |
| <b>9</b> Increased traffic due to construction.   | <ul style="list-style-type: none"><li>• Stagger the work in order to control traffic.</li></ul>  |
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- Build alternative routes.

**10** Chemical pollution spills and waste oil

- Develop prevention plans for spills and waste oil at the same time as cleaning programs.
- Use techniques spill containment.
- Carry out cleaning and restoration of affected areas.

**11** Hazards caused by leaks or breaks in pipelines.

- Marking clearly highly developed places are buried pipelines.
- Develop plans and emergency evacuation procedures.
- Perform a leak monitoring.
- Install an alarm system to warn the public in case of accidents.

**Indirect impacts****1** Led development occurring during construction

- Develop a detailed plan where the secondary development activities can take place.
- Construct facilities and provide financial support to existing infrastructure.

**2** Increased access to wilderness.

- Develop plans for protection and management of these areas.
- Construct barriers (eg. Palisades) prohibiting access to sensitive natural habitats.

### **Alternatives to projects**

17. Evaluation of environmental impacts of an oil pipeline or pipeline should include an analysis of reasonable alternatives in order to achieve the true objectives of the project. This analysis can lead to a design that is of both social and economic point of view of the environment, more satisfying than the originally proposed project. Should consider the following options :
- Do nothing (ie, to examine the possibility to respond to the request within the limits of the available capacity.)
  - Consider alternative means of transport fuels (eg oil.)
  - improve existing facilities ;
  - Develop alternative routes for pipelines and other facility locations ;
  - develop alternative methods of pipeline construction , taking into account cost and reliability ;
  - Develop another pipeline design and materials (eg. Buried pipes rather than surface).
18. The answer to the question of whether these alternatives are appropriate or not should depend on economic and environmental factors. The pipelines are linear systems; the choice of possible routes is one of the most important elements in solutions. The attention given to this aspect avoids many adverse environmental effects which are responsible for the oil and gas pipeline projects.

### **Management and training**

19. As has been said, the choice of route is probably the most difficult decision to make when it comes to construction and operation of oil and gas pipelines. Environmental experts are expected to do this work with project engineers and help develop appropriate mitigation measures.

20. Training on the management of the environment may be required if the level of knowledge and experience of staff of the oil and gas pipeline was insufficient. It is important, for example, that employees understand the rationale for the recommended mitigation measures and monitoring program they are likely to implement. Local, regional and national environmental agencies, whose task is to review and approve the project may also , to require training where they learn to exercise control and ensure that the project meets the requirements of environmental management .
21. It may be that education and training program is necessary for security issues including evacuation procedures, plans for containment of oil spills and emissions. A contingency plan may be prescribed if there is risk of accidents for people.

### **Monitoring**

22. The requirements for monitoring oil and gas pipelines are based on the nature of environmental resources and the degree of impact to which they are subject. Construction activities will result in a follow-up so that the rules of good practices and specific requirements must be applied to avoid or mitigate adverse effects and take immediate corrective actions when an impact is likely to be produce. Storage areas for materials and equipment repair and the construction camp should also be taken into consideration.
23. Control practices can range from a simple visual inspection (eg sediment traps). Mitigation techniques for a more thorough examination of the quality of water in the pipeline which crosses or approaches a body of water. If the construction of a pipeline may cause **resuspension** of toxic

substances, it may require a comprehensive chemical and biological monitoring.

24. Monitoring should be carried out before, during and shortly after the establishment or burial of the pipeline. The objective of the monitoring program is determined by the extent and duration of the water pollution. Monitoring the operation of oil and gas pipelines is necessary to ensure proper operation and to detect defects which may cause leaks or ruptures.