



Health Safety & Environment Protection using Fiber Optics

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Pt Panca Amara Utama



AGENDA

1. Company Introduction
2. The Health of Tank – Objective
3. The DTS System Basics
4. The Leak Detection System Development cycle
5. Early warning is Safety
6. Enhancements Possible

- PT Panca Amara Utama (“PAU”) is a 700,000 metric tons per annum (MTPA) capacity greenfield ammonia plant in Batui District, Banggai Regency, Central Sulawesi, Indonesia (“Project”).
- Natural gas for the plant will be supplied by Senoro-Toili gas fields, operated by JOB Pertamina-Medco E&P Tomori Sulawesi. Plant is expected to begin operations in first quarter 2018. PT Rekayasa Industri, a national contractor is appointed sole EPC Contractor for the project.
- PAU has received debt financing arranged by the International Finance Corporation (“IFC”, member of the World Bank Group). The syndication includes seven international banks such as ANZ, HSBC, KDB, OCBC, SMBC, Standard Chartered and UOB. IFC also holds an equity position in PAU in the form of a subordinated loan. This represents the IFC’s largest greenfield project funding in Asia over the last decade.
- Technology for the plant has been licensed from Kellogg Brown & Root (USA), and PAU will be the first in the world to apply KBR’s patented KRES + Purifier technology, thereby increasing Indonesia’s access to leading edge Technology.
- PT Panca Amara Utama (PAU) is a 60% subsidiary of Indonesia’s largest private LPG refiner, PT Surya Esa Perkasa Tbk. (ticker: ESSA).
- Yokogawa is DCS and Instruments partner of the Plant.

Company Introduction



- 1st in Indonesia with 100% LED Lighting
- 1st in Indonesia with Top End Temp. and Pressure Transmitters from Yokogawa
- 1st in SE Asia with KBR KRES + Purifier Together
- 1st in Indonesia with Super Duplex Sea Water Pumps
- 1st In Indonesia with Under-Insulation Corrosion Resistance Paints on Piping
- 1st in Indonesia with 100% Local EPC and Detailed Engineering (PT Rekayasa Industry)
- One of the Largest IFC (World Bank) funded Project in SE Asia in 100% Private Sector.

Company Introduction

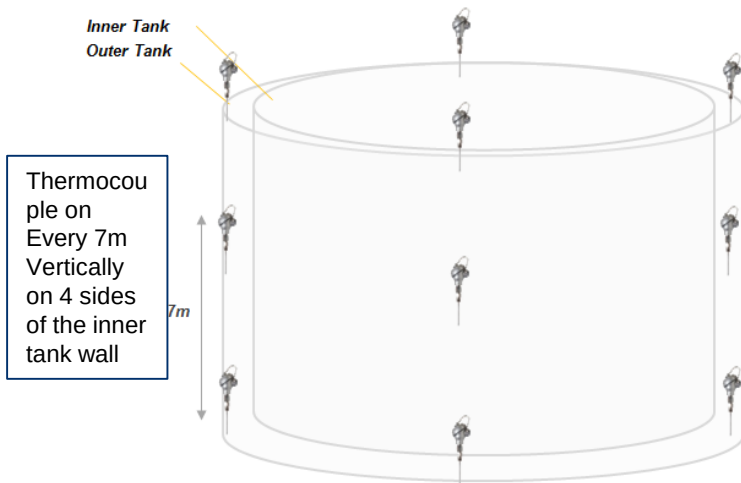
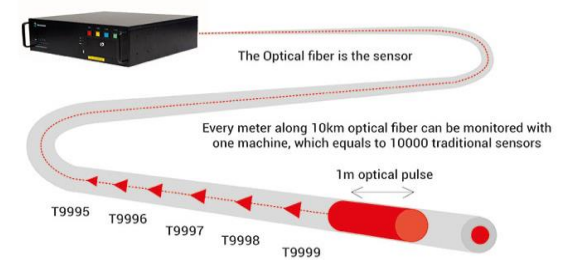


