



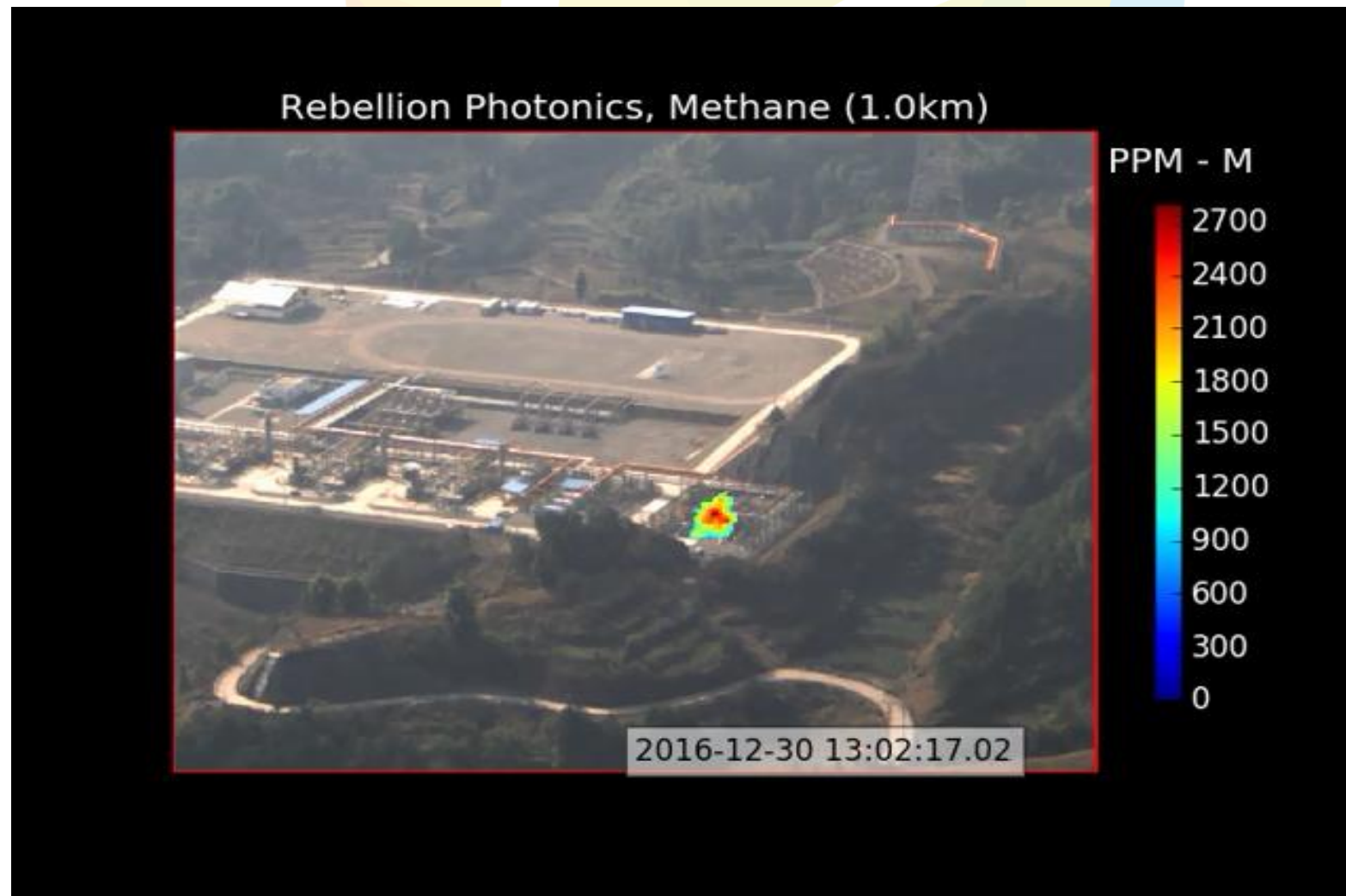
REBELLION
P H O T O N I C S



24/7 Autonomous Monitoring
Leak Detection System

JOIN THE REBELLION!

甲烷釋放和檢測 @在1公里距離



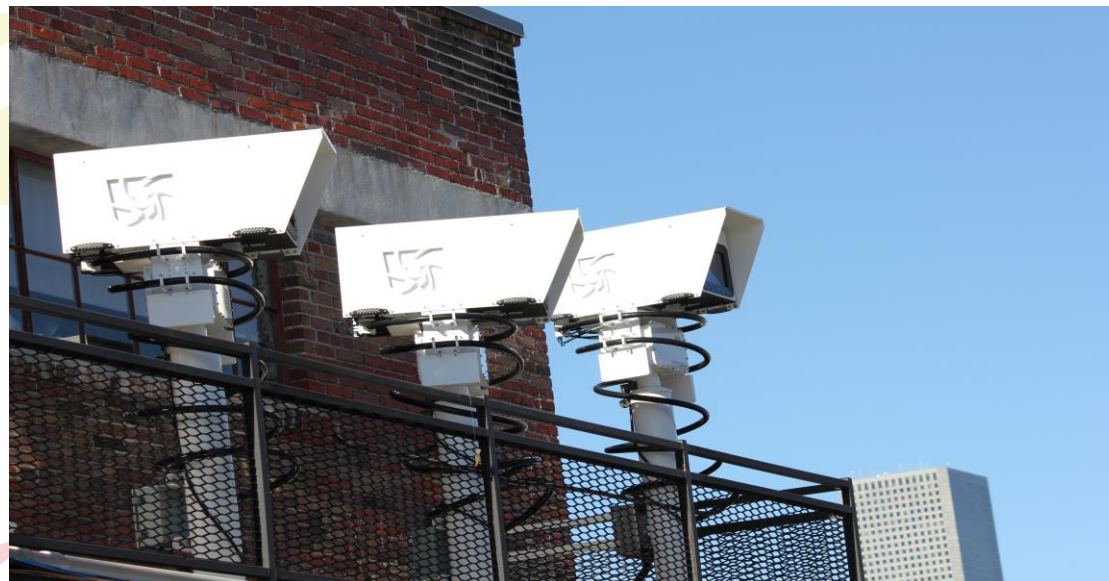
我們可以作什麼？

- 24小時/7天自動連續監測
- 即時性:
 - 檢測
 - 辨識(定性)
 - 量化
 - 氣體洩漏
 - 液體洩漏
 - 入侵(人員,車輛..)
- 自動檢測
 - 警報
 - 洩漏視像及圖檔儲存



Rebellion 能為你作什麼？

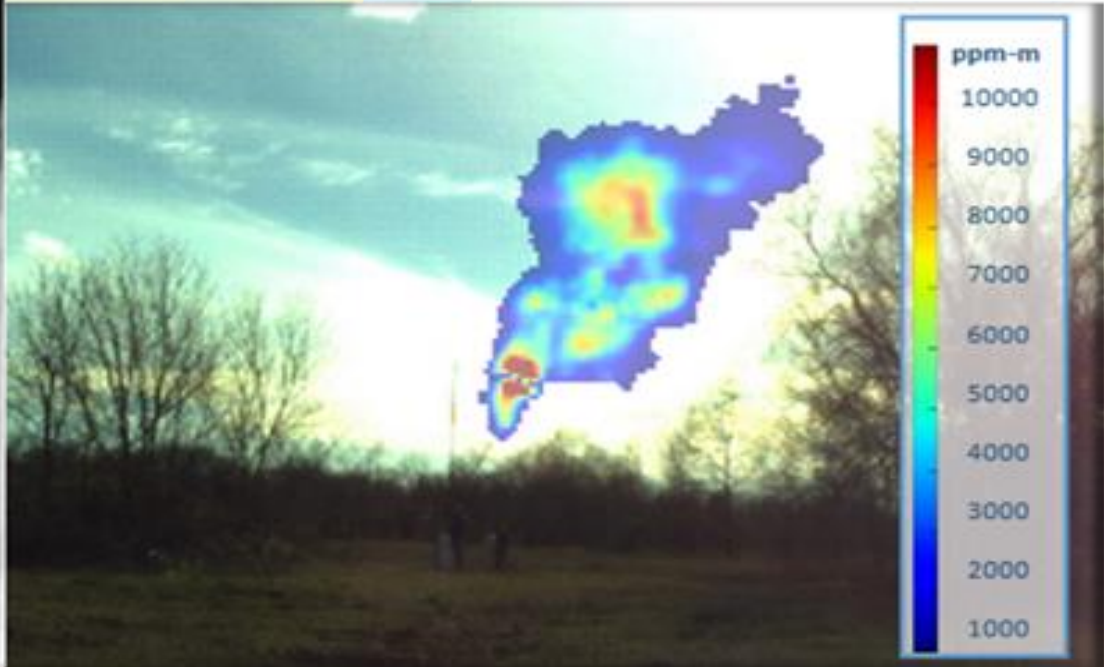
- **大區域早期預知及準確的檢測**
 - 50+ 碳氫化合物及 VOC' s.
 - 入侵:人員及車輛分析
 - 液態物質:地上及地下
- **成本大幅下降**
 - 1座攝影機可取代數仟個氣體偵測器
- **節省操作成本**
 - 24小時全自動操作.
 - 不需有人去監控本系統
- **減低保險支出**
 - 節省成本
- **安全性改善**
 - 不需現場操作人員使用手提偵測器暴露在危險區域執行巡檢洩漏工作
- **縮短設備修護時間**
 - 即時性洩漏確認-無浪費時間尋找洩漏源
- **大量減少誤警報**



方法-創新改變!



傳統的紅外線影像



Rebellion氣體雲成像技術

Rebellion 能為你作什麼？

Rebellion是氣體偵測的世界領導者....並且一台攝影機可作下列運用:



氣體偵測



液體偵測



侵入&保全



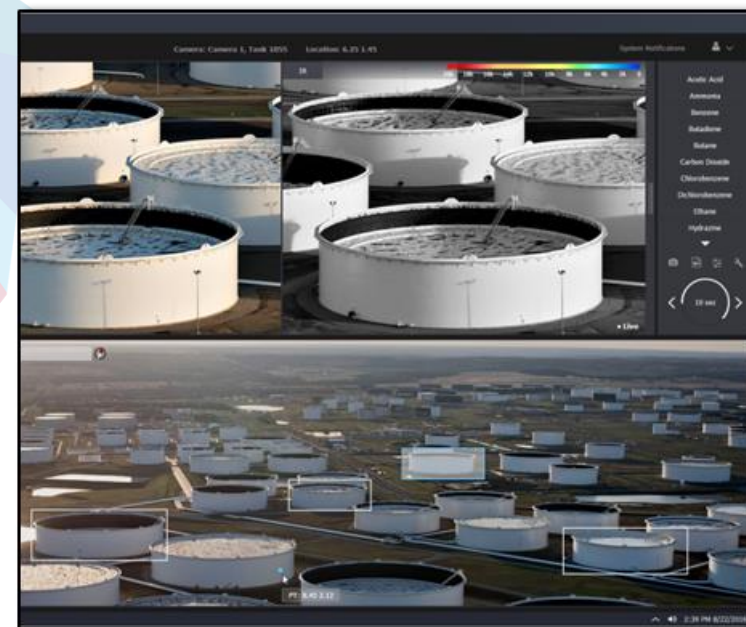
火災/火焰



燃燒塔監測



油槽液位監測



Rebellion Photonics的歷史

- Robert Kester at Rice University, 研究室成果轉移
- 2009由 Robert Kester and Allison Sawyer 創立
- Located in Houston, TX
- 2017 – Houston's 7th fastest growing Company

