Offshore Platform
Oil Leak Detection Using
Analytic Imaging Systems

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INTRODUCTION

Early detection of any leak is critical to reducing environmental impact — especially leaks over water, which can travel great distances in a short time and quickly become extremely difficult to contain. In addition to protecting fishing industries key to the economy, key drivers in the development of early leak detection technologies include: minimizing clean-up costs, reducing product loss, avoiding fines, and safeguarding against damage to corporate image.

IntelliView — a leader in video analytics and provider of intelligent imaging systems — has been providing remote site liquid leak detection and security systems to Oil & Gas partners since 2011. Continuous improvements, new generations of products, and increased exposure thanks to new customer adoption and deployment led to IntelliView being approached by a global producer. They asked IntelliView to evaluate the potential of utilizing an ATEX (C1D1) version of their real-time liquid leak detection & alerting solution, to monitor for accidental crude oil releases on remote well pads in the Gulf of Thailand — with monitoring taking place on a centralized production platform.

The system was installed in early 2019 and has been working continuously without any downtime.

TECHNOLOGY OVERVIEW

IntelliView conducted a feasibility study, with input from the customer. A number of design options were proposed, to meet the requirements.

The integrated IntelliView Vision System (IVS) solution package implemented for offshore platform liquid leak detection consisted of the IntelliView DCAS or Dual Camera Analytic Sensors (a thermal camera and a color video camera, in specialized explosion-proof ATEX housing enclosures for the hazardous environment), analytics software, and ruggedized hardware.
The DCAS was designed for automated real-time data capture, analysis, and reporting, and intended to be used to monitor a remote well pad in the Gulf of Thailand. Each case was assessed to determine the optimal combination of thermal and video coverage required to perform the most complete analysis of the area. Of course, standard layouts can utilize a standard leak detection design.

Once a leak or spill is detected, the system sends a notification, a photo, and 15-second video of the event to authorized personnel, using a supplied monitoring station located at the production platform. A live feed made possible by a wireless link can be viewed for verification — anytime and from anywhere, via a web user interface. This can also be tied into emergency response programs for rapid response — minimizing spill size, cleanup costs, fines, and negative publicity.

CUSTOMER BENEFITS

- Accurately and automatically detect leaks during the day or night, using operatorless visual technologies.
- Determine leak and spill events faster (in seconds) and improve response time.
- Eliminate false alerts by remotely confirming leak and spill incidents visually, with no extra manpower and windshield time cost.
- Augment field integrity management and decrease overall portfolio risk.
- Decrease shutdowns and, subsequently, increase production output and revenue.
Another benefit identified as a result of operator input, was the ability to add an additional camera to the leak detection system to monitor exhaust vents prior to remote startup of the well pad. The remote operator can now use the system’s Live View function for this purpose, removing the need to send a crew and crew boat to the remote pad. This led to significant savings of both time and money.

THERMAL LEAK DETECTION

The primary system sensor is a thermal camera core. Its primary function is to detect the heat signatures used to differentiate between pipeline product and background temperature.

Because the system is based on thermography and temperature change, it allows imaging in both day and nighttime, with no impact from marine environmental elements like rain, fog, and smoke.

IntelliView’s solution uses a combination of patented hardware, multiple advanced video processing algorithms with background learning analytics, and user-defined rules for alerting and reporting. It is optimized for the site, ensuring the accurate detection of product releases, including:

- small leaks
- sprays
- fast pooling on decking
HOW THE SYSTEM WORKS

During normal operation, a thermal sensor supplies imaging data to an industrial computer running the leak detection analytic. The analytic software is based on a learning system that learns what the normal background conditions are, and adjusts for normal temperature changes and environmental conditions like rain or fog.

In the event of a leak, the thermal imager and analytics operate at the pixel level. They are able to pick up the thermal signature of a fluid spray or flow emanating from an enclosed space that would typically have a different temperature than the background. If the leak meets the conditions set during commissioning, an alert is triggered. The color camera can then be used for visual verification by the operator.

The system can also be configured for the color camera to take snapshots of the scene at a set interval and send them to the user for visual verification. These snapshots can be sent to a remote monitoring station as required.

Characteristics of a spill can vary significantly and depend on the type of well pad being monitored, and what the piping is transporting. That is why a combination of thermal and video cameras is the key to successfully identifying and visualizing leaks. Temperature differences can be used to accurately identify leaks or spills through analysis, while color and size characteristics can be used for manual verification.

THERMAL CAMERA TECHNOLOGY

Thermal cameras are used day and night, primarily because temperature difference provides greater accuracy than methods that simply rely on flow, color, and size characteristics.

