Wireless Gas Detectors in PETRONAS

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ARC FORUM, ORLANDO
10TH FEB 2016

Presenter

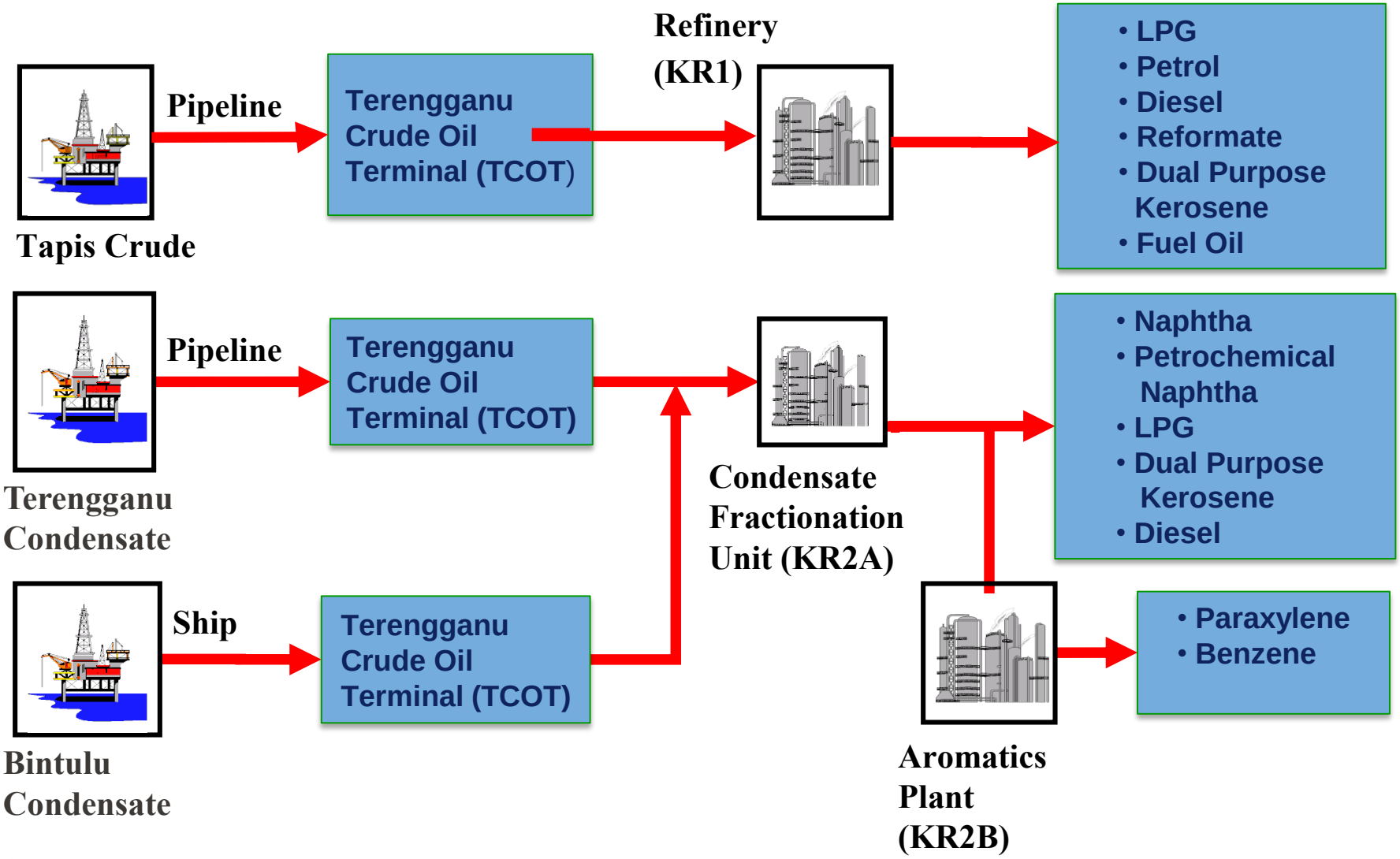
- Graduated in Bachelor of Science from Univ. of Miami, Coral Gables Florida in 1988
- Graduated in Master Engineering from University of Florida, Gainesville, Florida in 1990
- Has been serving with PETRONAS, for 22+ years in various Oil & Gas facilities in Malaysia:
  - ❑ Transmission (Pipeline) Operations Division, Segamat
  - ❑ Liquified Natural Gas (LNG) Plant, MLNG, Bintulu
  - ❑ Integrated Refinery and Aromatics Plant, Kertih
- Currently the Principal Engineer, Instrument & Control, leading an Instrumentation group for PETRONAS Penapisan Terengganu Sdn Bhd, a refinery in east coast of Peninsular Malaysia