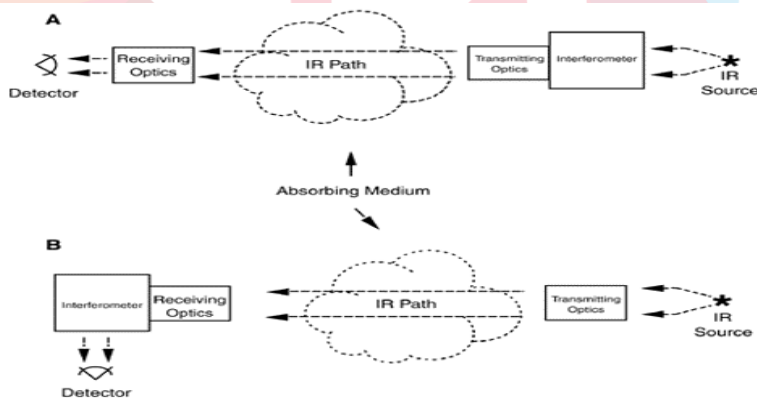


慣用的連續監測洩漏方式

單點式氣體偵測器

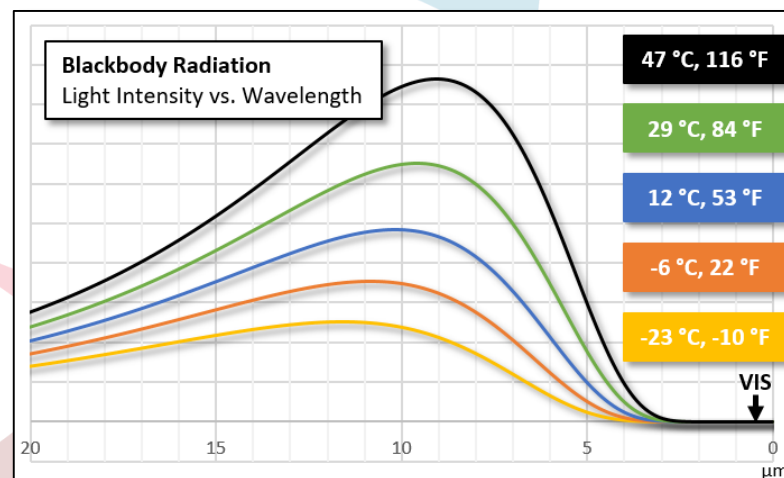
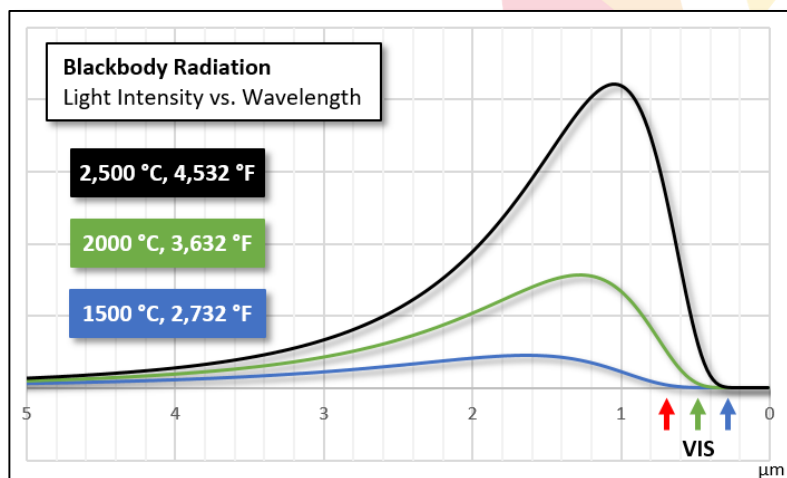


開徑式氣體偵測器



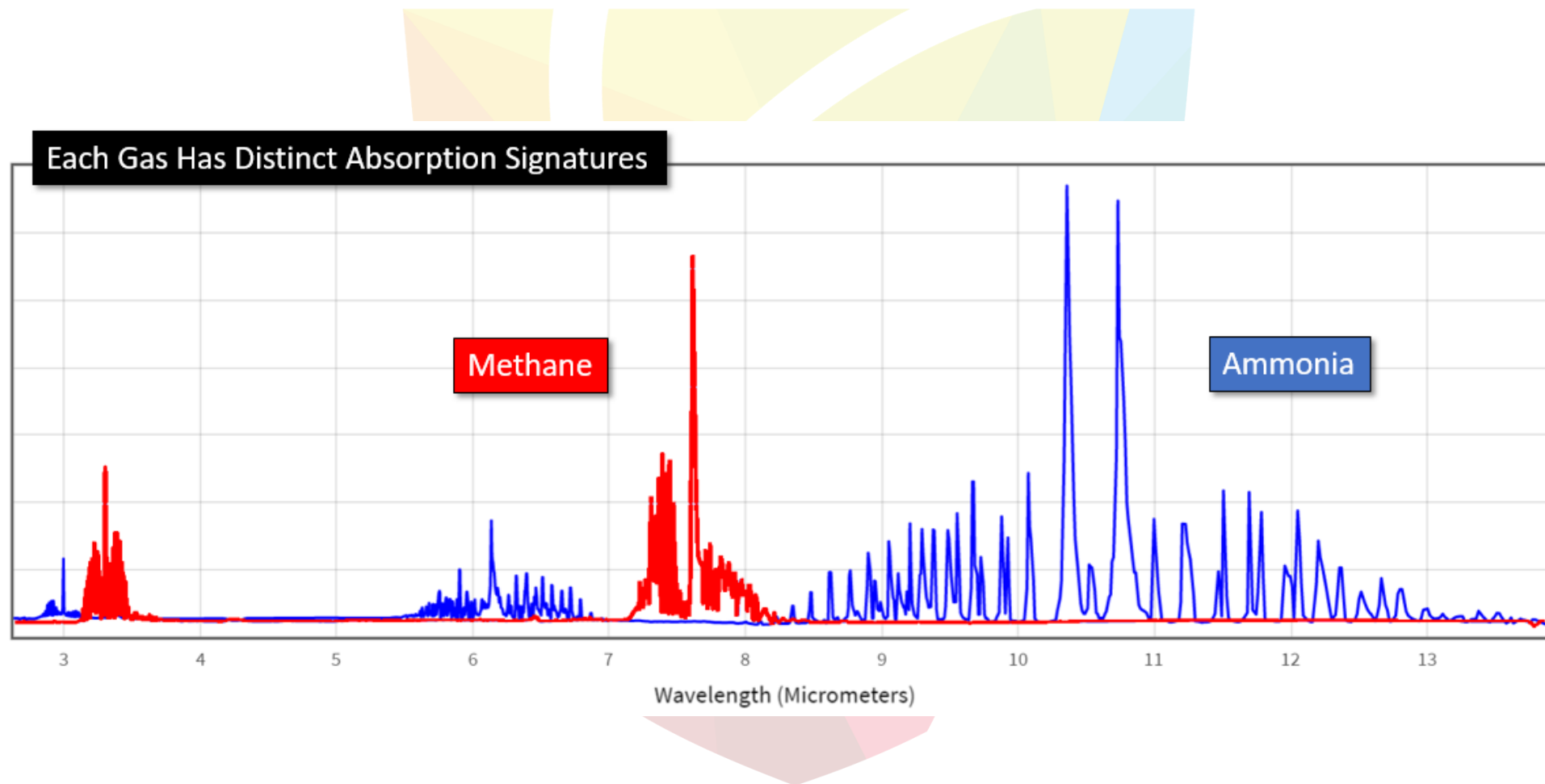
黑體輻射(Radiation)

