

Security Threats in the Oil and Gas (Petrochemical) Industry

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ABSTRACT

The oil and gas industry is an international and multi-million dollar industry today. As a result of this, the oil and gas industry remains a target of attacks by terrorists, insider attack/sabotage, cyber attack, attack of oil rigs, installations and facilities and its workforce. To this end, the oil and gas industry must rise up to these challenges to ensure and enhance security and safety of its staff, customers and facilities for smooth daily operations. The security department must be manned by skilled and experienced security personnel, who should be regularly trained and retrained to always keep abreast of modern security techniques. Security is everybody's business, every staff of the organization without exception must be security conscious. This paper looks into security in the oil and gas industry, its vulnerability, challenges, prospects, and the way forward in providing adequate security.

KEYWORDS: Oil, natural gas, fossil fuels, surveillance, onshore, offshore, artificial intelligence, cybersecurity, terrorism, risk management

INTRODUCTION

The development and production of oil and natural gas are energy resources called fossil fuels. Fossil fuels are formed from prehistoric organisms decomposed underground over several to tens of millions of years, which are now available for use as energy resources. Fossil fuels in the liquid state is known as oil, while those in the gaseous state is known as natural gas. Natural gas is distributed as city gas to general households and other uses, used as well for large-scale plants, in industrial facilities, and power generation. Natural gas is used too as raw materials for chemical products. Oil and natural gas are formed via [1]:

1. Dead plants and animals which accumulate and form strata.
2. They then transform into rocks that have the potential to produce oil/natural gas.
3. Kerogen transforms into oil and natural gas under high-temperature and high-pressure environments.
4. Oil and natural gas then accumulate.

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HISTORY OF THE OIL AND GAS INDUSTRY

Oil and gas had earlier been used as in lamps and as a material for construction for thousands of years before the modern era, with the earliest known oil wells being drilled in China in 347 AD. The modern history of the oil and gas industry started in 1847 with a discovery made by a Scottish chemist James Young, who observed natural petroleum seepage in the Riddings coal mine, and from this seepage distilled both a light thin oil suitable for lamps and a thicker oil suitable for lubrication. Young was able also to distill a number of liquids and an early form of petroleum. He patented these oils and paraffin wax, distilled from coal in 1850, and later formed a partnership same year with geologist Edward William Binney. They formed the first truly commercial oil refinery and oil-works in the world, manufacturing oil and paraffin wax from locally mined coal. In 1846, Canadian geologist Abraham Pineo Gesner refined a liquid from coal, oil shale and bitumen that was cheaper and burned more cleanly than other oils this liquid he called "kerosene" and founded the Kerosene Gaslight Company in 1850, using the oil to light the streets of Halifax and later the US.

A Polish engineer Ignacy Lukaszewicz improved Gesner's method to easily distill kerosene and petroleum in 1852, opening the first "rock oil" in Bobrka, Poland in 1854.

The first oil well drilled was in the town of La Brea, Trinidad in 1857, drilled to a depth of 280ft by the American Merrimac Company.

The first modern oil well in America was drilled by Edward Drake in Titusville, Pennsylvania in 1859, which led to the Pennsylvania "oil rush," making oil one of the most valuable commodities in America, as shown in Figure 1.

Late 18th and 19th century marked the creation of major oil companies that still dominate the oil and gas industry today. John D. Rockefeller founded the Standard Oil Company in 1865 becoming the world's first oil baron. ExxonMobil, one of Standard's successors after it dissolved in 1911, is the world's ninth largest company by revenue today.

In Russia, the Rothchild family commissioned oil tankers from British trader Marcus Samuel to expand their oil operations and reach more overseas customers. Samuel's first vessel, the Murex, was the first oil tanker to pass through the Suez Canal connecting the Mediterranean Sea to the Red Sea. The Murex became the flagship vessel of Shell Transport and Trading, which eventually merged with Royal Dutch Petroleum to become Royal Dutch Shell. As at today, Royal Dutch Shell is the fifth largest company in the world and one of six oil and gas supermajors.