PETRONAS

Brief Overview of PETRONAS
- website 'www.discoverypetronas.com'

- PETRONAS, incorporated on 17 Aug. 1974 as the national oil company of Malaysia, vested with the entire ownership and control of the petroleum resources in the country and has been ranked among the FORTUNE Global 500® largest corporations in the world.
- Over the years, we have gained unique experience and expertise in nation building and this, coupled with our technical and operational competencies have allowed PETRONAS to be increasingly accepted as the preferred strategic partner by international companies and the host countries where we operate.
- This augurs well for the realisation of our vision to become a "Leading Oil and Gas Multinational of Choice".

PETRONAS refinery core business is to refine Malaysian indigenous crude oil into high-value petroleum products for domestic and exports markets.



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Fire and Gas Mapping

Fire and Gas Mapping Study

Background

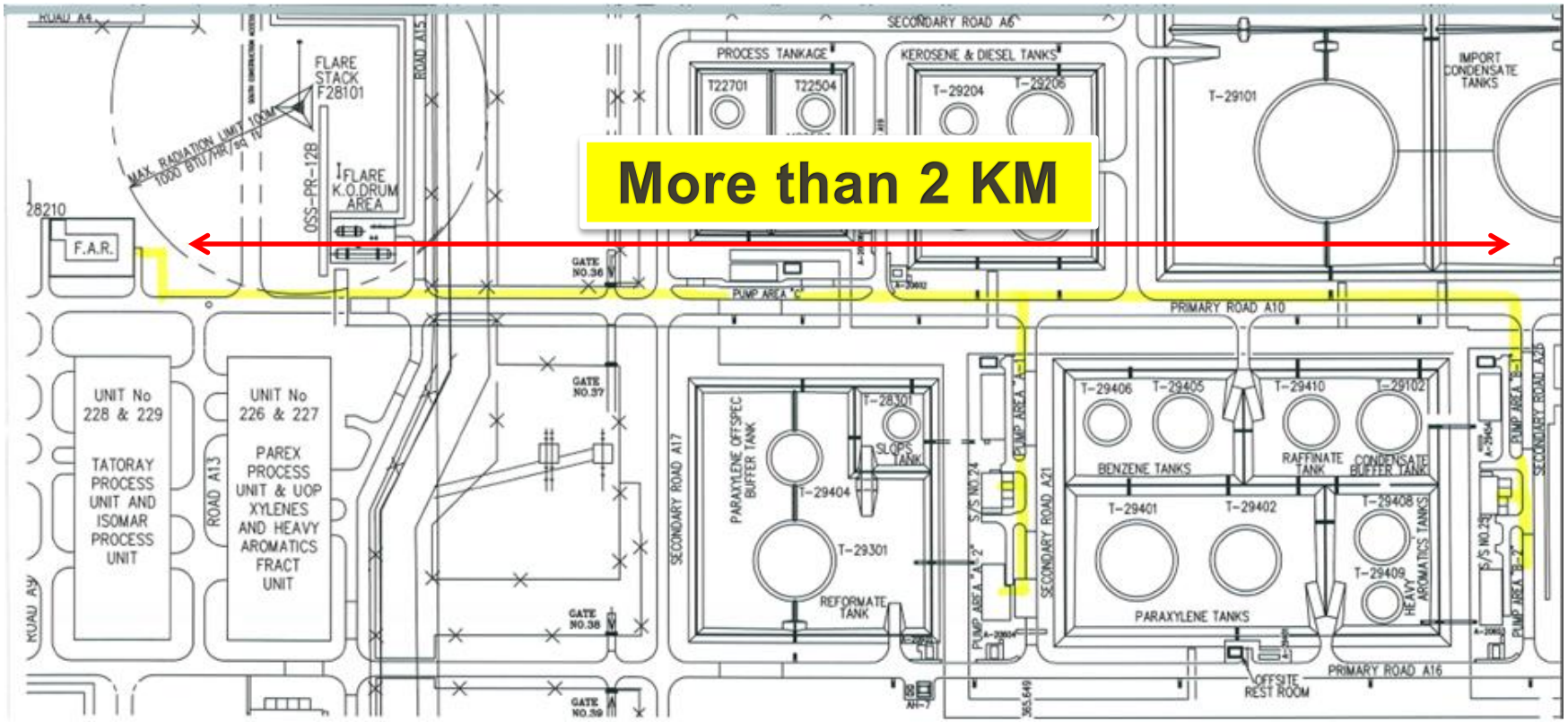
- PETRONAS Refinery conducted its fire and gas mapping exercise in 2011.
- The fire and gas mapping recommendations were to be implemented in phases according to the roll out plan.

