STRATEGIC ENVIRONMENTAL ASSESSMENT FOR THE DEVELOPMENT OF A PHASED GAS PIPELINE NETWORK AND EXPANSION OF THE ELECTRICITY GRID INFRASTRUCTURE IN SOUTH AFRICA

Typical Operational Safety Aspects for a Gas Transmission Pipeline

The efficient and effective movement of gas from a producer to consumption regions requires an extensive and elaborate transportation system. In many instances, gas is produced in an area and will have to travel a great distance to reach its point of use.

The transportation system for gas consists of a complex network of pipelines, designed to quickly and efficiently transport gas from its origin, to areas of high gas demand. The gas transportation system within South Africa is regulated by the Gas Act (Act No. 48 of 2001). The Gas Act was promulgated to promote the orderly development of the piped gas industry in South Africa. It further provides for the establishment of the National Gas Regulator as the custodian and enforcer of the national regulatory framework and to provide for matters connected therewith. It promotes the efficient, effective, sustainable and orderly development and operation of gas transmission, storage, distribution, liquefaction and regasification facilities and the provision of efficient, effective and sustainable gas transmission, storage, distribution, liquefaction, re-gasification and trading services.

Transmission Pipes

Transmission pipes can typically range in size anywhere from 6 to 48 inches in diameter, depending on the economics and their function.

The operating pressure of transmission pipelines can exceed 100 bar gauge, and the suppliers of the gas into the pipeline are usually responsible for compressing the gas before supplying it at the inlet flange. The pipeline itself commonly consists of carbon steel material, engineered to meet standards set by the American Petroleum Institute (API) or similar. The proposed pipeline network would be designed in accordance with ASME B31.8 and the material grade would typically be X65 or X70. The top of underground pipelines are generally between 1 to 2 m below the ground level.

The pipe sections used for transmission pipelines are generally produced in steel mills, which are sometimes specialised to produce only pipeline. There are typically two different

production techniques, one for small diameter pipes and one for large diameter pipes. For large diameter pipes, from 6 to 42 inches in diameter, the pipes are produced from sheets of metal which are folded into a tube shape, with the ends welded together to form a pipe section. Small diameter pipe, on the other hand, can be produced seamlessly. This involves heating a metal bar to very high temperatures, then punching a hole through the middle of the bar to produce a hollow tube. In either case, the pipe is tested before being shipped from the steel mill, to ensure that it can meet the pressure and strength standards for transporting natural gas. Pipelines are often supplied in 12m or 18 m lengths, with a preference for the 18 m lengths as it requires less welding during construction.

The acceptable manufacturing processes are:

- Electric resistance or induction welded
    - HFW High Frequency electric welding

- Submerged arc welding
    - LSAW longitudinal weld seam
    - HSAW Helical weld seam (Spiral welded pipe)

In general, the pipelines are also covered with a specialised coating to ensure that it does not corrode once placed in the ground. The purpose of the coating is to protect the pipe from moisture, which causes corrosion. There are a number of different coating techniques. In the past, pipelines were coated with specialised coal tar enamel. Today, pipes are often protected with what is known as a fusion bond epoxy. In addition, cathodic protection is often used; which is a technique of running a low voltage electric current (typically equal to or less than 3V) through the pipe to ward off corrosion.

Compression

Reservoir gas is generally at a high pressure or compressed at the production facility to transport the gas to processing facilities. An inlet pressure of 100 bar is generally sufficient to transport gas up to 800 km. After that, compression becomes necessary to increase throughput. Compression will be required if the network has a single source input transporting gas over long distances. However, if there are multiple inputs 500 km apart, then compression will generally not be required. The installation of the compressor stations will be considered during the engineering studies for each phase of the network.

NOTE: Compressor stations have **not been** included in the scope of work of this SEA. Should a compressor station be required at a specific stage of the project, a dedicated environmental assessment process will be required.

Figure 1: Example of a compressor station – Location: Komatipoort (Source: Google Earth)

Pigging Stations

Pigging is essentially used for cleaning and inspecting the pipelines, whereby the pig is inserted into a "pig launcher" which is then closed and the pressure-driven flow of the product in the pipeline is used to push the pig along the pipe until it reaches the receiving trap or "receiving station". There are also "intelligent pigs" used to inspect pipelines for the purpose of detecting defects and corrosion thereby preventing leaks. Leaks can be explosive if within a specific range of gas/air mixture and is therefore dangerous to the environment and people in the vicinity. The pigging exercise usually does not interrupt production, though some product can be lost when the pig is extracted.

Pigging stations are can be located anywhere between 130 km and 500 km apart, the limitations being the capability of the pig in terms of battery life and on-board memory storage.

