

Original Article

# Designs of Radio Antenna Systems for the Oil and Gas Industry

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Received: 07 August 2022

Revised: 15 September 2022

Accepted: 25 September 2022

Published: 10 October 2022

**Abstract** - Several oil and gas companies are using radio communication as the first mean of communication to optimize operations, boost profitability, and operate safely. Radio communications are considered the most crucial service for oil and gas plants since they are intrinsically safe and have many required features, such as group calls. This article illustrates the designs of radio antenna systems for the oil and gas industry as well as their best examples of use. In addition, it explains the challenges in the design and how to overcome them.

**Keywords** - Radio, Omni Antenna, Panel Antenna, Oil and Gas Industry, Indoor Repeaters.

## 1. Introduction

This article sheds light on leveraging radio communication for the oil and gas industry. It explores the radio uses in the industry besides its advantages. In addition, the article illustrates the different types of radio antenna system designs to provide adequate radio coverage for the needed locations. Furthermore, some challenges are introduced regarding designing the radio antenna system and providing recommendations to overcome these challenges.

## 2. Radio Importance for the Oil and Gas Industry

Radio communication is considered the best communication method in the oil and gas Industry. There are being used in different facilities based on business requirements.

### 2.1. Use of Radio in the Oil and Gas Industry:

The use of radio communication is very crucial in the oil and gas industry in order to maintain an efficient and safe operation. For example, the use of radio communication within the refineries of the oil industry has grown with remarkable speed in the last few years [1]. This is because it was extremely difficult in the bigger refineries to find point-to-point wire communications adequate for their needs. For instance, an average-sized refinery of 100 thousand barrel-per-day capacity will encompass huge areas and be manned by more than 2,000 people. These people must be in motion to carry out their duties between unspecified locations. This presents a communication problem that is unique [1]. Therefore, wireless communication is the best fit to provide mobile communication for plant operators.

### 2.2. Radio Communications advantages

Radio communications are considered the best way of safe and secure communication in the oil and gas Industry. It is due to the fact that Radio technology enjoys several benefits making it the most appropriate solution for communication within oil and gas facilities, including:

#### 2.2.1. Intrinsically Safe

The oil and gas facilities are considered hazardous, and it is necessary to utilize Intrinsically Safe devices only in these areas. A hazardous area can be defined as any location with a risk of an explosion. But every hazardous area is different, and each has specific requirements depending on the atmosphere's nature and the elements present. [2] Communication in a hazardous area is always possible by employing an efficient, Intrinsically Safe device such as two-way radio wireless [3]. They are far much better than mobile phones because of their safety as they don't cause any ignition when they are used.

#### 2.2.2. Group call

Group call is a major service in radio, and it is a key feature to involve numerous participants in one group [4]. Group Call provides voice call service between one individual user and a predetermined group of users. All parties in the group can hear each other. It enables the plant supervisor to easily give orders to his team so everyone in the group call will be aware of the ongoing activities and can work in sync with others.



### 3. Designs of Radio Antenna Systems for the Oil and Gas Industry

The oil and gas industry varies regarding the need for radio coverage. For instance, the required radio coverage for pipeline operations differs from plants such as refineries and gas plants.

#### 3.1. 2-panel Antennas with the Narrow Band

The first common design to provide radio convergence is to install 2-panel antennas with narrow bands and high gain. These two antennas work together to provide long-distance coverage while it is narrow. This type of design is considered the most cost-effective solution for specific areas, such as pipelines, where the maintenance team only needs coverage around the pipeline. This design implemented in pipeline areas results in a huge cost saving as it minimizes the number of communications sites, including a communication tower, radio base stations, radio cables and antennas. In this design, both antennas work together to transmit and receive.



Fig. 1 The radiation pattern of 2 bi-directional antennas [5]

#### 3.2. 3-panel antennas with wide band and one Omni Antenna

The second design uses 4 antennas with high gain to provide a wide coverage that looks like a circle. This design is the best one to provide radio coverage for the oil and gas industry plants such as gas and oil separation plants, refineries and distribution plants. The first antenna is an Omni antenna and is responsible for transmitting only. As for receiving, this design offers 3-panel antennas combined together (tri-sector) to provide sufficient coverage that looks like a circle and hence covers a specific area or plant. The reason for using 3 antennas for receiving is to enable the radio base station to detect small signals coming from handheld radios with low power, unlike transmitting, where the base station has high power and can transmit the signal to far distances using one antenna only. [6]

### 4. Challenges

#### 4.1. Shadow Areas

When designing the radio antenna system, one challenge to be faced is the shadow areas. It results from blocking the radio signals from the radio base stations and vice versa. The blocking can be caused by huge buildings with strong isolation, mountains or other facilities [8]. To overcome this challenge, the antenna system designer may increase the antennas' height and tilt them down to provide sufficient coverage for the area while avoiding blocking objects. Also, the designer must choose the best location for the antenna system to cover the needed radio communication areas.

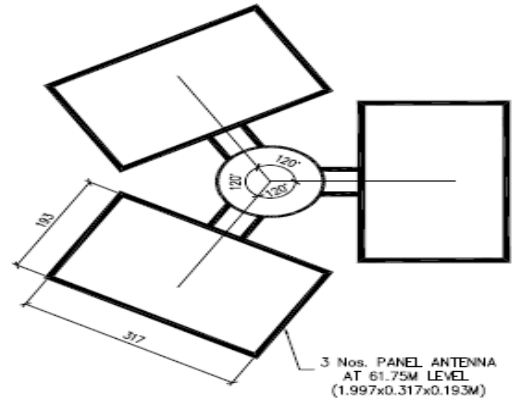


Fig. 2 3-panel antennas combined together (tri-sector)

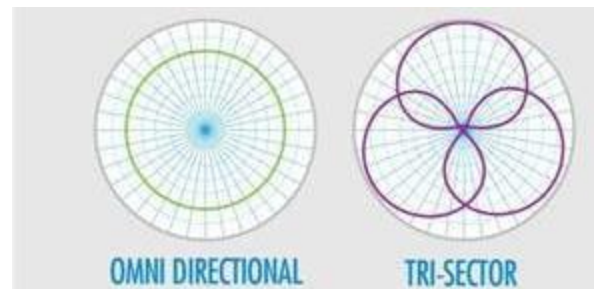


Fig. 3 Omni and Tri-Sector Antennas Signals Pattern [7]

#### 4.2. Buildings Isolation

Another challenge to be faced by the designer is the weak indoor coverage caused by the building's strong isolation. Usually, the buildings in the oil and gas industry are constructed as explosion-proof to protect the workforce inside the building in case of any incident. [26] Therefore, the designer must consider a radio indoor repeaters solution. The indoor radio repeaters work perfectly in a building with strong isolation as they take the signal from outside, amplify it, and repeat it inside the building while not causing any radio signal interference. [10]

### 5. Conclusion

As illustrated in this article, radio communication is the most important means of communication in the oil and gas industry since it is intrinsically safe and has many required features, such as group calls. Therefore, the antenna systems design must be developed carefully to ensure the availability of sufficient radio coverage. The article introduced two designs; 2-panel antennas with a narrow band recommended for areas such as pipelines and another design with 3-panel antennas and one omni antenna that fulfill the radio coverage needs in gas and oil plants. Lastly, the article discussed the challenges of having shadow areas and strong isolation building and how to overcome them.

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