Challenges

- Scarcity of spare junction boxes at site.
- High risk involved when laying new cables for detectors especially when excavation is involved.
- Installation and commissioning of new detectors have to be done online while plant is running.
- Remote location such as tank farms makes it difficult for cable routing with bund walls and road crossings.

Fire and Gas Mapping Study

Plot plan of tank farm installation



- More than 2 kilometres of homerun and branch cables required if conventional wired solution is adopted.
- Large CAPEX required.

Fire and Gas Mapping Study

Solution

- Wireless gas detectors.

Success Factors

- Proven in use.
- Product maturity.
- Compliance to ISA100.11a wireless communication standard.
- Satisfies IEC60079-29-1 performance requirements.
- Interoperability with existing wireless network and host DCS.
- Used for monitoring purposed only.

Wireless Gas Detectors

Wireless Gas Detectors

Interoperability testing

•Test 1: 7 units of GS01 coexistence test with 10 units of Yokogawa YTA510 (March 2012 @ Kårstø gas processing plant, **Norway**)

•Test 2: 7 units of GS01 with 1 unit of Yokogawa YTA510 provisioned into the wireless mesh network (March 2012 @ Kårstø gas processing plant, **Norway**)

•Test 3: GS01 with Yokogawa YTA510, YFGW510 and YFGW410 (6th Nov 2013 @ Yokogawa **Japan**).

•Test 4: GS01 with YTA510, YFGW510, YFGW410 and Centum DCS (22nd Nov 2013 @ Yokogawa **Malaysia**). Witnessed by PETRONAS