The discovery of oil in Masjed Soleyman, Iran by William Knox D'Arcy led to the incorporation of the Anglo-Persian Oil Company (APOC) in 1907. The British Government purchased 51% of the company to provide the Navy with oil during the World War I in 1914. In 1954, APOC became British Petroleum, known today as BP, which is currently the sixth largest oil and gas company in the world.

From the late 20th century, changes in the oil market has moved influence from oil-consuming areas such as US and Europe to oil-producing countries. Iran, Iraq, Kuwait, Venezuela and Saudi Arabia formed the Organization of the Petroleum Exporting Countries (OPEC) in 1960 in response to multinationals in the "Seven Sisters" including ExxoMobil – at the time split into Esso and Mobil – Shell and BP, which operated from oil-consuming countries. Despite the competition from renewable sources of energy, the oil and gas industry is still thriving today, albeit in a more volatile state than ever due to world events [2].

SECURITY TRENDS AFFECTING THE OIL AND GAS SECTOR

Surveillance specialist Senstar (a global technology leader) has identified three security trends affecting the oil and gas sector in 2023 as:

1. Ongoing conflicts and physical threats,
2. New artificial intelligence-enhanced technologies, and
3. Remaining vigilant against cyber-security threats.

"The conflict in Ukraine, regional instabilities, and the potential for geopolitical or ecological-based terrorism continues to pose substantial threats to the physical security of oil and gas infrastructure and its personnel" as stated by Senstar Product Manager Stewart Dewar to Rigzone. He further stated that "2022 has unfortunately demonstrated that pipelines, undefended over large distances, are at high risk from sabotage and hot tapping, while facilities and staff, particularly in unstable regions, remain at risk from direct, coordinated attacks [3].

According to Stewart Dewar, "in 2023 and beyond one specific area of focus is the physical security of liquefied natural gas (LNG) infrastructure, including plants, export terminals, and regasification facilities. The strategic significance of LNG infrastructure cannot be overstated – in many jurisdictions, physical security systems must be fully certificated before operations can even start, making LNG facilities high-value targets with substantial security requirements," as shown in Figures 2 and 3.

To mitigate these risks, the oil and gas companies are to:

1. Devote substantial resources to improving their ability to detect physical security threats as they occur,
2. Maintain situational awareness via improved remote monitoring, and
3. Reduce reaction times of security forces.

However, for buried pipelines, this will require the deployment of long-range fiber optic sensors that can locate and classify disturbances to within a few feet or meters and relay this information to the central monitoring centre. For oil and gas facilities, a new generation of perimeter intrusion sensors, low-cost thermal cameras, and AI-powered video analytics provide security personnel with improved situational awareness, empowering them to take quick and effective action as situations develop.

The oil and gas is a major industry supporting the global economy as oil and gas still remain the primary sources of energy for industrialized and developing economies of the world. The oil and gas industry is one of the most attractive targets for

growing global terrorism and maritime piracy. While the threat of terrorism and sabotage attacks are across the supply chain of the oil and gas industry – from oil wells, transportation to refineries, the threat of piracy primarily concerns the oil tanker industry, as shown in Figures 4 and 5. The Somali pirates attack on an oil tanker, resulting in increased costs for oil transportation and in turn leads in higher end prices for consumers. Any major terrorist attack or act of sabotage on production facilities like oil rigs, offshore platforms and refineries will result in loss or complete stoppage of production, which might take months to restart. The entire supply chain from oil wells and offshore platforms to pipelines, tankers and refineries can be affected by the following security threats:

- Piracy
- Terrorism
- Insurgency
- Organized crime
- Civil protest
- Inter-state hostilities
- Vandalism
- Internal sabotage.

Any of the above threats can cause severe economical and ecological damage that might affect the international oil and gas markets.

The offshore industry requires a sophisticated approach for security such as:

1. Threat and risk analysis: Field operations require assessment and development of practical security measurements to mitigate risks. This process requires identification of potential risks, establishment of boundaries, evaluation of the consequences and generation of prevention and business recovery plans.
2. There is the need to understand the types of threats faced by offshore installations including knowledge of various threat groups, the dangers they represent, their goals, intentions, offshore capabilities, opportunities, past attacks and interferences with offshore installations and possible future actions.
3. Another important factor is the geographical one, as attacks on oil and gas installations occur in many countries, but oil companies face different security risks depending on the region they operate in. Oil companies that operate in high security risk areas such as conflict zones, and those that operate in economically and politically unstable countries are always at a higher risk of attack.