黑體吸收其表面的所有輻射來源,並基於其表面溫度發出輻射。我們使用來自大自然的黑體輻射作為 GCI 攝像機的光源。

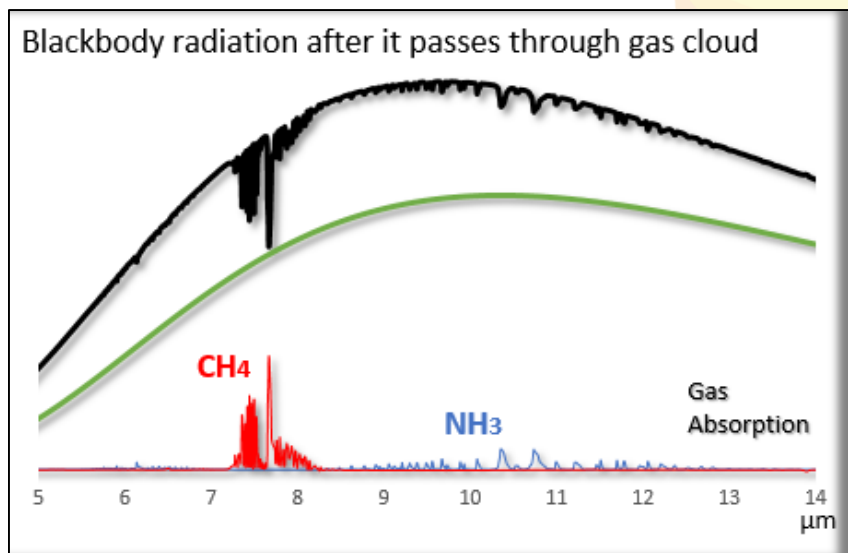


- 表面溫度決定了 光的亮度和波長。

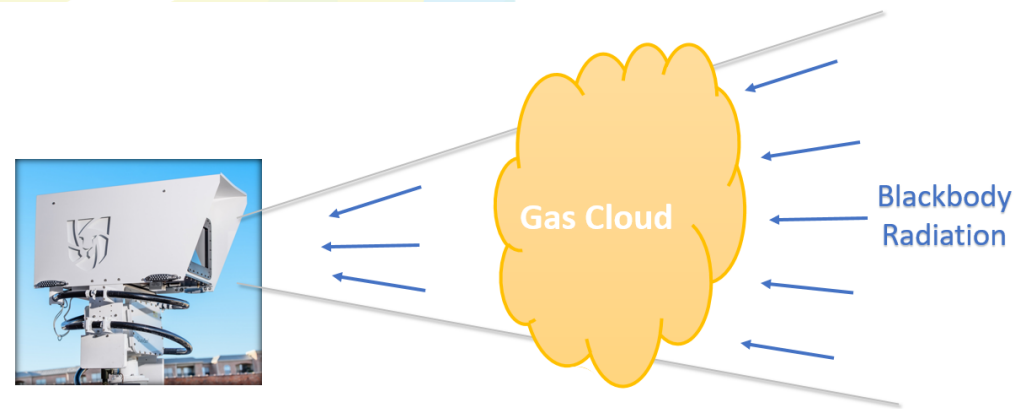
每種氣體都有獨特的吸收特徵。



氣體雲量測



- 吸收的強度告訴我們氣體的濃度。
- 吸收的波長的形狀區別了氣體種類。
- 黑色曲線是黑體輻射后,它通過氣體雲所形成的曲線。
- 綠色曲線是雲層前的黑體輻射

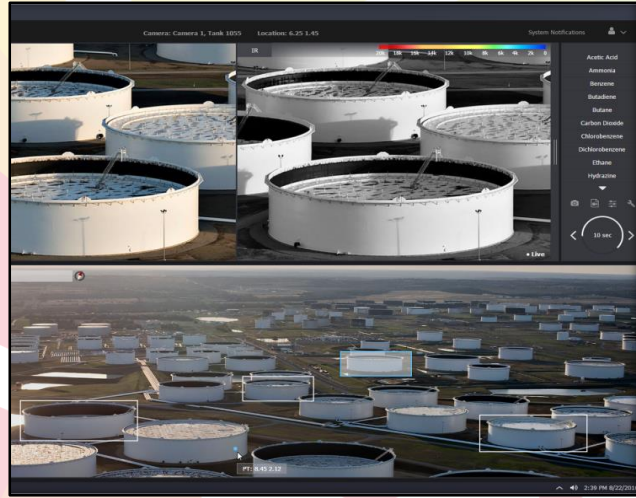


來自周圍環境的黑體輻射通過氣體雲。GCI 攝像機可檢測因洩漏的氣體雲所產生的吸收特徵,以準確辯識氣體種類。

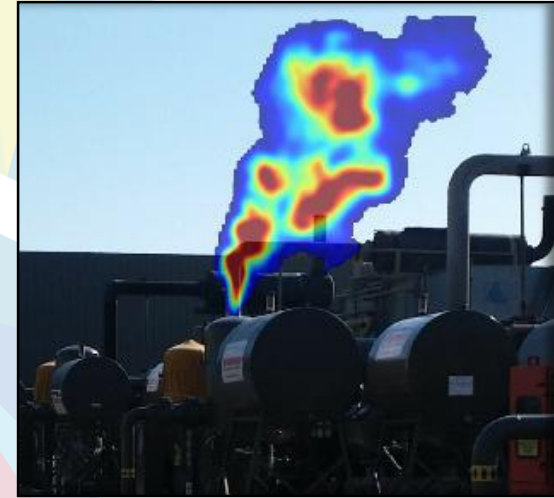
Rebellion Photonics: 完整及全自動的系統



硬體



軟體



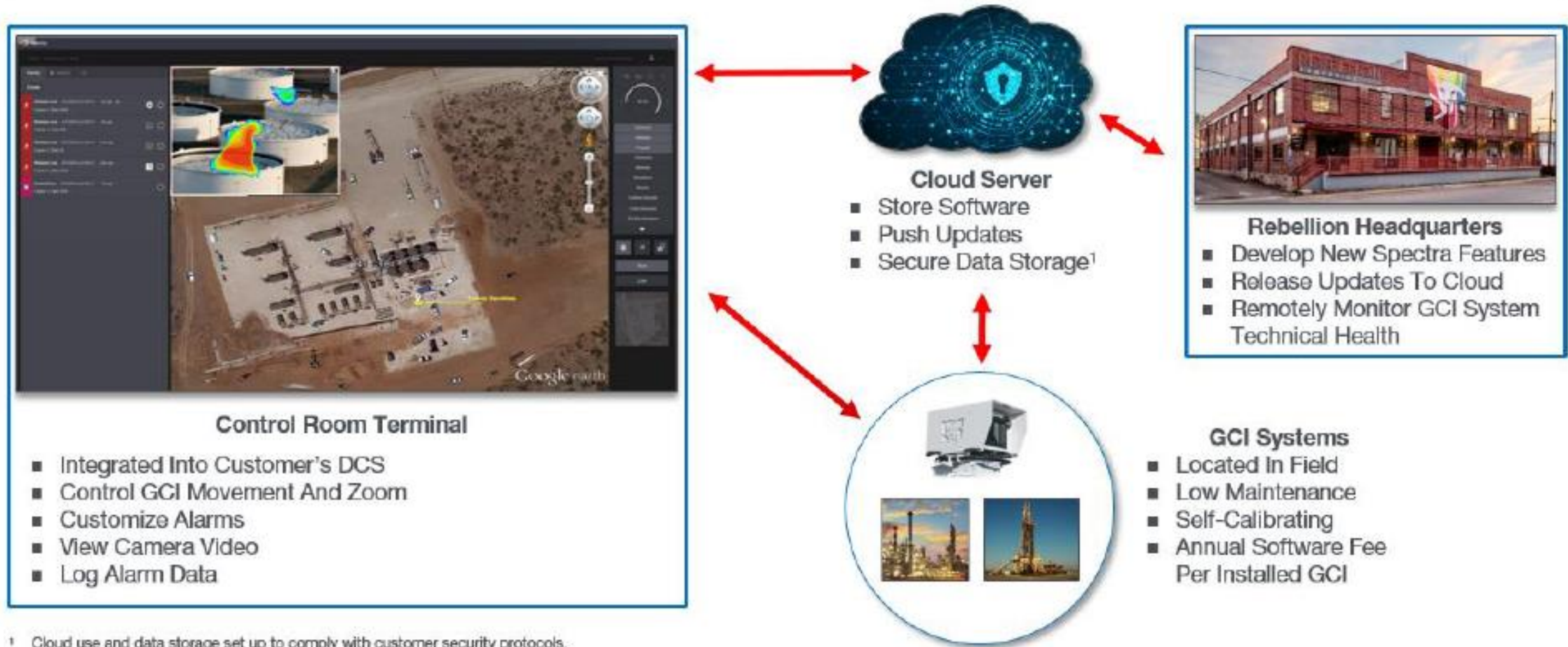
分析

- 依客戶需求而量身製作
- 調適到最佳性能
- 以豐富的經驗提供完整的支援

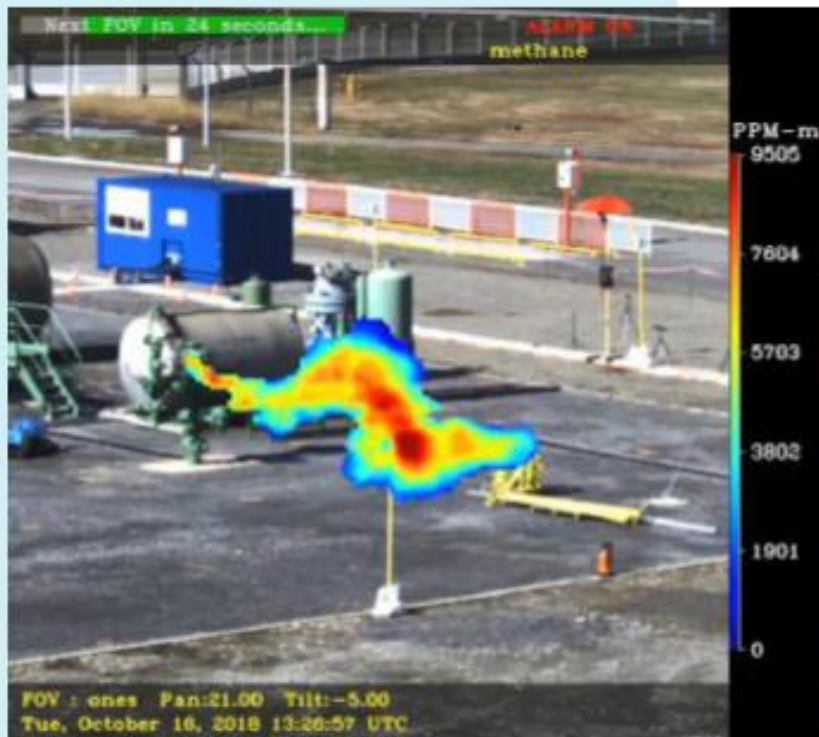


	Standard GCI	Mini GCI	Mini Skid	Mini-Ex GCI	Micro GCI
Relevant Applications	Refineries Chemical Plants LNG Plants Pipelines Tank Farms	Refineries Chemical Plants LNG Plants Power Plants Industrial Plants	Onshore Wellpads Drilling Rigs	Offshore Production Platforms	Mobile Evaluations LDAR

Spectra Cloud-Based Software Platform Enables Effective Remote Monitoring



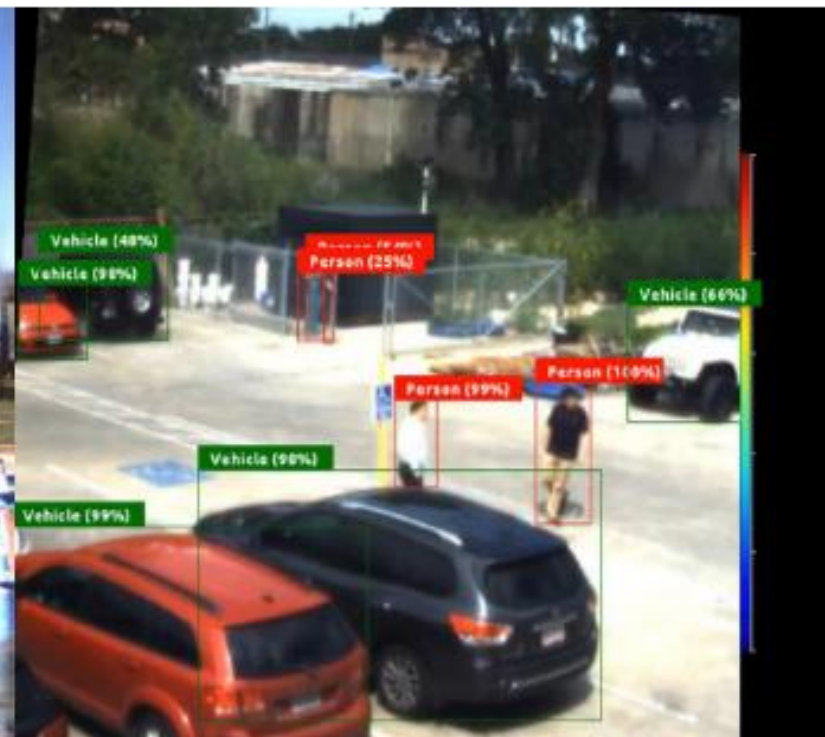
¹ Cloud use and data storage set up to comply with customer security protocols.



Gas



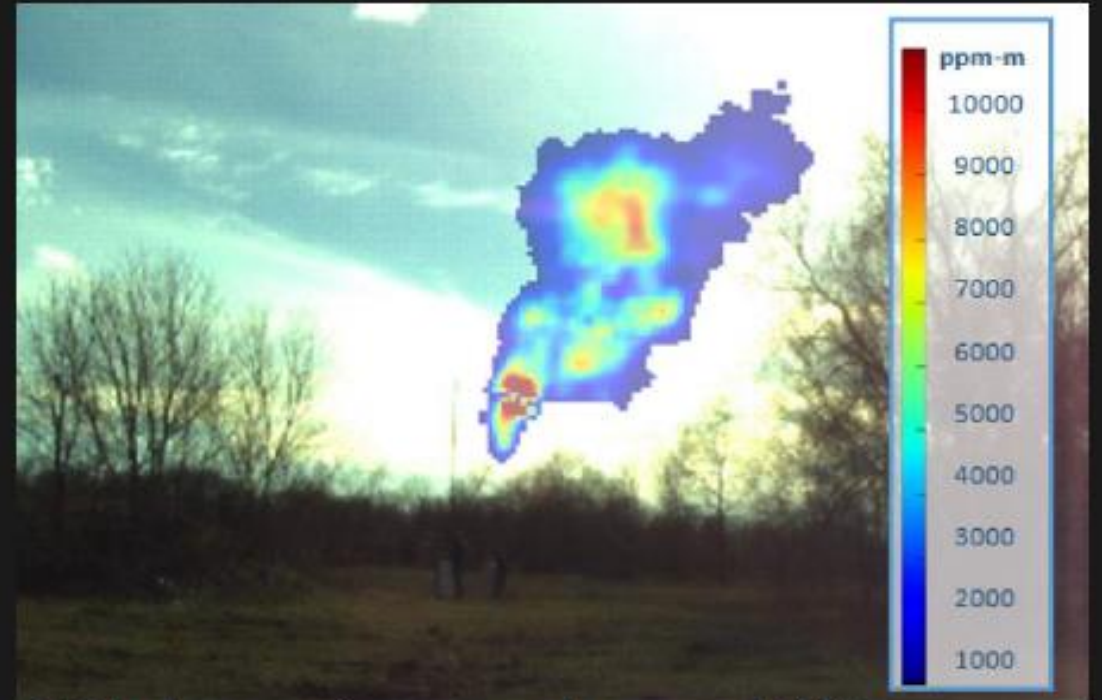
Fire



Security



IR camera



GCI detection overlay on VIS camera

Limitations of IR Cameras for Continuous Monitoring

- Cannot Differentiate Steam from Gas
 - High False Alarm Rate
 - Cannot Quantify



Very low false alarm rate < 1%



- Detected Methane Leaks in Heavy Fog

Other Weather Conditions

- Snow
- Rain
- Night
- Windy (40 MPH)

Rebellion Photonics: GCI硬體



- 固定安裝
- 24小時連續監測
- 無人操控
- 360°視野with $\pm 180^\circ$ 旋轉臺
- $\pm 45^\circ$ 上下
- 偵測距離 1700 Meters

The Mini GCI Camera



Visible Camera

Hyperspectral
Imaging
Camera (Patented)

- Fix Mounted
- 24/7 Continuous Monitoring
- No Operator Required
- Pan $\pm 180^\circ$ (360° full rotation), Tilt $\pm 45^\circ$
- Detection Out To 100 Meters

The Mini GCI Camera



Methane Leak

Analytics

我們樂於客戶
合作增加此清
單表列物質

GASES		LIQUIDS
Acetic Acid	1,1 - Difluoroethane	Butane (Liquid)
Butadiene	Benzene	Crude (WTI)
Carbon Dioxide	Ethane/Ethylene/Propane Mix	Diesel
Ethane	Ethylene/Propylene Mix	Propane (Liquid)
Ethanol	Gasoline	Alkylate
Ethylene	HVN	Black Oil
Hydrogen Chloride	Jet Fuel	C/U Jet
Iso-Butane	LCN	HCC/LSR/Isomerase
Iso-Butylene	LVN	HGO
Iso-Pentane	MoGas	LCC/Poly
LPG	Propylene/Propane Mix	LCO & Regular D/O
Methane	Toluene	Reformate
Methanol	Ultraformate	Resid/Asphalt
N-Butane	Vinyl Chloride	White Oil
Propane	Xylene	RPG
Propylene	Ammonia	OTHER
R22	Hydrogen Sulfide	
Unleaded Gasoline	Naptha	
Boron TriFluoride	1,2 - Dichloroethane	

The **Gas Cloud Imaging (GCI)** camera uses snapshot hyperspectral imaging to visualize and quantify gas release in real-time, allowing you to fix problems before safety issues or environmental incidents occur.