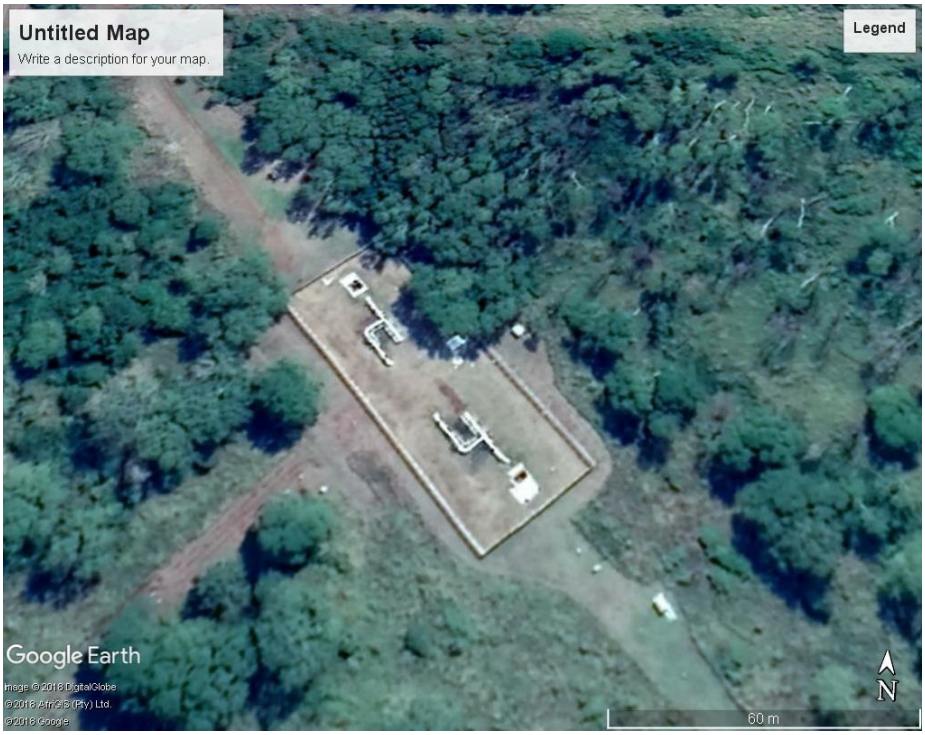

Figure 2: Example of a pigging station – Location: near Komatipoort (Source: Google Earth)

Metering Stations

In addition to compressing gas to reduce its volume and push it through the pipe, metering stations are placed at the end user's site. Essentially, these metering stations measure the flow of gas to the customer, and allow pipeline companies to 'track' the amount of gas conveyed to the end user.

Valves

Valves are usually placed at strategic intervals (30 km) along the length of a pipeline. Valves are usually open and allow gas to flow freely, or they can be used to stop gas flow along a certain section of pipe. The main reason why a pipeline may need to restrict gas flow in certain areas is if a section of pipe requires replacement or maintenance or for emergency shut-down.

Control Stations and SCADA Systems

Pipelines are usually monitored through a suitable system to manage and monitor the transmission of the gas through the pipeline. These systems are essentially sophisticated communications systems that take measurements and collect data along the pipeline and transmit it to the control centre. Flow rates through the pipeline, operational status, pressure, and temperature readings may all be used to assess the status of the pipeline at any one time. These systems also work in real time, meaning that there is little lag time between the measurements taken along the pipeline and their transmission to the control station. This enables quick reactions to equipment malfunctions, leaks, or any other unusual activity along the pipeline.

Pipeline Inspection and Safety

In order to ensure the efficient and safe operation of the gas pipeline, routine inspections are generally undertaken to inspect the pipelines for corrosion and defects. This is usually achieved through the use of sophisticated pieces of equipment known as “smart Pipeline Intelligence Gauges (PIGS)”. Smart pigs are intelligent robotic devices that are propelled down pipelines to evaluate the interior of the pipe. Smart pigs can test pipe thickness, and roundness, check for signs of corrosion, detect minute leaks, and any other defect along the interior of the pipeline that may either impede the flow of gas, or pose a potential safety risk to the operation of the pipeline. Pigs can also assess the state of the external coating of the pipeline. This process is commonly known as ‘pigging’ the pipeline.

In addition to inspection with smart pigs, there are a number of safety precautions and procedures in place to minimise the risk of accidents.

A few of the safety precautions associated with gas pipelines may include:

- **Aerial Patrols** – Helicopters surveys are used to ensure no construction activities are taking place too close to the route of the pipeline, particularly in residential areas. Unauthorised construction and digging is considered a huge threat to pipeline safety.
- **Odour** - In its natural form, gas is odourless, colourless and tasteless. Mercaptan, a harmless chemical added to natural gas contains sulfur, which makes it smell.
- **Leak Detection** – Natural gas detecting equipment is periodically used by pipeline personnel on the surface to check for leaks. This is especially important in areas where the natural gas is not odourised.
- **Pipeline Markers** – Signs on the surface above gas pipelines indicate the presence of underground pipelines to the public, to reduce the chance of any interference with the pipeline.
- **Preventative Maintenance** – This involves the testing of valves, repairing of defects, repairs of washaways and the removal of surface impediments to pipeline inspection.
- **Emergency Response** – Emergency response teams that are prepared for the possibility of a wide range of potential accidents and emergencies.