Ammonia Storage Tank Leak Detection

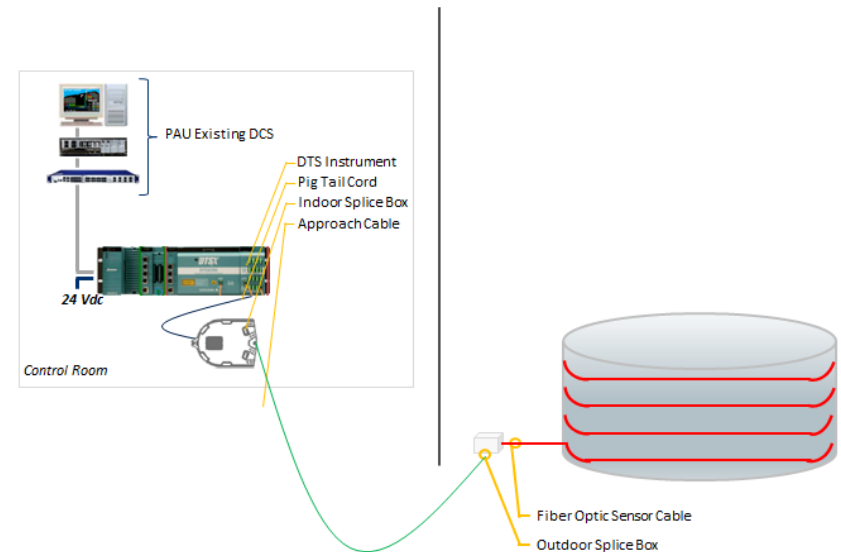
Ammonia Storage Tank



Tank ID : 51m
Height : 25.9m
FO Length : 5000m



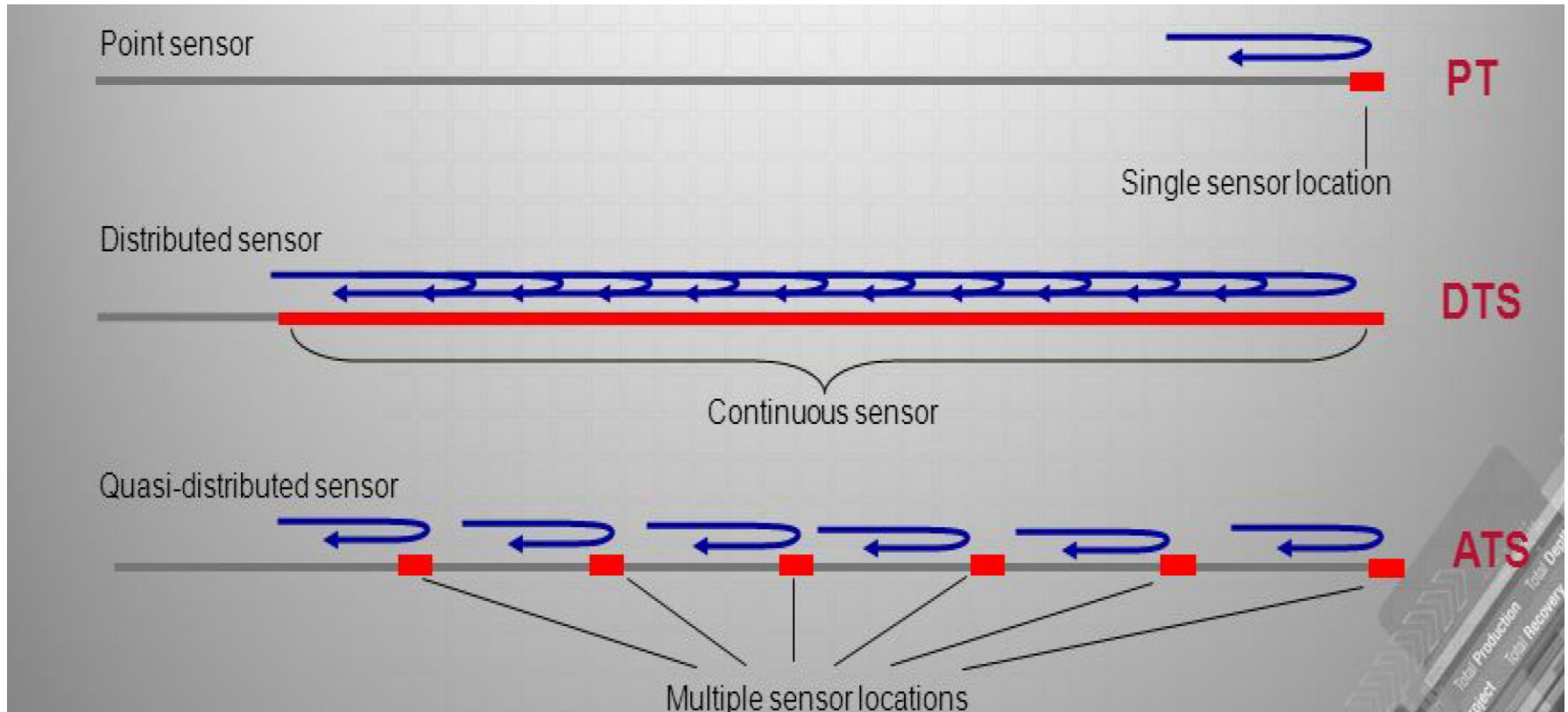
Existing Method for Leak Detection



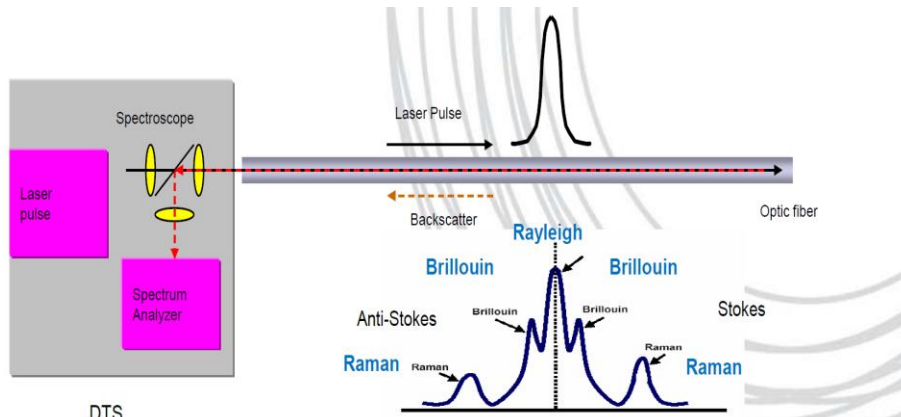
Co-innovating Project of Integrated Ammonia Leak Detection System using DTSX

- a. Measure Tank Health Continuously in Specific Measurable way