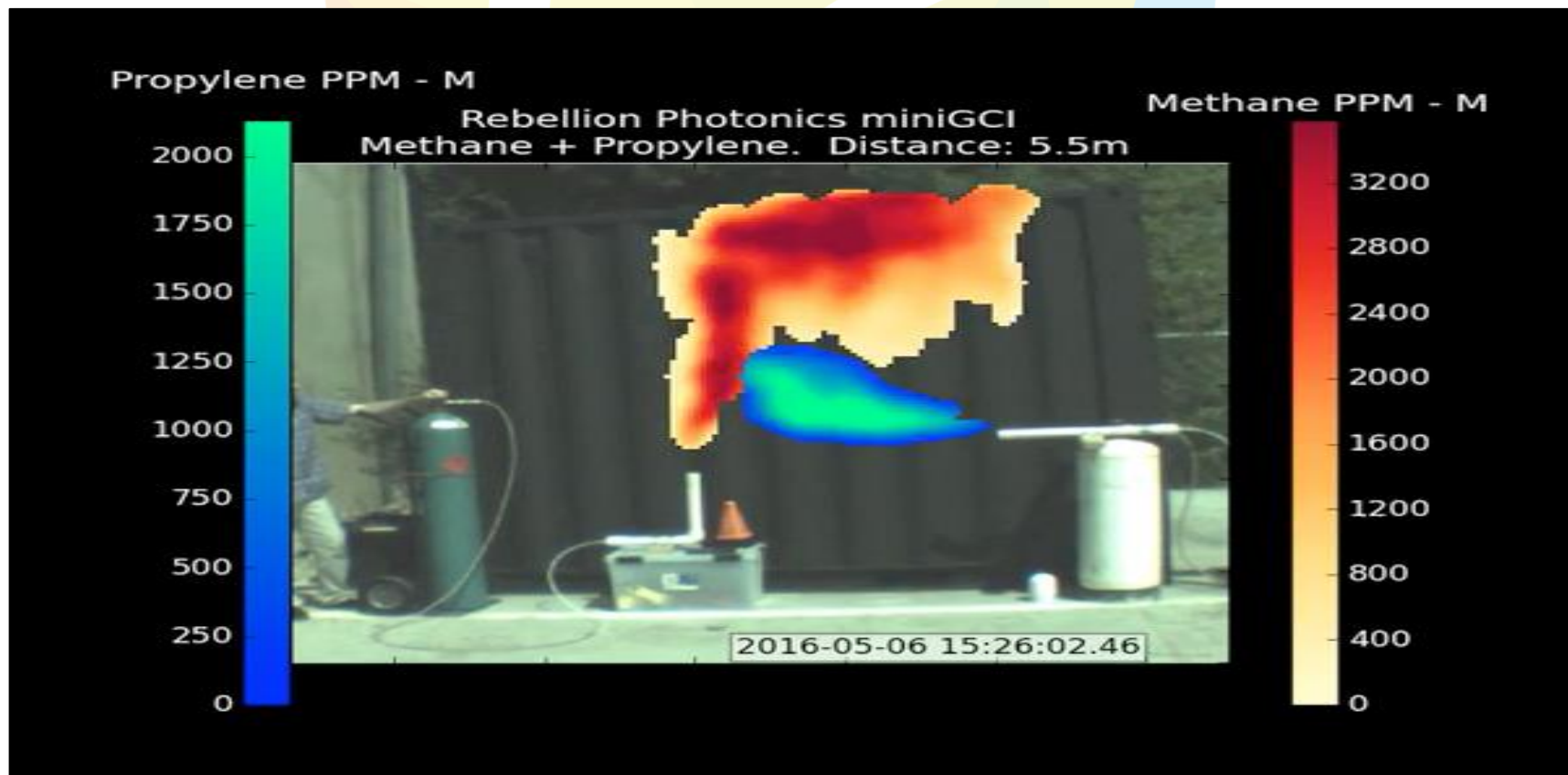


Product Specifications

Detection Approach	Snapshot Hyperspectral Infrared Imaging
Detection time	< 1 second
Field of View	<i>Long Range:</i> 10.0° x 5.0° <i>Wide Field:</i> 33.8° x 22.6°
Position Control	Pan +/-180° (360° full rotation), Tilt -45/+60°
Detection Range	<i>Long Range:</i> up to 1,700 m (5,577 ft) <i>Wide Field:</i> up to 660 m (2,165 ft)
Alert/alarm	Fully automatic alarm with live visual display, audible alert, email, and/or text message
False Alarm Rate	≤ 1%
DCS Integration	Modbus TCP/IP
Video Output	200 x 200 pixels (IR) / 600 x 600 pixels (Visible) at 15 Hz
Weather Conditions	Validated for all weather and light conditions
Temperature Range	-40°C to 55°C (-40°F to 131°F)
Electrical Requirements	Camera: 24 VDC, 10 A (peak), 5 A (continuous)
	Pan/Tilt: 24 VDC, 12 A (peak), 6.4 A (continuous)
	Analyzer: 24 VDC or 120/240 VAC (< 600 W)
Connections	3 Multi-mode Fibers, LC Connectors

Popular Gas Species*	Minimum Detection Level (ppm-m)
Acetic acid	180
Ammonia	13.5
Benzene	125
Butadiene	125
Butane	250
Carbon Dioxide	1079
Ethane	250
Ethanol	15
Ethylene	250
Iso-Butylene	125
Iso-Pentane	40
Methane	250
Methanol	10
N-Pentane	20
Propane	500
Propylene	125
Sulfur Dioxide	20
Toluene	150
Vinyl Chloride	2.5
p- or m-Xylene	20

Speciation of Gases



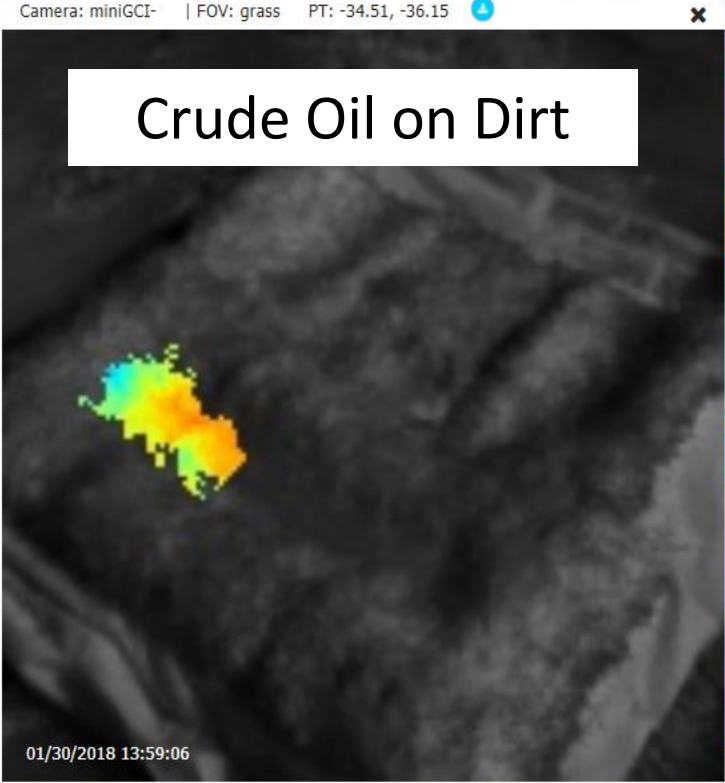
Events

Priority	Starred	All	Ack'd	
1	2			
Alert	Camera	Fov	From	To
UNDERGROUND-LEAK-OIL Alert! Jan 30 2018 at 13:59:06 1hr ago	miniGCI-00003	grass	S	☐
UNDERGROUND-LEAK-OIL Alert! Jan 30 2018 at 13:51:35 1hr ago	miniGCI-00003	grass	S	☐
UNDERGROUND-LEAK-OIL Alert! Jan 30 2018 at 13:36:10 1hr ago	miniGCI-00003	dirt	S	☐
UNDERGROUND-LEAK-OIL Alert! Jan 30 2018 at 13:28:10 1hr ago	miniGCI-00003	dirt	S	☐
Window Obscuration. Jan 30 2018 at 14:25:25 53m ago	miniGCI-00003	box		☐
Window Obscuration. Jan 30 2018 at 14:23:04 55m ago	miniGCI-00003	box		☐
Window Obscuration. Jan 30 2018 at 14:22:37 56m ago	miniGCI-00003	office		☐
Window Obscuration. Jan 30 2018 at 14:22:17 56m ago	miniGCI-00003	dirt		☐
Window Obscuration. Jan 30 2018 at 14:22:02 56m ago	miniGCI-00003	grass		☐
Window Obscuration. Jan 30 2018 at 14:21:34 57m ago	miniGCI-00003	box		☐
Window Obscuration. Jan 30 2018 at 14:21:21 57m ago	miniGCI-00003	box		☐