Therefore, geography and other enabling factors, such as the presence of armed conflict in the area play

important role in identifying, qualifying and quantifying potential risks to offshore oil and gas installations. Threat and risk analysis will help to build proper-layered security levels in order to form a quick reaction/response force for any potential threat.

EXPERIENCED SECURITY PERSONNEL

Hiring of skilled and experienced security personnel is a must to protect company's assets with insured operations to be unmolested. The Operations Department must have efficiently developed security culture policy that responds to all international security norms and standards (e. g. of ALSS employee).

There is also the need for close coordination of security experts with the Cyber Security Department to ensure databases and networks are secure, and that intellectual property is protected from outside use in order to mitigate any potential risks. The goal is to provide secure and safe environment for the organization, as shown in Figures 6 and 7.

24/7 MONITORING AND CONTROL CENTRE

The growing trend is towards the use of Remote Control Centers because security of data is as important as physical security that requires continuous monitoring and constant remote observation for the company's strategic offshore resources. ALSS Control Centre is the infrastructure where data is fused, events correlated and warnings issued. It identifies offshore and onshore objects, detects targets, analyses threats, gives warnings and alarms, and provides navigation assistance, logistics support and incident with intervention management.

By offering a complete solution for intrusion from the sea, air and subsea we guarantee secure communications to enable operators to analyze threats, generate early warnings, prepare intervention programs and manage crises.

ALSS MODUS OF OPERANDI

24/7 observation, panoramic scanning and automatic intruder detection systems which are optimal for any distance range (long, medium, and short) within the area surrounding the oil rig, for nonstop monitoring of unfamiliar objects and for the detection of suspicious motions. In the event of an intrusion, security forces will be automatically alerted to quickly respond to the threat while it is still at a safe distance. It is wholly integrated to a Security Control Centre, which can be either onshore or at an offshore installation.

Personnel access to sensitive zones on the rigs must be tightly controlled to ensure safety while also allowing freedom of movement for both company personnel and appropriate subcontractors within

authorized areas, therefore it requires constant remote observation for the strategic offshore unit 24/7/266.

IMPLEMENTATION OF THE LATEST SURVEILLANCE TECHNOLOGIES AND SECURITY SYSTEMS

Security of oil and gas fuel cycle, from the front end of exploration to the back end of supply and distribution is considered to be a prime concern for all the parties involved. The security process in which the oil and gas operational sectors, namely, upstream, midstream, and downstream are secured with the help of stringent physical and network security measures to enhance operational efficiency and minimize losses associated with security breaches is carefully monitored by specialists [4]. ALSS specialists use various surveillance, monitoring and detection techniques to protect the client's facilities from threats wherever they may come from.

With installation of the latest surveillance systems, automation, and alarm technologies, comprehensive security management systems ALSS offers effective solutions for the growing security challenges in today's onshore and offshore operating environment.

ENSURING SAFETY IN THE OIL AND GAS INDUSTRY

Being an oil and gas worker is said to be one of the "most dangerous jobs in America," and with a fatality rate of seven times higher when compared to all other industries in the US. According to the 2019 report published by the International Association of Oil and Gas Producers (IOGP), the industry experienced 25 deaths in 22 separate incidents – down from 31 fatalities the previous year. It is known that the biggest proportion of deaths were to what is categorized as "caught in, under or between" incidents, which exclude incidents involving dropped objects. The oil and gas industry must do more to reduce the number of injuries sustained by workers and deaths due to the attendant trauma and distress to both the victims and their families, and the damage to the industry's image. Staff security is very important and should be accorded its rightful place in an organization as discussed by Paul Adekunle et al. [5]. The following 10 safety tips are put forward [6]:

1. Work closely with local emergency response services.
2. Develop a safety program that brings workers together.
3. Ensure familiarity with the workplace.
4. Don't neglect housekeeping.
5. Monitor workers' mental health.
6. Use labeling and colour-coding.