Wireless Gas Detectors

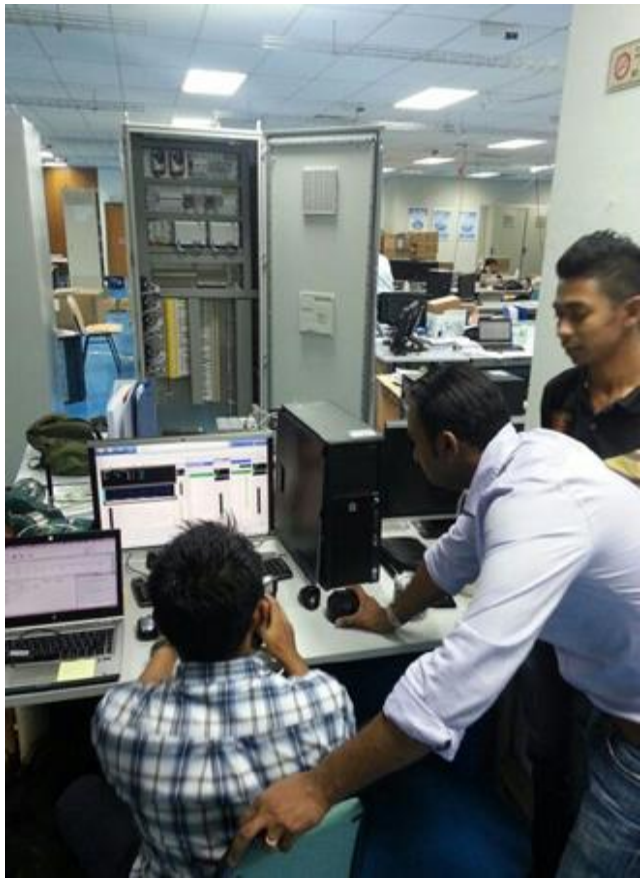
Rigorous testing criteria

Category	Test	Description	Acceptance Criteria
Sped of Response	Speed of response	Test the detector using bottled test gas and measure the speed of response via walkie-walkie or log file. This is from time of gas release from volume bottle to detection of GD at site to alarming at DCS/FGS System.	Speed of response from gas exposure to signal at Triconex (for PPTSB) should be less than 7s; or Fast Tool (for PCSB) should be less than 30s.
Accuracy and linearity	Accuracy and linearity	Expose the detector to 50% LEL methane via tubing. This operation shall be carried out three times. Record output signal against time.	+/-5% LEL. Long Term Test: The above to be conducted once a month for a period of X months.
Warning singal	Low battery	The detector should give a warning signal when battery voltage drops below a set threshold. This should provide operators with enough time to change the battery before the detector stops working. A low voltage battery package will be used to test that signal is received at control system.	nal received within 20s
	Communication error	If communication fails, the controller should register and give error signal within 60 seconds. The detector will be marked as unavailable at faceplate. Error should be simulated by taking out the battery.	Signal received within 20s
Battery	Battery lifetime	Battery lifetime will be tested by looking at the battery status in the log file.	Must reflect the 2 years average battery lifetime.
	Change of battery	Battery should be easily replaceable. Detector with new battery should stay in network or automatically rejoin.	1) Detector in network in less than 10 minutes after new power 2) Out of network in less than 60 seconds after battery removal
Wireless communication	New detector added to network (PPTSB only)	It should be easy to add new detectors to the network as the mesh will self-configure. Add 2-3 detectors to the network and the added detector should automatically be included in the mesh network structure.	Added detector should be available and added to the mesh network in less than 20 minutes from installation and power
	Interoperability with Yokogawa wireless mesh network	The gas detectors are configured into Yokogawa ISA100 network. No negative effects like increased packet loss and unavailability should be observed.	The gas detector should pass the rest of the criteria in this test.
	Coexistence with existing wireless networks	The gas detectors are to be tested with sporadic use of site's radio communication.	No negative effects like increased packet loss and unavailability should be observed
Environmental tests	Condensation	No false gas alarms should be generated by condensation. The log file will be analyzed especially during period of monsoon season.	No false alarm
	Combined heavy wind and rain	Detectors should show normal operation during heavy wind (Venturi) and rain, and during a combination of wind and rain.	1) Normal operation 2) Internals of device to be free of water ingress or visible signs of corrosion
	UV Ray	At least 1 detector should be exposed to the sun.	1) Normal operation 2) No observable integrity issues
	Operation near rotating equipment (pumps/compressors)	The gas detectors are to be installed near rotating equipment to test exposure to mild vibration and EM radiation.	No negative effects like increased packet loss and unavailability should be observed