Leak detection is difficult because some leaks start out so small, they cannot be detected using existing technology — which generally requires at least a 1% rate loss. Early leak detection is critical in reducing both environmental impact and the cost of cleanup. The IntelliView solution has been developed to continuously monitor and analyze a scene, capture data, send real-time notification of qualified events, and in critical areas where other solutions have proven impractical or insufficient.

The system can detect small temperature changes, and a 2°C temperature difference is required between the fluid and its surroundings. In field conditions, all temperatures of fluid leaks have been detected due to: liquids reacting with the surroundings to create temperature changes, or perceived temperature changes due to the characteristics of various petroleum products.
SYSTEM SETUP

For the system to be most effective, the DCAS should be positioned to cover a view of the critical points of a well pad. Ideally, the setup should be mounted approximately 20 feet (7 meters) above the deck, so cameras have a view of the area below. This allows the video analytics software to detect any anomalies resulting from oil spills, sprays, or leaks. Due to the tight constraints of well pads and the amount of equipment present, multiple cameras are typically required.

Together, the color camera and the thermal camera improve the effectiveness of visual verification by remote users.

The thermal camera’s field of view can have eight separate analytic regions. This means that the camera can simultaneously monitor up to eight separate regions of interest or pieces of equipment (e.g. joints, valves, vents) using different alert conditions. This is useful in situations where the temperature of monitored products varies significantly within one field of view, or when a secondary analytic solution (e.g. security, wildlife detection) is needed along with the leak solution to provide more comprehensive coverage with minimal additional cost.

Placing a 7.5mm thermal camera at a corner location at 5-7m height will create a detection area approximately 13m long and 22m wide for a leak of 1L/s @ 80psi. A leak this size is typically configured to be detected within 20 seconds, with an alert sent to the monitoring station (and optionally to an email address) immediately afterwards.

The system is highly configurable and can be set up to detect smaller leaks in shorter time frames. However, this typically results in higher false alert rates, due to environmental conditions. An advantage of this system is that configurations can be changed by the system administrator at any time, from the monitoring station or through the IntelliView WebView interface.
Detection Area Example: The overlay illustrates the detection area of a 7.5mm thermal camera on a portion of a typical offshore well pad. The 7.5mm lens is generally specified due to the short distances required on the platform, and visibility due to the presence of multiple pieces of equipment.

Leak Detection: The thermal camera requires visibility of a leak in order to detect it. In this example, visibility of all equipment is not possible due to density. However, on-site testing has proven that leaks will be detected due to spray or pooling within the visible area of the camera.

In this example, a second camera located across and aimed in the opposite direction would give complete coverage (not included for clarity). A larger spill can be detected at further distance, and conversely a smaller spill can be detected closer to the camera.
FALSE ALERTS REDUCTION

False alerts can be triggered due to many factors, with studies showing that high false alert levels can lead to operator fatigue and loss of effectiveness. There are several ways IntelliView has reduced false positives to below industry average.

The analytic system is capable of effectively distinguishing between the normal operating environment and the characteristics of a leak — a powerful tool for preventing false alerts. Additional configuration options allow the user to apply an environmental filter that eliminates the potential effects of abnormal rain or wind conditions. The ability to draw multiple regions, mask potential trouble areas, and other configuration options all contribute to lowering false alerts.

As an additional measure, an event reported by a thermal camera can be confirmed by viewing the high quality live/recorded color video. This provides a clearer picture of the field condition without the need to send a team to investigate, and allows a false alert to be quickly dismissed.

Each site has different requirements. In general, the false alert rate is less than once per day, per camera. A typical well pad would generate one false alert per day (e.g. environmental factors, birds, personnel on site, etc.) that can be easily and quickly verified by an operator. Several well pads can be monitored in the course of normal operations without over-tasking an existing operator.
ABOUT INTELLIVIEW

IntelliView is a leading provider of intelligent computer vision solutions for industrial surveillance applications, and offers customized solution packages that cost-effectively enhance safety, security, and efficiency of operations while protecting the environment. The technology platform incorporates thermal/optical sensors and patented video and image processing technologies to monitor, detect, and analyze events in real time, and instantly generate pre-programmed notifications.

Advantages of the IntelliView Vision System (IVS) include:

- 24/7 unmanned site monitoring
- Automated real-time event detection and notification
- Remote monitoring via control station, internet (web interface), intranet, radio, SCADA, and other methods to eliminate unnecessary site visits, windshield time, and associated costs
- Up to eight analytic regions per camera, for greater and multi-solution coverage
- Customizable reporting options
- Minimal bandwidth requirements, ensuring low data transmission costs
- Highly configurable environmental filters that reduce false alerts
- Hardware & software scalability (single site to centralized monitoring of distributed assets)