Camera: miniGCI- | FOV: grass PT: -34.51, -36.15

No Alarm

Crude Oil on Dirt

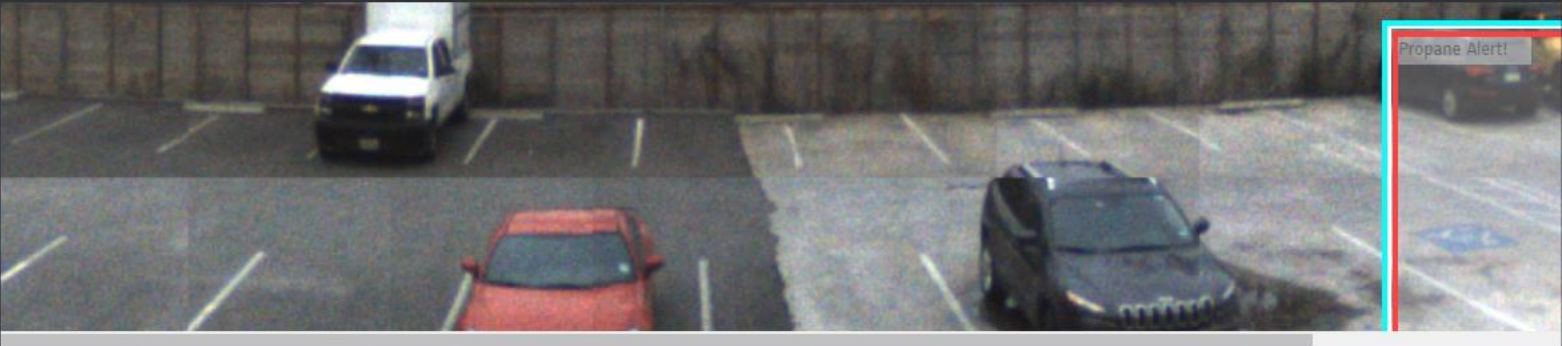


01/30/2018 13:59:06



°C 37° 32° 28° 24° 19° 15°

Jan 30 2018 15:27:10 PT: 34.88, -10.19 | FOV: Bo



11 sec

N Butane
Propane

Progressive

Live

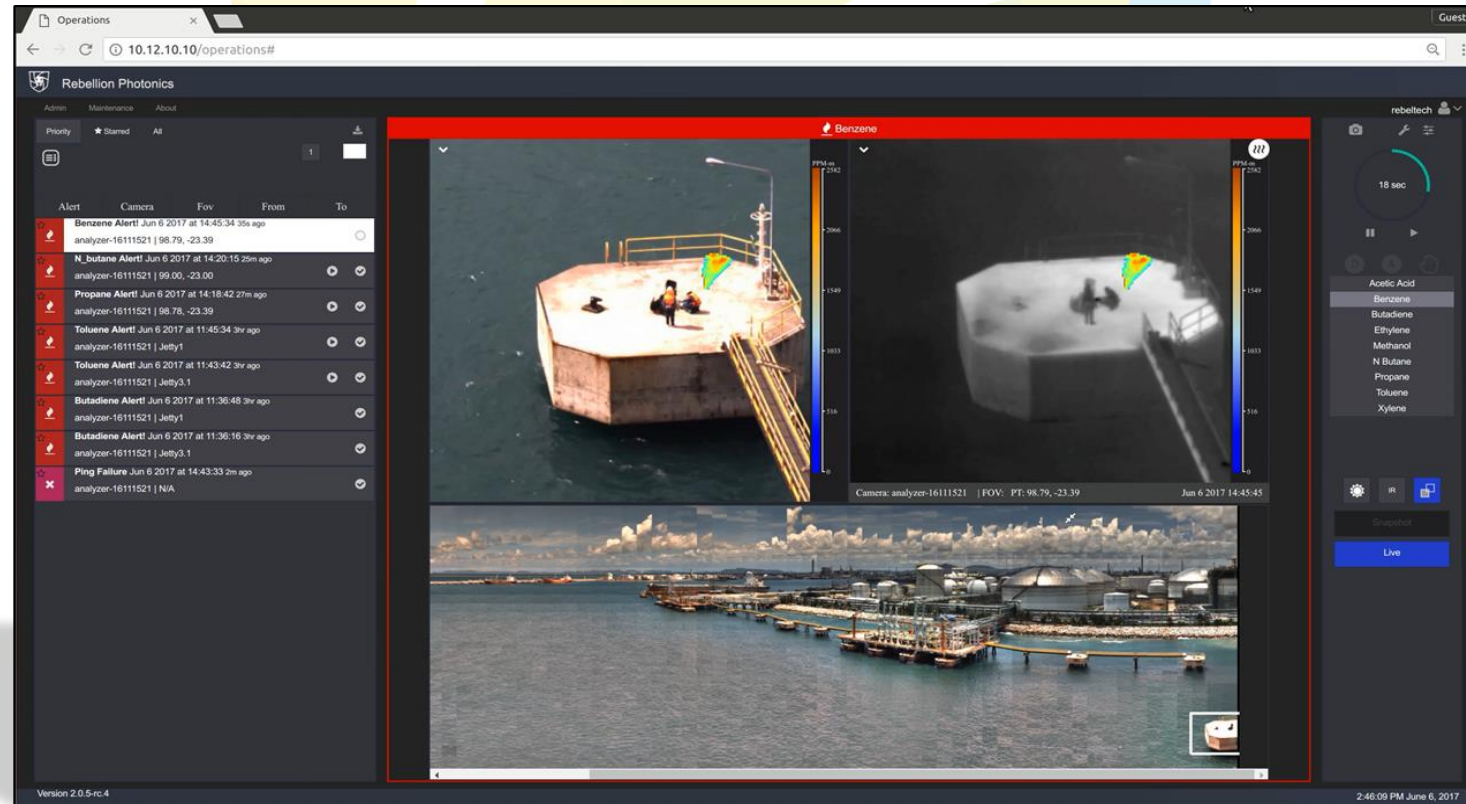
Tools
Thresholds
Cameras

地下液體物質洩漏檢測



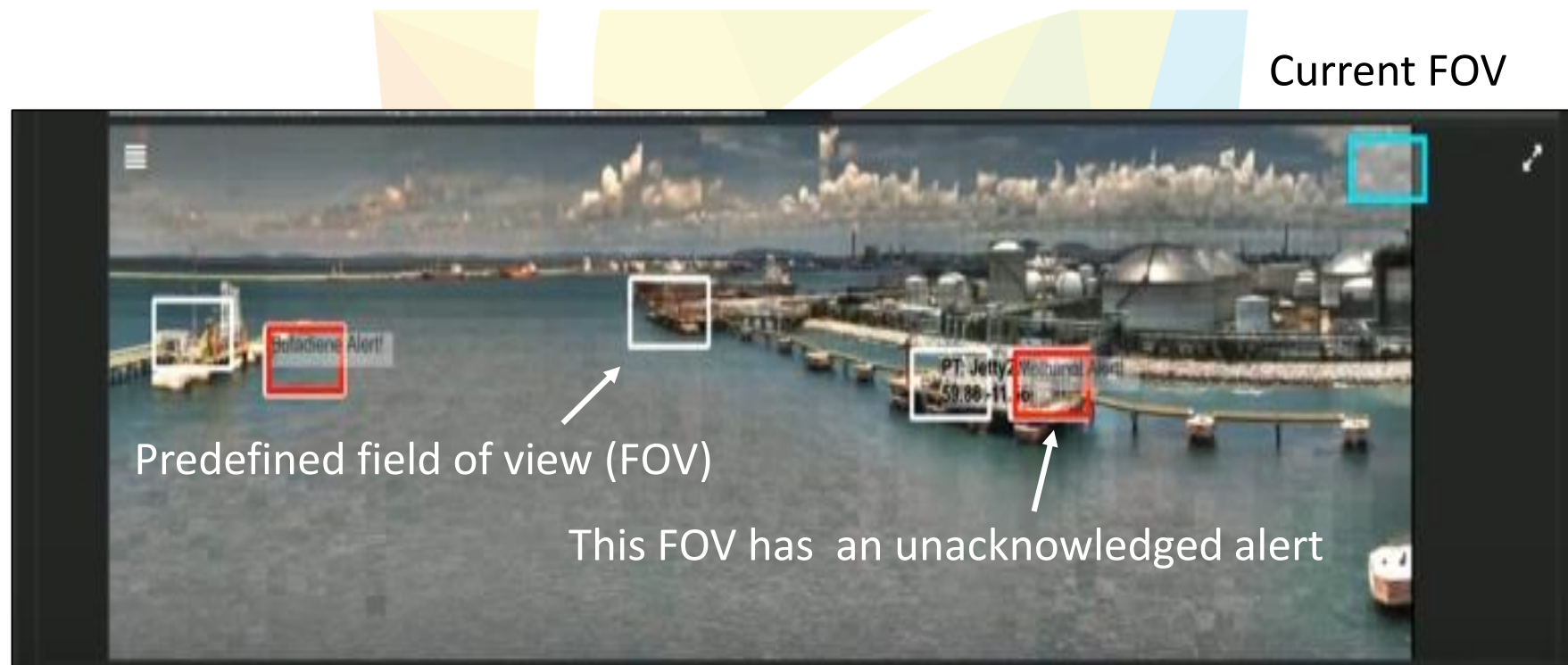
產品 = 原油, 時間推移影像超過 15 分鐘。

Video Management Software - Spectra



- Manage 100's of systems from a single workstation
- Interface with DCS or SCADA systems
- Multi-view functionality in January 2018 release
- Fully autonomous, 24/7 automatic operation

Spectra Software - Mosaic View



Mosaic是具有攝影機掃描路徑(白色矩形)的全景圖片。用戶可以按下 Mosaic任意位置來更改攝像機 FOV(先前標定的位置)。

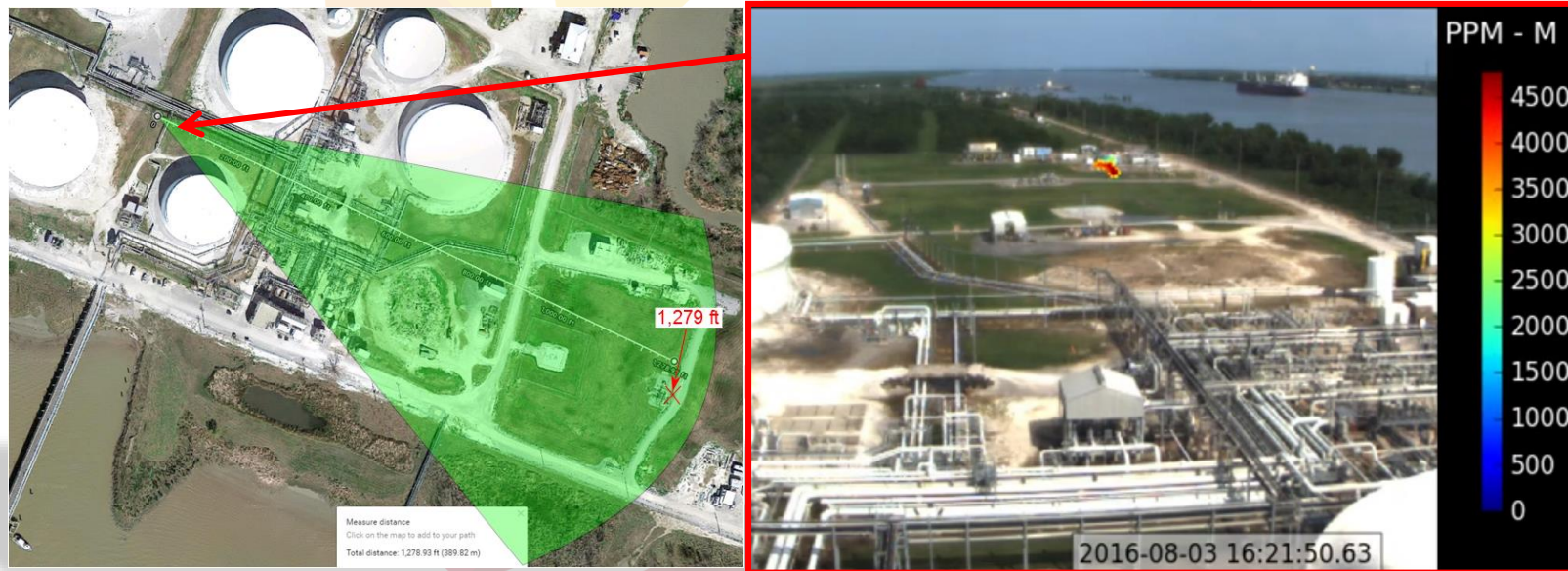
軟體支援 - 遠距離執行

- 軟體版本進階 [一年多次]
 - 新功能添加
 - 加強原功能效益
 - 改善使用者經驗
- 維護及軟體升級 [當有需求時]
- 遠端技術支援 [24/7]
- 主動性警報通報系統 [當有需求時]

- 系統健診 [每個月]
 - 影像檔整理建檔
 - 事件資料庫
 - 系統登錄
- 最佳化性能及功能 [當有需求時]
 - 移動路徑調整
 - 警報閾值改變
 - 預設區改變

Standard GCI –全覆蓋整個設施

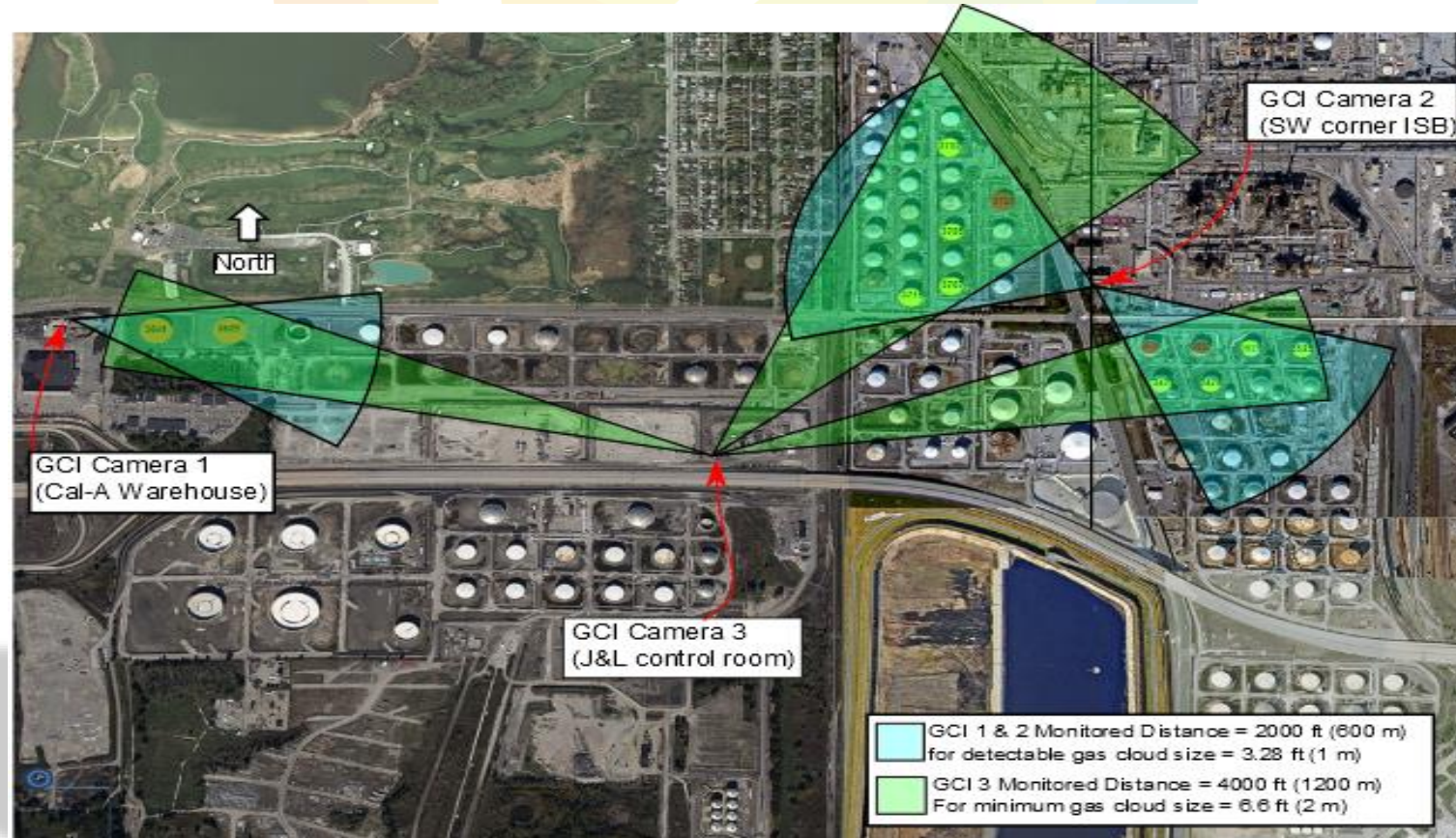
涵蓋大區域早期及準確的監測



- Methane releases were performed at edge of facility = 1300 ft (400 m)
- We can monitor for gas leaks out to 1 mile (1.7Km)