Test Criteria

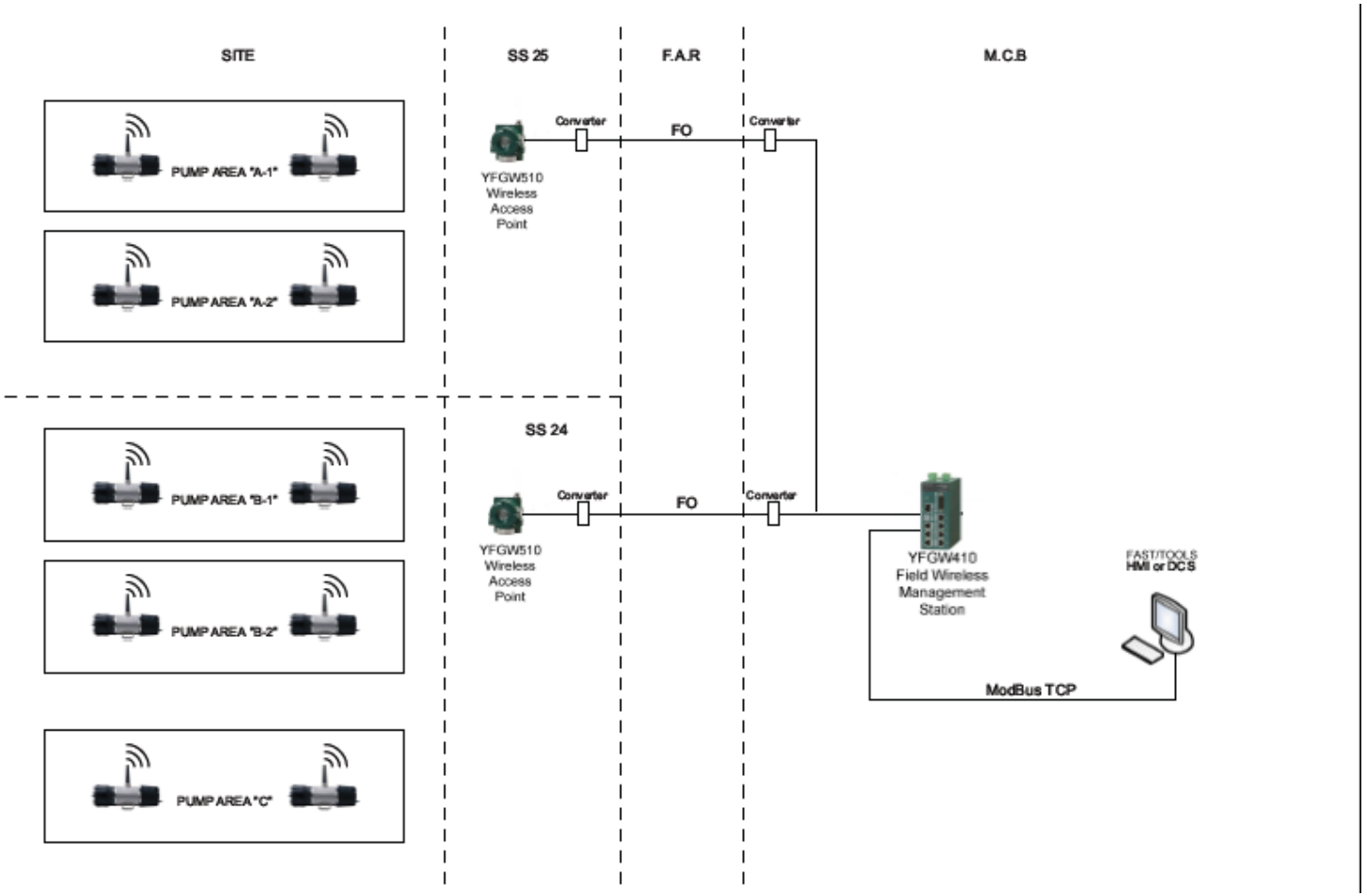
Wireless Gas Detector & DCS Host Integration