- b. Have Localised information of the Whole Tank Surface Area
- c. Have an Early warning system
- d. Have systems which Helps formulate Specific Response
- e. A System which is Always On

TEMPERATURE MEASUREMENT BY FIBER SENSOR TECHNICAL POSSIBILITIES

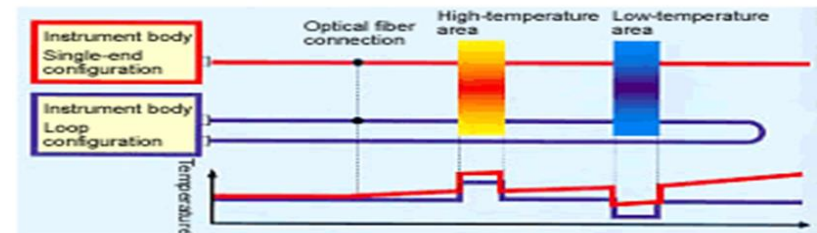
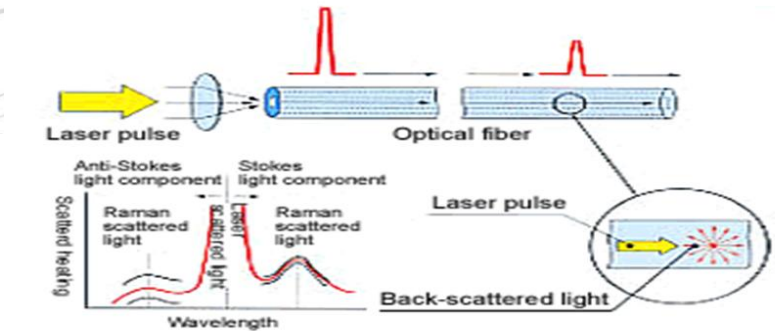
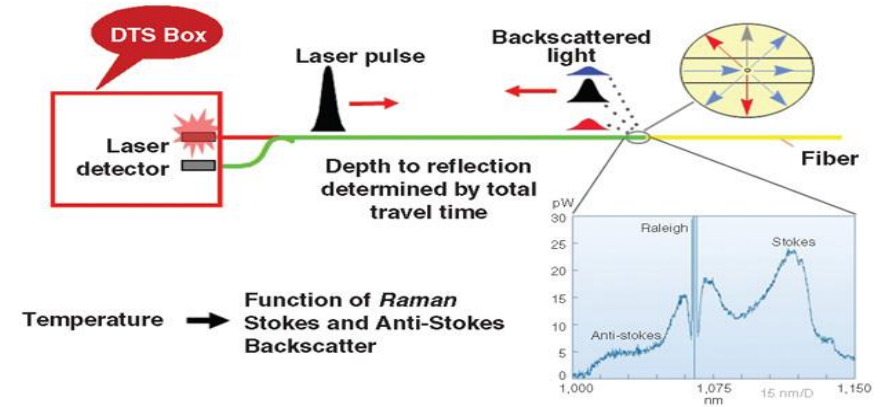
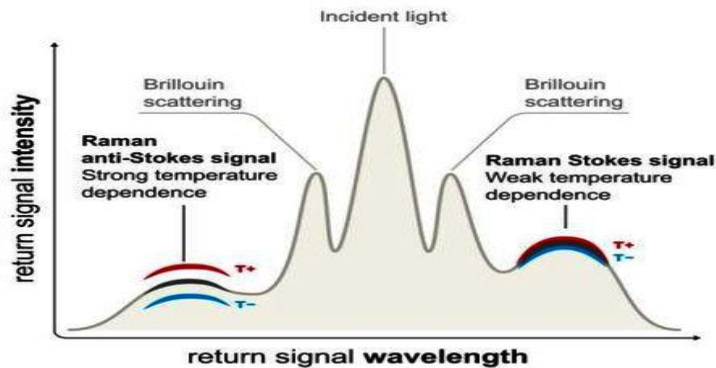