7. Ensure illegible signage is replaced.
8. Conduct a safety check when projects change.
9. Keep up machine maintenance.
10. Install in-vehicle monitoring systems (IVMS).

USE OF ARTIFICIAL INTELLIGENCE (AI) FOR SAFETY IN THE OIL AND GAS INDUSTRY

AI can significantly enhance safety in the oil and gas industry through various applications such as [7, 8]:

- Predictive maintenance: AI algorithms can continuously monitor equipment health and performance, detecting anomalies and potential failures before they escalate into safety hazards. This proactive approach to maintenance can prevent accidents and ensure smooth operation of facilities (i. e. defect detection).
- Risk management: the AI-driven risk management tools can analyze data to predict and mitigate risks, improving overall safety and efficiency.
- Physical security: AI-powered surveillance systems can detect unauthorized individuals or activities, triggering alerts and preventing potential security breaches (workplace security).
- Emergency response: In emergency situations, AI systems can coordinate response efforts, ensuring that the right resources are deployed quickly and efficiently. They can also stimulate various scenarios to train personnel for real-life emergency situations.
- Surface analysis/geological assessment.
- Reducing well/equipment downtime.
- Emission tracking.
- AI led inventory management.
- Backoffice process optimization.
- Optimized procurement.
- Optimizing production and scheduling.
- Analytics-driven decision making.

The integration of all these AI solutions would create a safer and secure working environment and reduce the likelihood of accidents, which is crucial for the protection of both personnel and the environment, as shown in Figures 8 and 9.

CHALLENGES FACING THE OIL AND GAS INDUSTRY

The oil and gas companies often operate in a challenging and risky environment. Some of these are [8]:

- Financial risks – this is as a result of higher costs and fluctuating energy prices.
- Safety concerns.
- Litigation trends – societal inflation can increase the risk of an oil and gas company facing a lawsuit. The average jury verdict in the National Law Journal's Top 100 Verdicts more than tripled, from \$64 million to \$214 million [9].
- The shifting energy landscape – geopolitics, global market disruptions, changes in the mix of energy sources and a focus on transition to lower-carbon energy systems is likely to alter the future of the oil and gas industry across the planet, as the demand for renewable energy continues to grow.
- Supply chain impacts – this is due to the increased complexity of supply chain which is subject to a number of variables, such as price increases, equipment shipping delays and weather events. Other areas that can lead to increased costs are drilling exploration, extraction and production as experienced during COVID-19 pandemic which could be an issue for the foreseeable future.
- Labour shortage – this is as a result of steady decline in the available workforce due to difficult work conditions and fluctuations in the industry, causing some workers to leave the oil and gas industry for more stable positions.
- Market volatility – world events and natural disasters can disrupt otherwise smooth business operations and affect bottom lines across the oil and gas industry. Some of the events are such as critical equipment failure, cyberattack, fire, flood or earthquake which can disrupt business operations and affect profit.

SOLUTIONS TO CHALLENGES IN OIL AND GAS INDUSTRY

Some of the solutions proffered to solving some of these challenges are [10, 11]:

- Developing a safety culture focused on accident prevention to help businesses avoid worker injuries that can lead to lawsuit. Therefore, a contractual risk transfer program and specialized insurance coverage could help manage these risks.
- The oil and gas companies must identify strategies to stay ahead of these challenges, for example, understanding and following regulations, and also working with policymakers on the industry's role in new energy to help mitigate these risks.

- Oil and gas companies must take steps to anticipate and manage supply chain issues before they occur. The supply chain management would include the quality of materials and spare parts, and having a resilient supply chain and inventory management system in place.
- Oil and gas companies must develop strong “onboarding and retention strategies” to help make employee recruiting more effective. These would include comprehensive training and mentoring programs that drive performance and safety and broaden the labour pool.
- Regularly updating and reviewing the contingency plan with a qualified professional familiar with the risks and needs of the business and industry. In addition, get the right insurance coverage, the time spent developing, updating and communicating your plan is a proactive way to mitigate risks and maintain financial viability amid uncertainty,