Testing @ Yokogawa, Malaysia



Overall System Architecture

Schematic for site installation

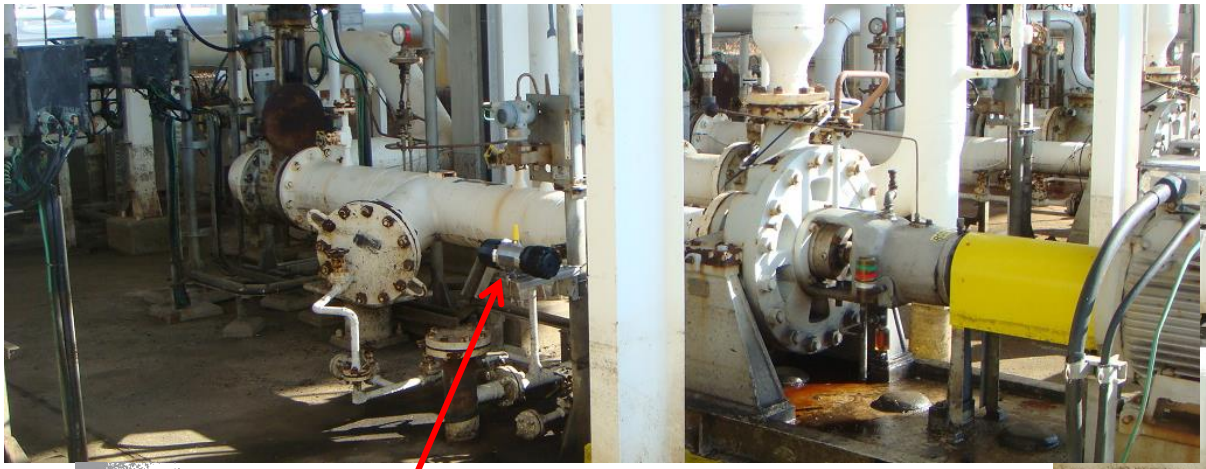


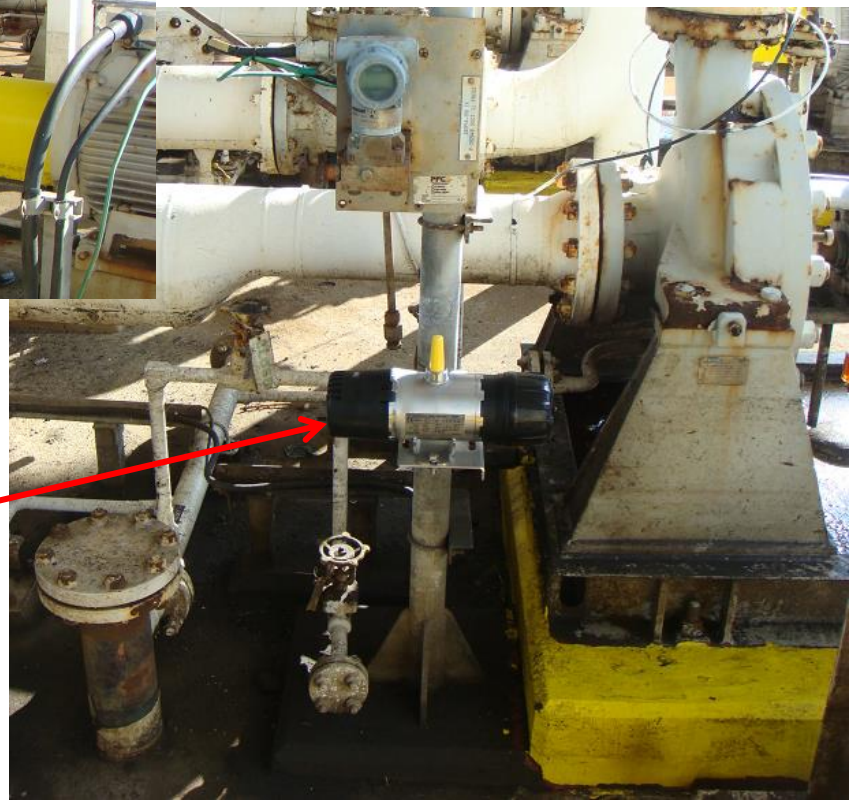
Challenges

Item	Issue	Cause	Impact
1	The 2 YFGW510 could not start-up and gave a Red Indication light during commissioning.	The fibre optics between YFGW510 and the SS24 and SS25 were damaged and no connection could be established to the YFGW410 at the Control Room. .	Poor quality of fibre optics can significantly affect transmission of signal.
2	No connection between GD#157 at Pump House C and the YFGW510 at SS24.	No Line of Sight (LOS) between the YFGW510 at SS24 and the detectors at Pump House C. Omnidirectional signal propagation needs attention when installation involves enclosed areas.	A repeater had to be used to established a clear LOS between the 2 locations.