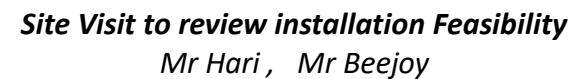
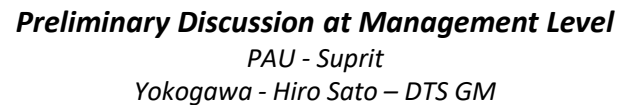
The Physics Behind the DTS



DTS

- DTS instruments measure the change in reflected light against time.
- Nature of optical reflections change with temperature, strain and pressure
- Measure all points along a fibre - distributed.



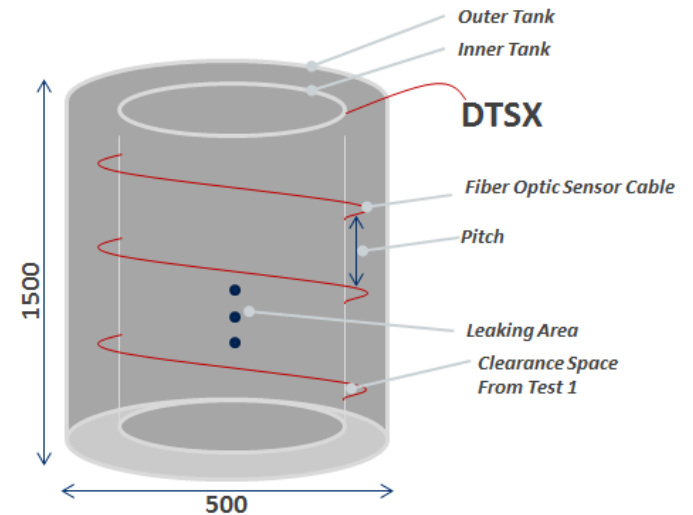


Preliminary Test Idea Proposed to PAU

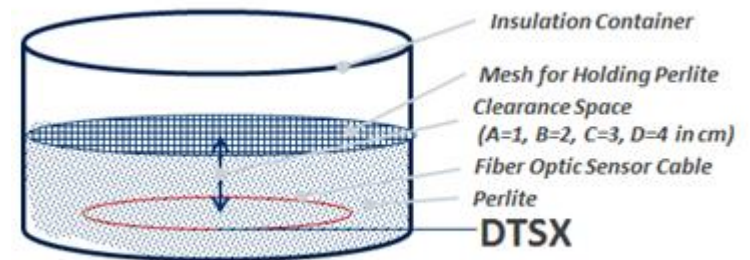
Internal Simulation Tests and Jigs



Internal Test Set-up



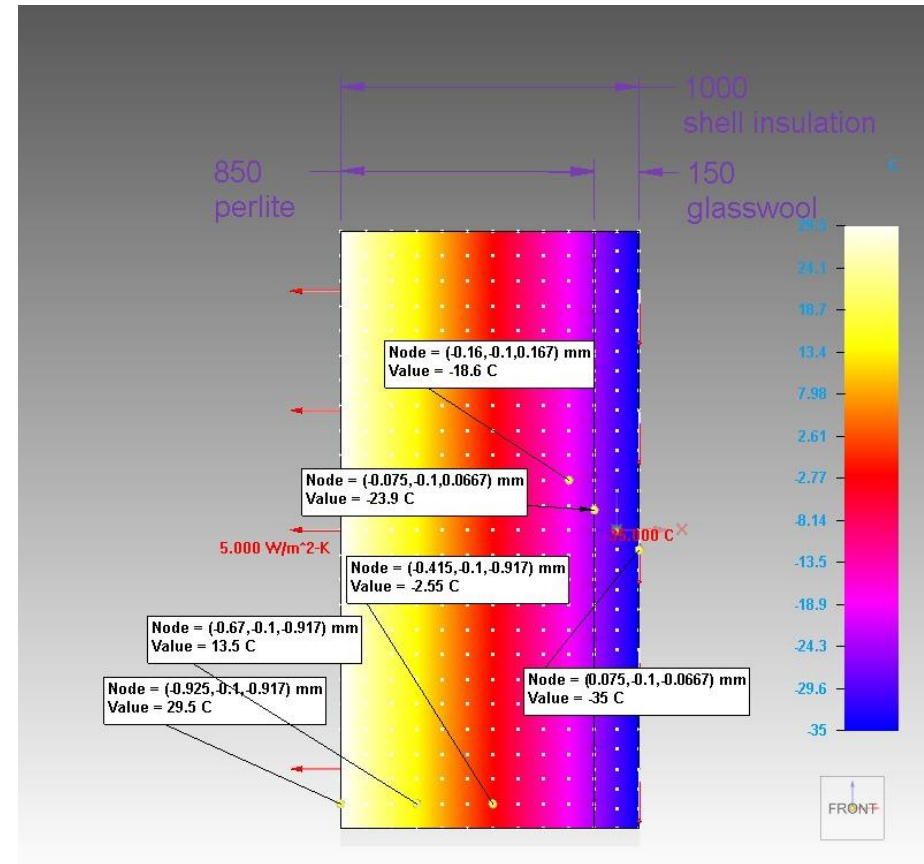
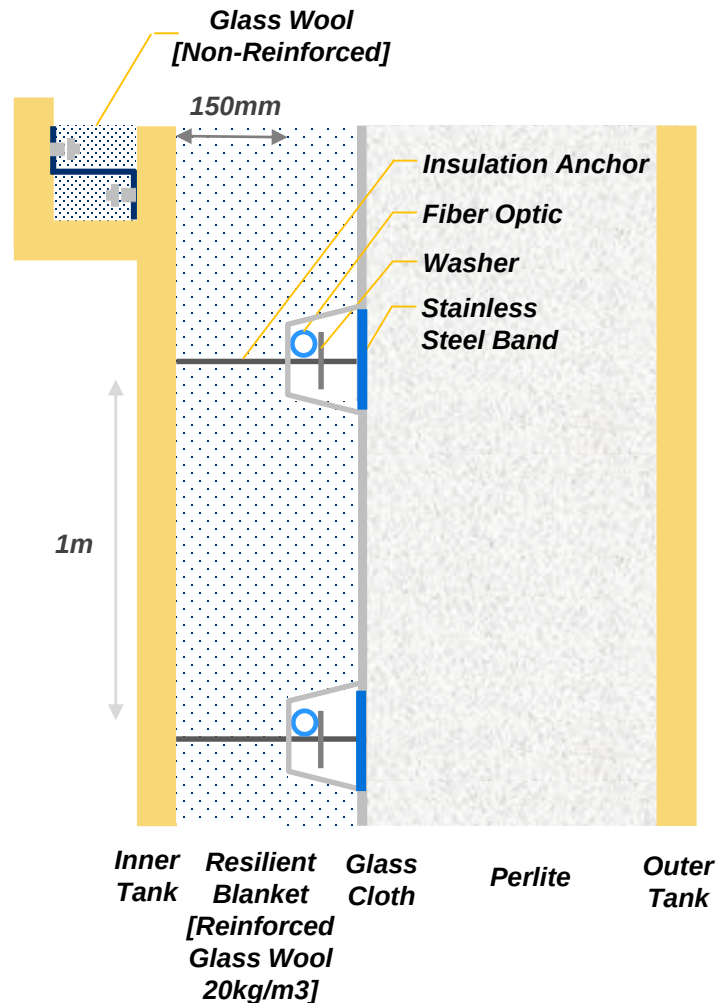
Test to Determine Pitch