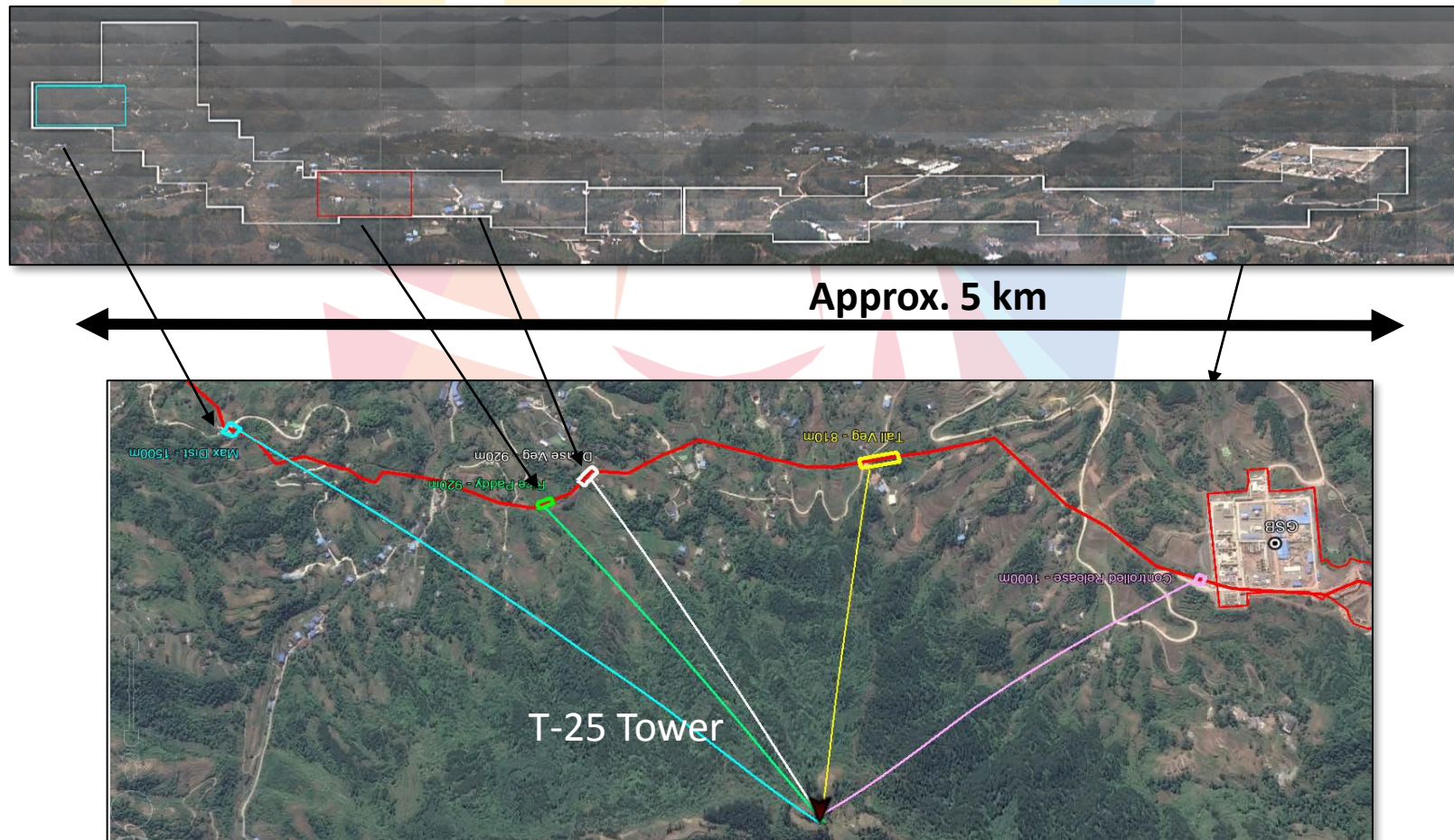
Site Assessment – Camera Placement Modeling for Tank Farm