Detectors at site

Actual site installation





Benefits & Lessons Learned

Fit for purpose solution

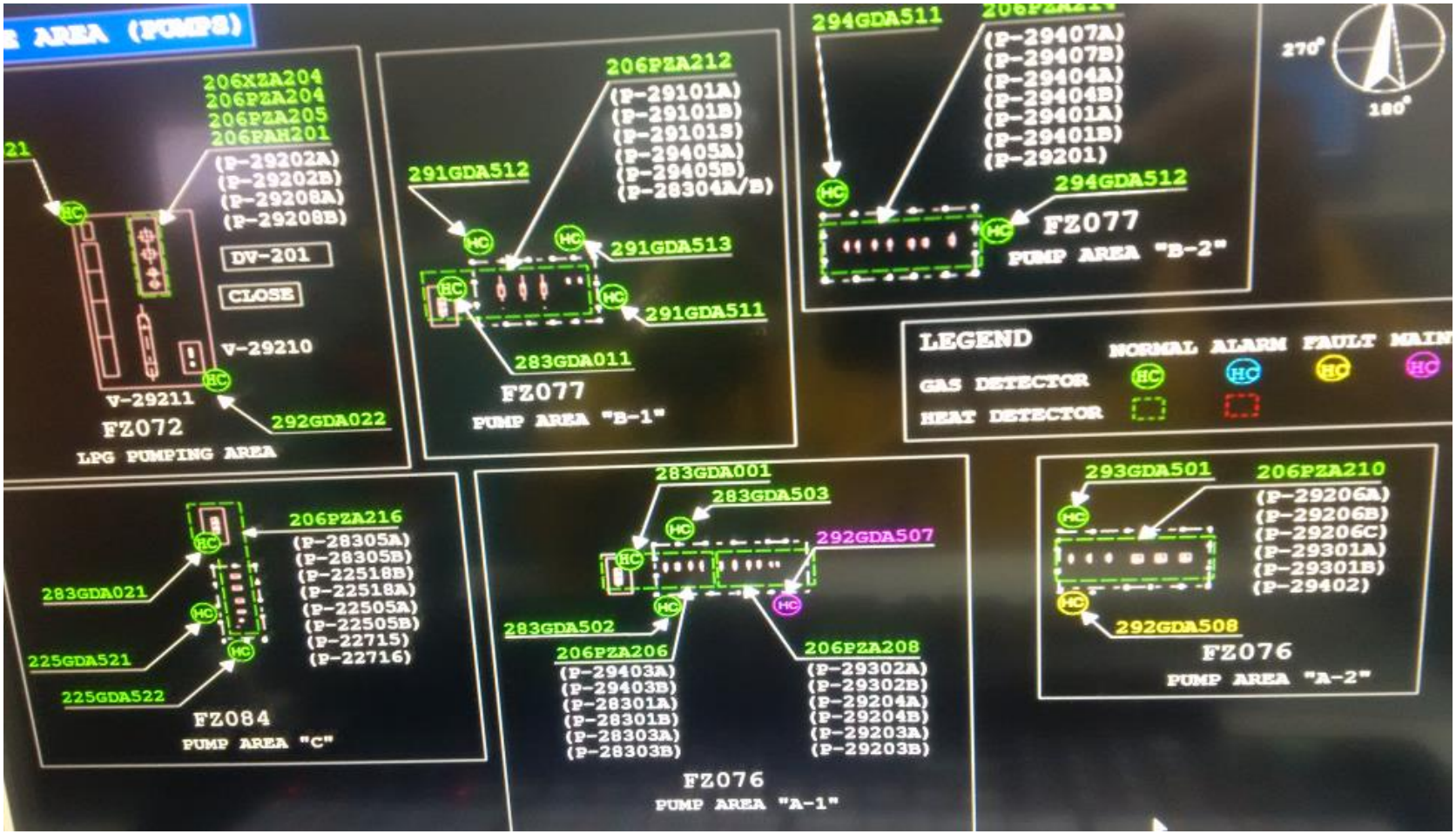
Benefits

- Reduction in overall project risk. No cables; hence no excavation and working at height.
- Installation can be done quickly, safely and seamlessly while plant is online.
- Simplifies engineering and drawing updates.
- Significant reduction in overall project cost.

Lessons Learned

- Good stakeholder management
  - Client, principal, local business partner and vendors were involved right from the beginning.
- Good communication plan
  - Good support and collaboration between all parties involved ensured the system was tested successfully to the client's requirements.
- Need to pay attention on future upgrades of hardware that may affect the network.

DCS graphics of 12 wireless gas detectors



The End

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