Test to Determine Clearance

Internal Test to Determine Installation Method Prior to Actual Installation

RELEVANT SIMULATION AND CALCULATION



Fiber optic installation location within Tank annulus

Resilient Blanket [Reinforced Glass Wool]



*Resilient Blanket
[Reinforced Glass Wool]*

Insulation Anchor



*Glass Cloth – Used
for smoothing and
polishing against
perlite*



The Material as follows :

1. "KIMMCO" GLASSWOOL RESILIENT BLANKET
Density : # 20 Kg./M3
Size : # 150 mm x 1.2 x 10 M
Qty. : 746 Roll
2. "KIMMCO" GLASSWOOL BLANKET
Density : # 24 Kg./M3
Size : # 50 mm x 1.2 x 15 M
Qty. : 908 Roll



Insulation Anchor & SS Band



Insulation Anchor
[Max Load Per Anchor : 20kg]



Washer on Tip of Insulation Anchor
[Installed on Glass Cloth Surface]



Insulation Anchor
[Max Load Per Anchor : 20kg]



Stainless Steel Band

Entrance and Exit of Fiber Optic



Spare Flange
[for Fiber Optic Entrance and Exit]
2" RF 150#



Concept of How Fiber Optic Cable
Enter & Exist Flange

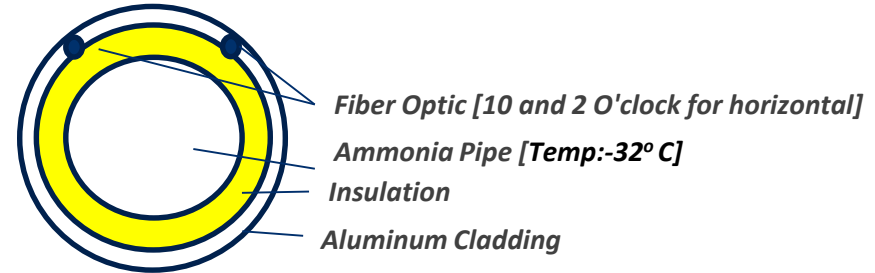


Sample Spare Flange

FO installation in Ammonia Pipeline

Further to information that ammonia will be in vapor state after the pipe insulation if there is any leak from pipeline and the temperature here will be close to ambient, it is agreed to position fiber optic cable at ;

- 10 and 2 O'clock for horizontal insulated above ground ammonia pipes
- wound around the pipe with a wire pitch of 0.5 m for vertical insulated above ground ammonia pipes.



- Note: Temp between Insulation & Aluminum cladding is close to ambient.