CONCLUSION

Since the oil and gas industry is a major/critical target to both internal and external attacks, there is the urgent need for proactive and reactive means by the industry to engage the services of experienced security professionals or experts. The security guards must be well trained to secure the oil and gas operational sectors, that is, upstream, midstream, and downstream with the help of stringent physical and network security measures to ensure and enhance operational efficiency and to minimize losses. Robust communication and security measures are of paramount importance, such as: radio communication, satellite communication, fiber optic communications, unified communication systems, emergency communication, CCTV surveillance, access control, intrusion detection systems, cybersecurity, fire and gas detection systems, emergency shutdown systems, data and network security, remote monitoring and control, pipeline monitoring systems, personnel tracking [12]. Further readings can be obtained from the following books:

- Top 8 Digital Safety Trends in Oil and Gas in 2023.
- Oil and Gas Data Security: What you need to know.
- Oil and Gas Development I Threats – WWF.

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Figure 1. Oil well - Wikipedia

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Figure 2. Natural-gas processing – Wikipedia

Source:https://www.google.com/search?sca_esv=514d789ccece10d1&sxsrf=ADLYWIKw_1rVDuHoOqjhh3zCeZHwJxOQ8w:1716456029677&q=images+on+oil+and+gas+industry+by+wikipedia&tbm=isch&source=lnms&prmd=invbzmz&sa=X&ved=2ahUKEwjSnK__uKOGAxWqWEEAHeHkBCYQ0pQJegQIDBAb&biw=1034&bih=539&dpr=1#imgsrc=SeJjUuLKOBHxaM



Figure 3. Liquefied natural gas – Wikipedia

Source:https://www.google.com/search?sca_esv=514d789ccece10d1&sxsrf=ADLYWIIvCmpbiJNdVEZD3QrC0bcEajlcRA:1716456949762&q=images+on+oil+and+gas+industry+by+wikipedia&tbm=isch&source=lnms&prmd=invbzmz&sa=X&ved=2ahUKEwia14y2vKOGAxUUZEEAHT2IDbkQ0pQJegQIDRAB&biw=1034&bih=539&dpr=1#imgsrc=gjOwFW-JA99fcM



Figure 4. Petrochemical – Wikipedia

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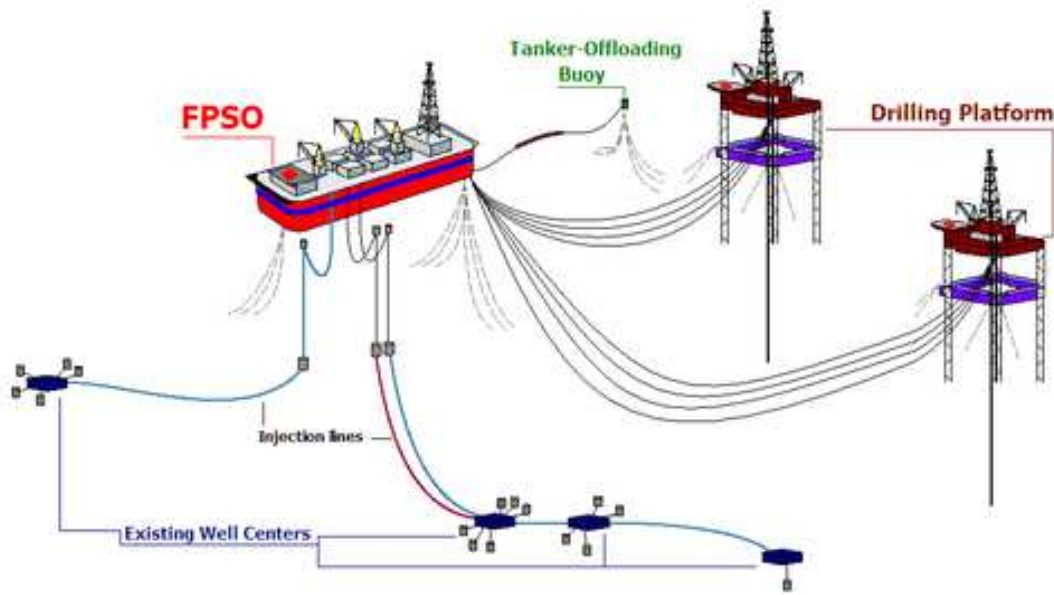