Saves Opex: - Fully autonomous, 24/7 operation. No humans needed to monitor

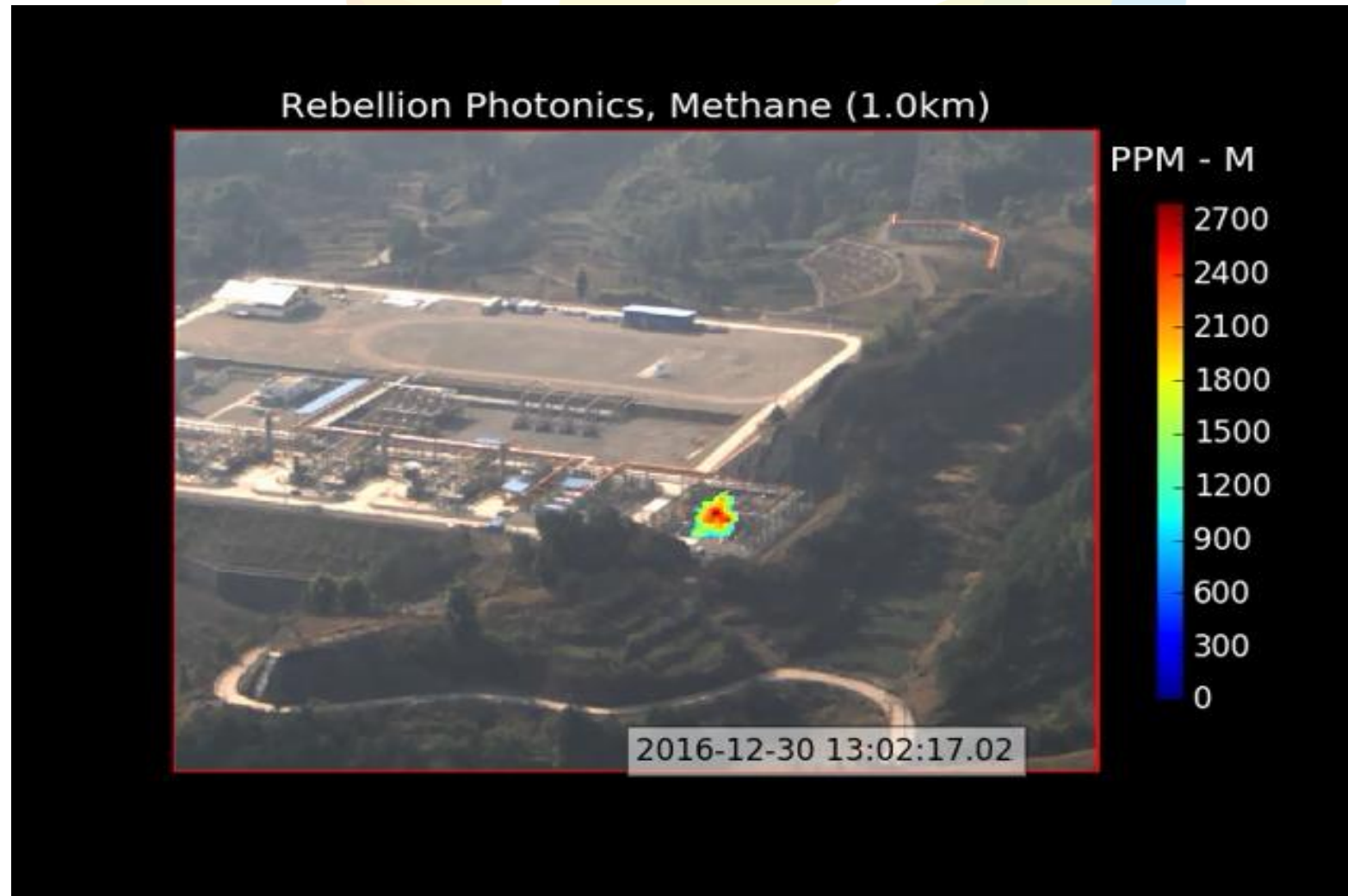


Pipeline Monitoring

Improves Safety: No need to explore hazardous gas plumes to quantify the leak



Methane Release & Detection @ 1km Distance

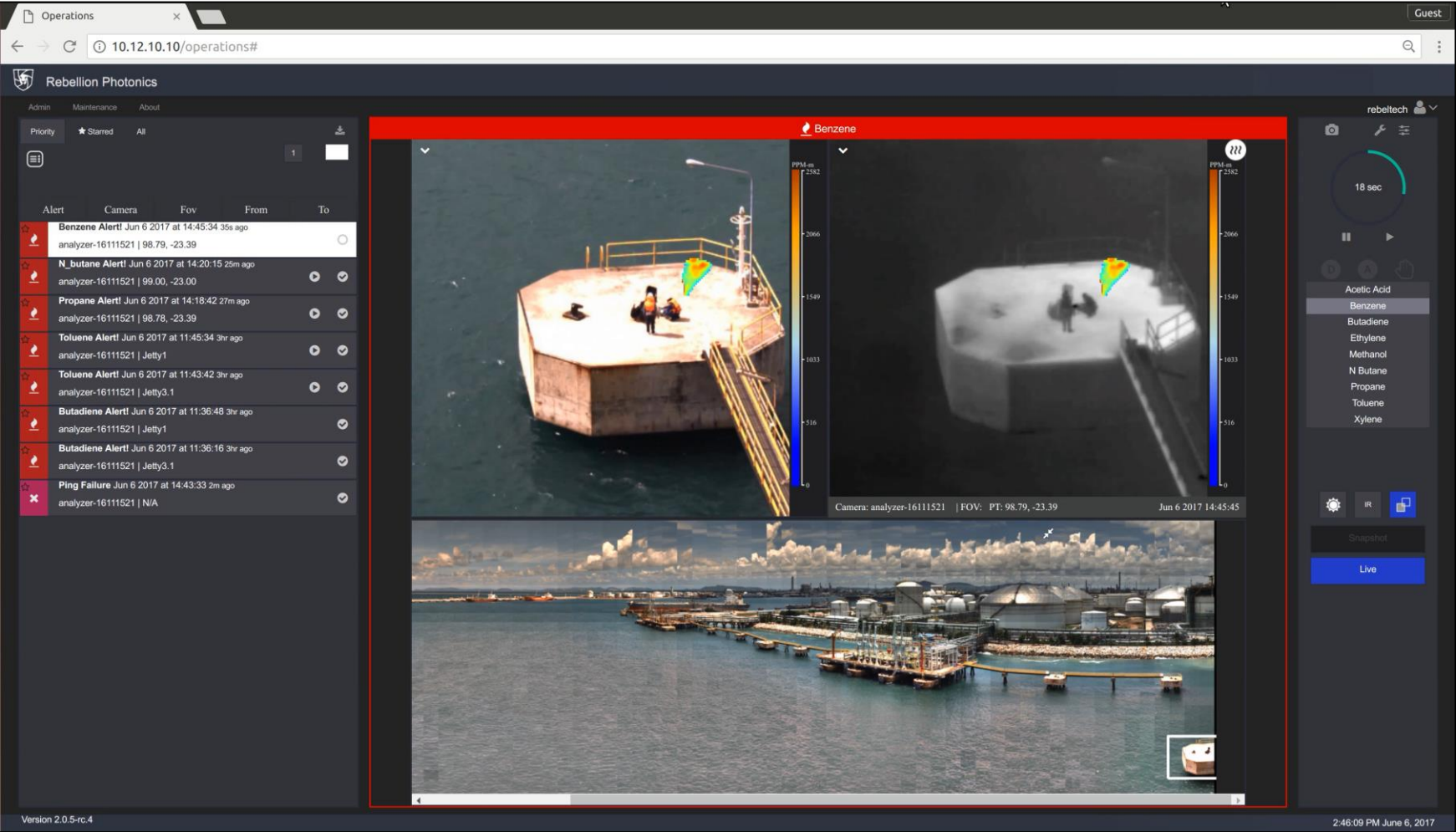


Faraway Vision - 1500 meter detection



Benzene Release & Alarm

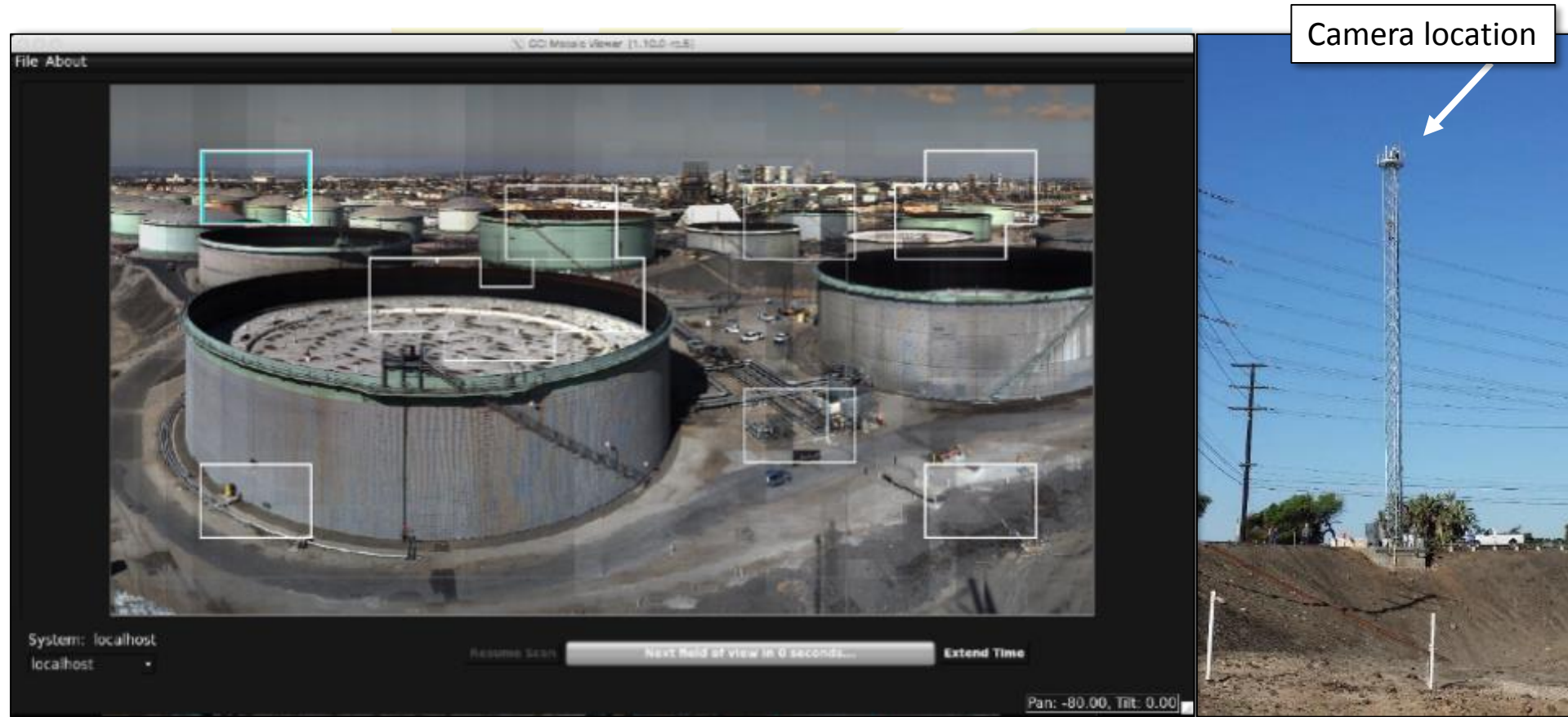
Viewed in Spectra software



Fully autonomous, 24/7 operation. No humans needed to monitor



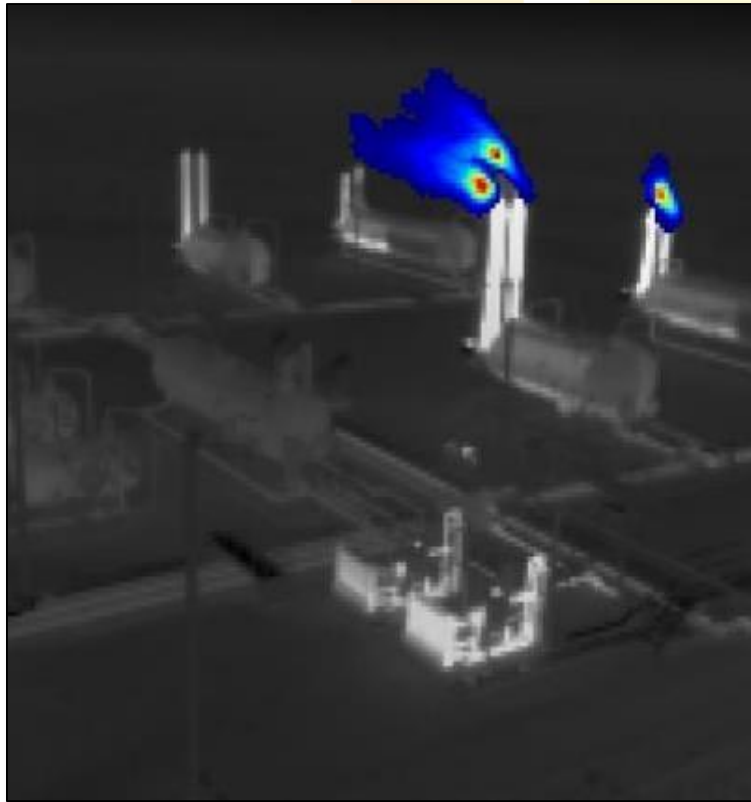
Storage Tank Farm Monitoring



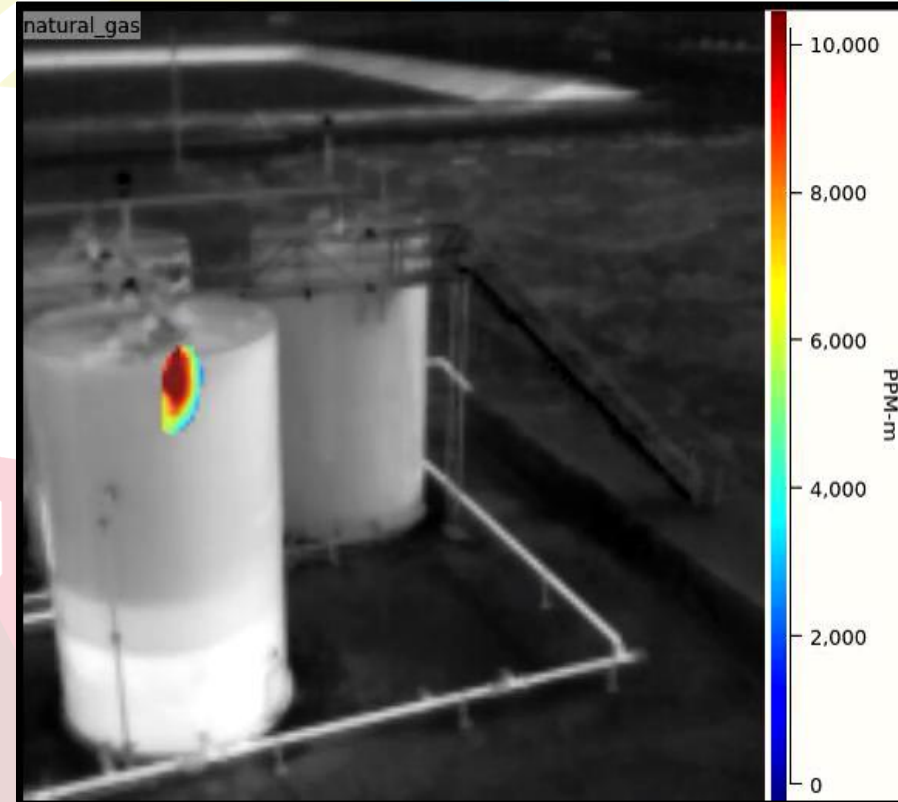
- Providing 24/7 monitoring of Tank Farm
- Monitoring for 6 different gases simultaneously

Tank Battery Monitoring

Saves Time on Maintenance – leaks immediately identified



Combustion Efficiency from
Heater Treaters



Gas Leak from Thief Hatch

Industries Served by GCI Technology



TANK FARMS



CHEMICAL PLANTS



GAS PROCESSING PLANTS



POWER PLANTS



REFINERIES



DRILLING & WELL SITES



LNG FACILITIES



PORTS



OFFSHORE PRODUCTION FACILITIES

Pipeline Leak Detection System at Chuandongbei Project



中国石油



Unocal East China Sea Ltd

川东北天然气项目
Chuandongbei Gas Project

Dr. Min Chen
Vice President (China)
Unocal East China Sea Ltd.
November 15, 2017



U.S.- China Oil & Gas Industry Forum
中美石油和天然气工业论坛

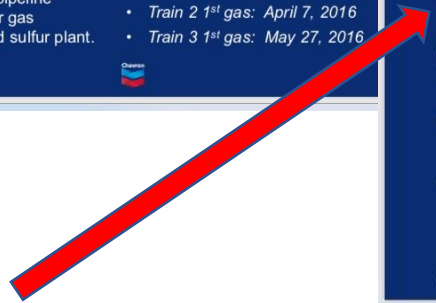


Project Overview

- 30-year Production Sharing Contract (PSC) signed between Unocal East China Sea, Ltd. ("Chevron") and CNPC in 2007.
- Co-developed by Chevron (Operator) and China National Petroleum Corporation (CNPC).
- 49% participating interest by Chevron, and 51% by CNPC.
- Over 800 square kilometers in Sichuan Province and Chongqing Municipality in southwest China.
- 2 well pads, 30-km pipeline network, 3-train sour gas processing plant and sulfur plant.



- Well Pad A Start-up: December
- Train 1 1st gas: January 25, 2016
- Train 2 1st gas: April 7, 2016
- Train 3 1st gas: May 27, 2016



Safety and Technology Leadership

Leak Detection – Multiple technologies deployed to detect leaks quickly, enabling timely emergency response.

- ATMOS pressure sensing
- Low pressure safety system
- Distributed temperature sensing (DTS)
- Distributed acoustic sensing (DAS)
- Rebellion GCI cameras
- Foot patrols
- Intrusion detection
- Mass balance



© 2016 Chevron Corporation

Case Study: Gas Leak Monitoring At Pernis Refinery, Rotterdam

Client



GCI's Deployed

1 Standard GCI
Long Range

Project Scope And Challenges

- System monitors for gas leaks in Europe's largest refinery
- Monitoring for 8 different gases including Ethylene Oxide
- DCMR – environmental regulator – keeping a close eye on performance

Proposed future stack locations



Initial pilot location

Rebellion Highlights And Value Proposition

- First GCI System installed in the EU
- Includes custom development of the analytic for Ethylene Oxide - the first analytic ever developed to detect, identify and quantify EO
- Gases monitored: Ethylene Oxide; Methane; Ethane; Propane; n-butane; Iso-butane; Propylene Oxide; Acrylonitrile
- Future expansion is for an additional 2 or 3 GCI Systems to be installed on very tall stacks located in the eastern and western sections of the refinery requiring custom-designed mountings



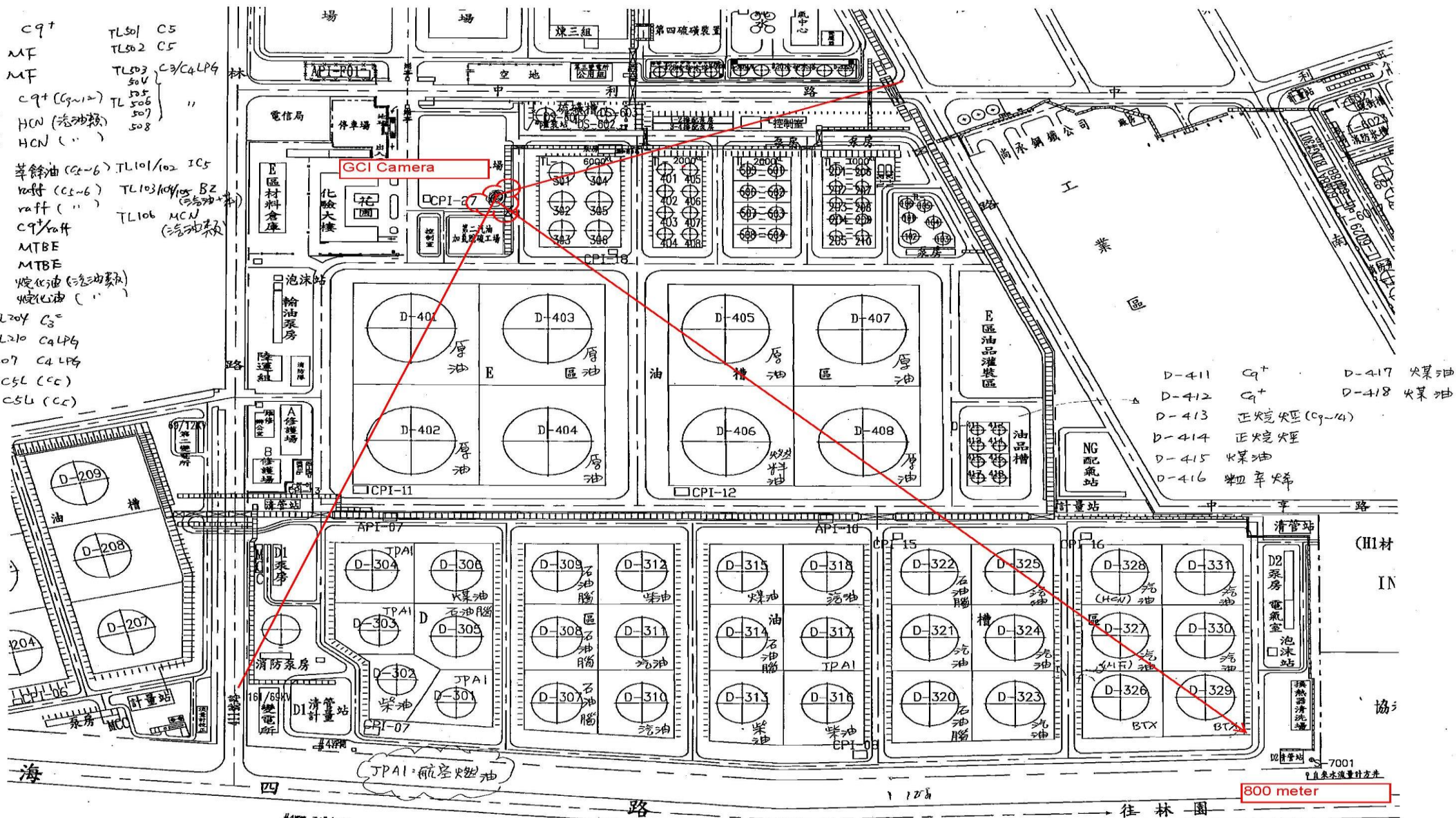
中油大林廠GCI一期

TL 301 C9+
TL 302 MF
TL 303 MF
TL 304 C9+ (C9+2)
TL 305 HCN (汽油類)
TL 306 HCN (")

TL 501 C5
TL 502 C5
TL 503 C3/C4LP4
TL 504 50V
TL 505 505
TL 506 506
TL 507 507
TL 508 508

TL 401 萃餘油 (C5~6) TL 101/102 IC5
TL 402 raff (C5~6) TL 103/104/105 BZ
TL 403 raff (") TL 106 MCN
TL 404 C9+raff
TL 405 MTBE
TL 406 MTBE
TL 407 烷化油 (汽油類)
TL 408 烷化油 (")

TL 201~TL 204 C3
TL 205/TL 210 C4LP4
TL 206/207 C4LP4
TL 208 C5L (CC)
TL 209 C5L (CC)



D-411 C9+
D-412 C9+
D-413 正火定火型 (C9~4)
D-414 正火定火型
D-415 火果油
D-416 柴油
D-417 火果油
D-418 火果油

800 meter

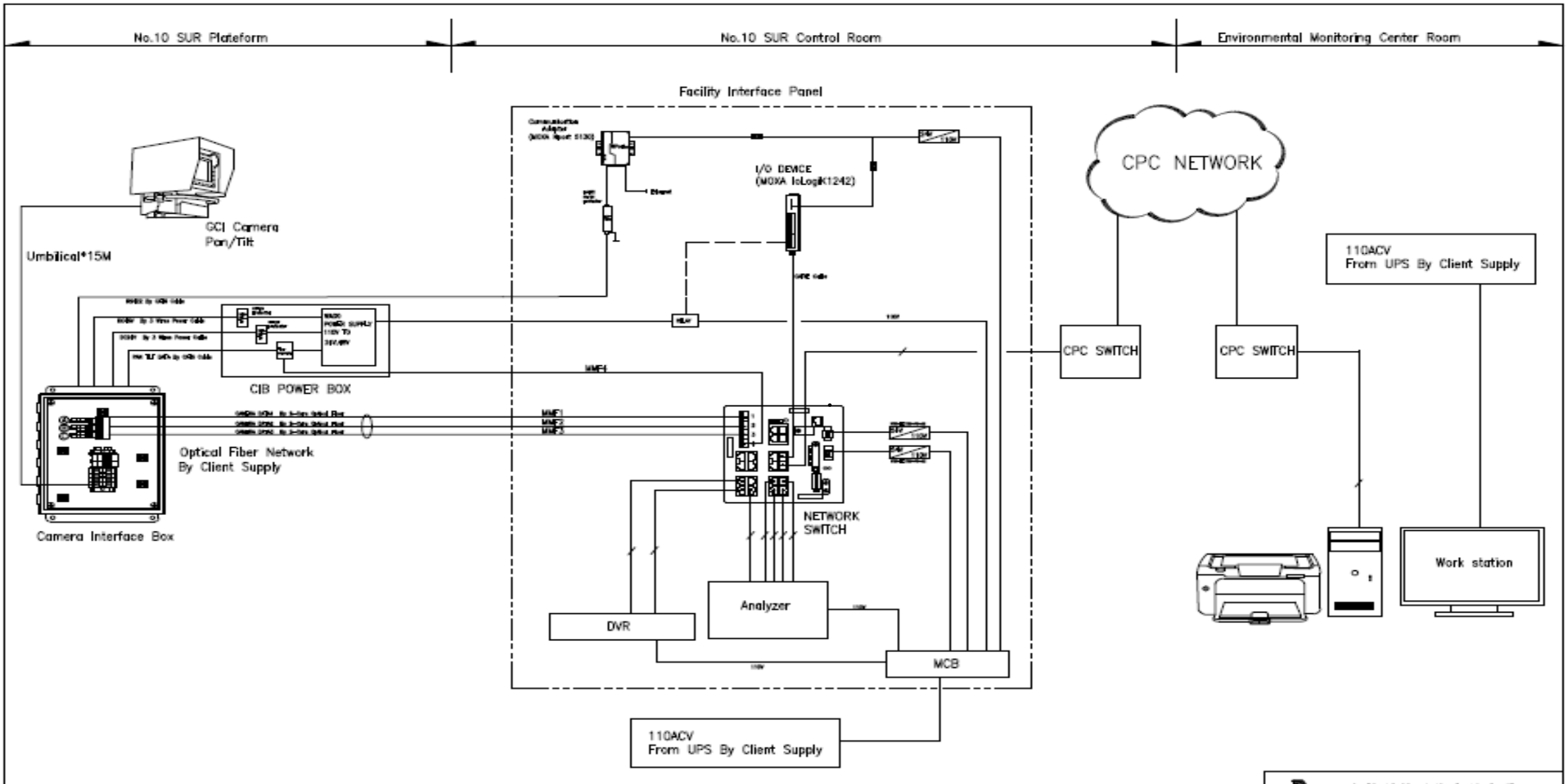
#400 34"/2PC

往林園

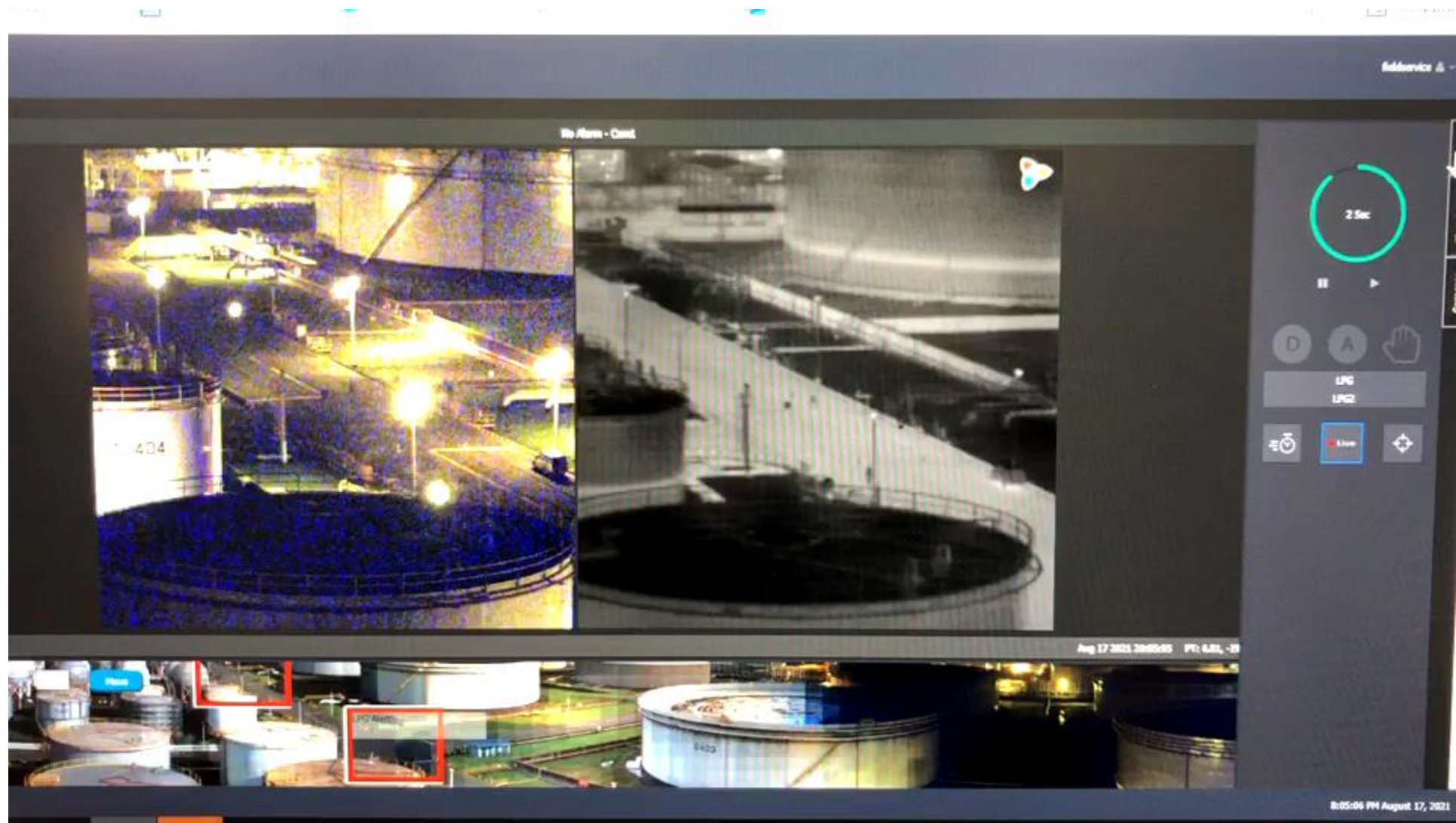


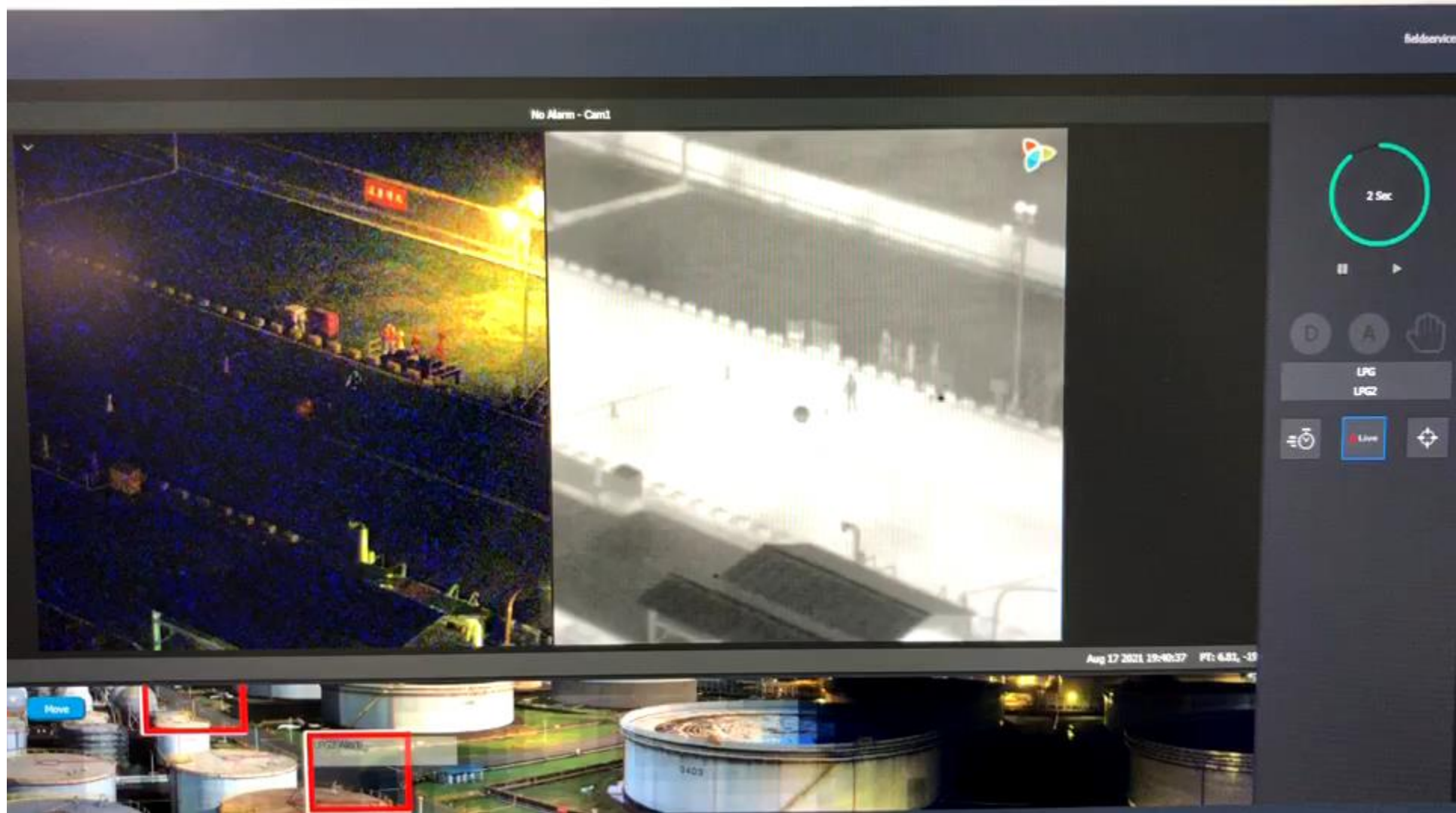
主要連續監測物質
NAPTHA、
JET FUEL OIL、BTX、
C3-C5、ALKYLATE、
及GASOLINE OIL等。

中油大林煉油廠GCI系統架構



中油大林2021.08.10夜間洩漏測試





MAKING THE ENERGY