Figure 5. Floating production storage and offloading – Wikipedia

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Figure 6. Physical security – Wikipedia

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Figure 7. Security guard – Wikipedia

Source:https://www.google.com/search?q=images+on+surveillance++by+wikipedia&tbm=isch&ved=2ahUKEwj93P7j6OGAxVDSKQEhDR3AvUQ2cCegQIABAA&oq=images+on+surveillance++by+wikipedia&gs_lp=EgNpbWciJGltYWdleyBvbiBzdXJ2ZWlzbGFuY2UgIGJ5IHdpa2lwZWVpYTIIEECMYJ0iSblDAE1iOQ3AAeACQAQGYAe4DoAGZL6oBCDIItMjEuMS4yuAEMyAEA-AEBigILZ3dzLXdpei1pbWeIBgE&scient=img&ei=ZVBPZr2WGsOQkdUP1O-JqA8&bih=539&biw=1034&prmd=ivnsbmz



Figure 8. Surveillance - Wikipedia

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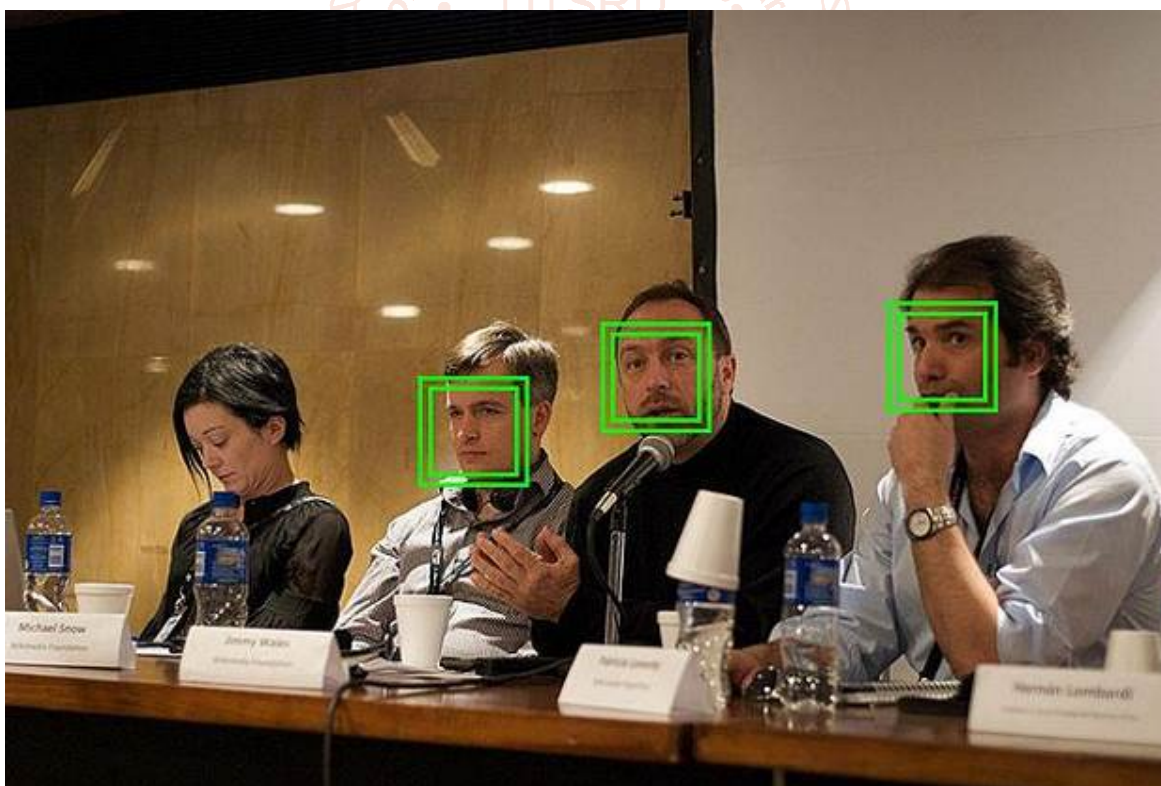


Figure 9. Artificial intelligence for video surveillance – Wikipedia

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Figure 8. Surveillance - Wikipedia

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