Ammonia Pipeline
Horizontal section

Ammonia Pipeline
Vertical section

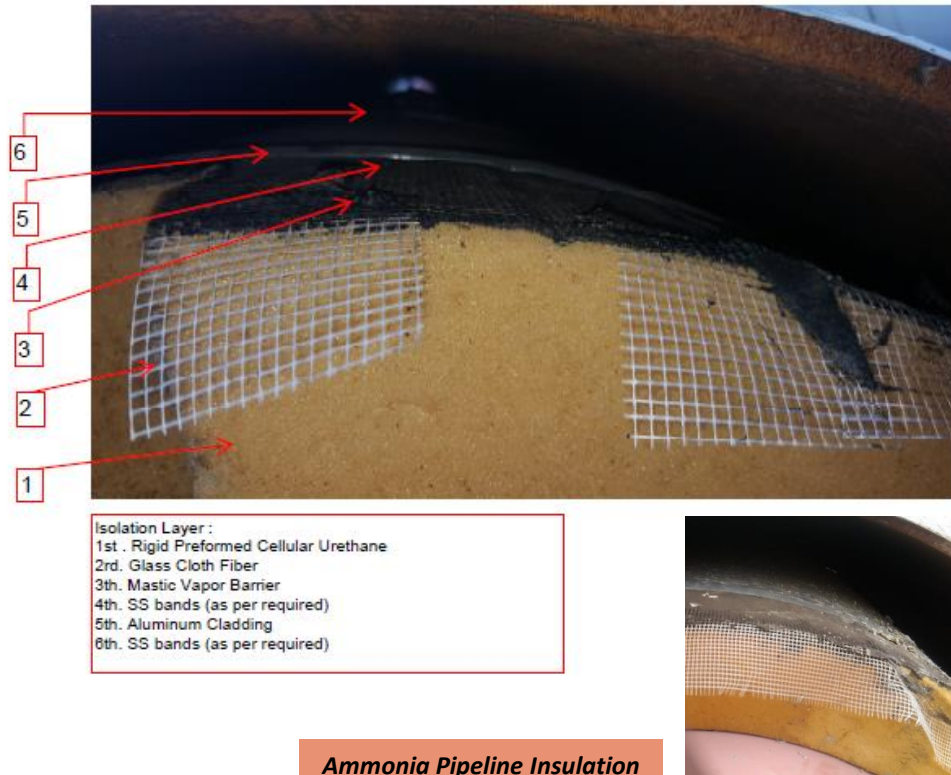
Ammonia Pipeline
Horizontal section

Above Ground

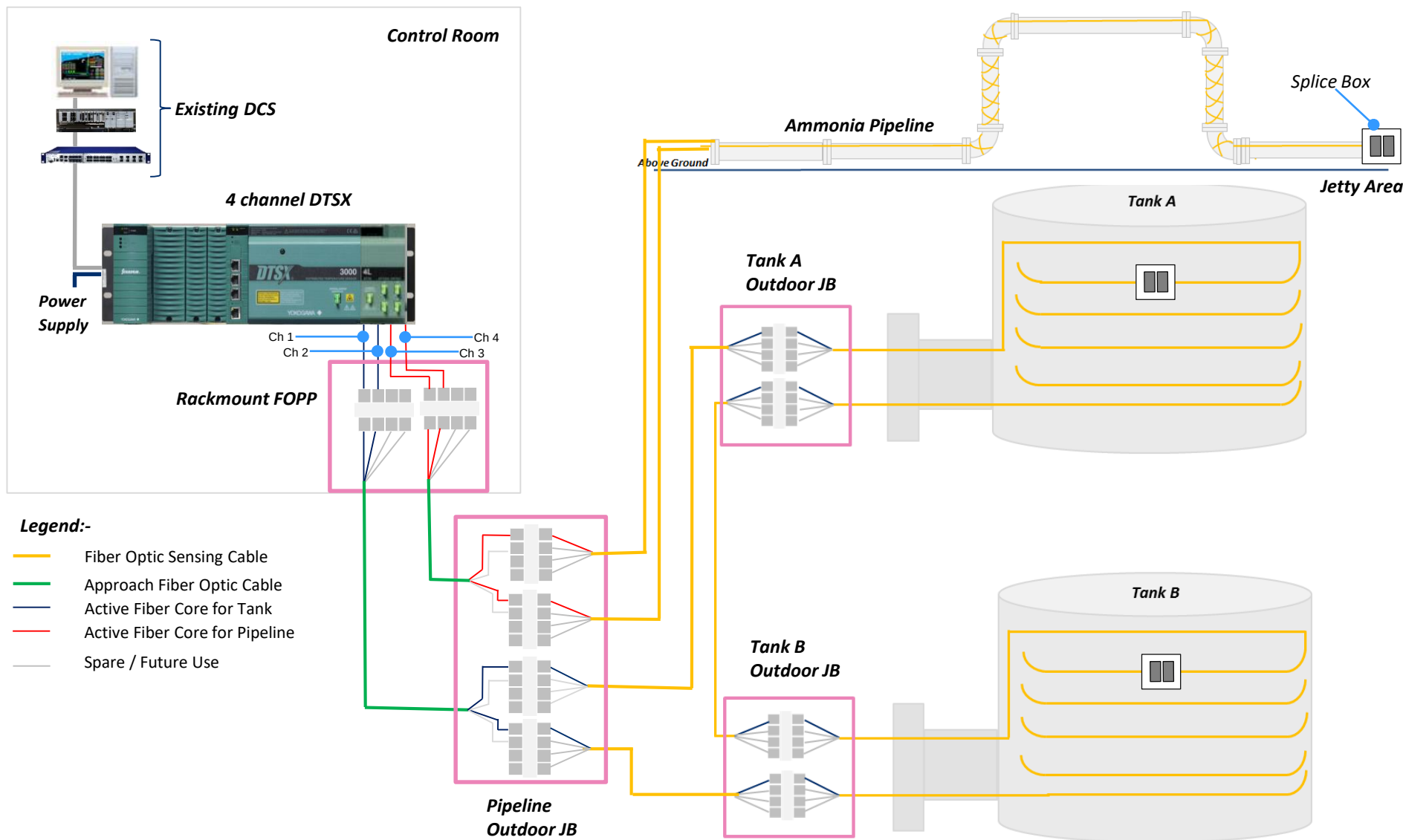
Insulation for Ammonia Pipeline

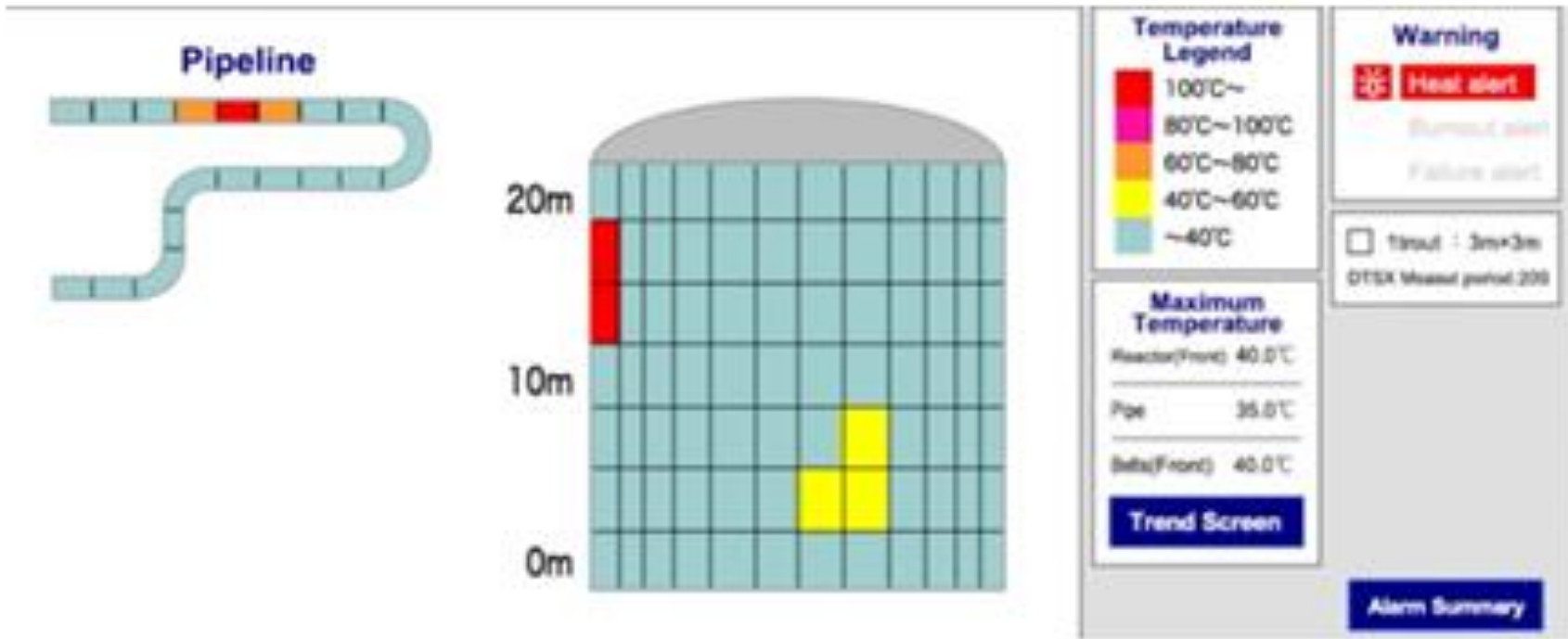
Inside Ammonia Pipe

- Temp: -32° C
 - State: Liquid
 - Pressure: Ammonia tank to Pump 0.07kg/cm2
Pump to Jetty: 9.3kg/cm2
 - Pipe Size: Various [available in attached document Appendix 1]
- Note: PAU inform that ammonia will be vapour state after pipe insulation if any leak from ammonia pipeline. Refer to email attached Appendix 2*



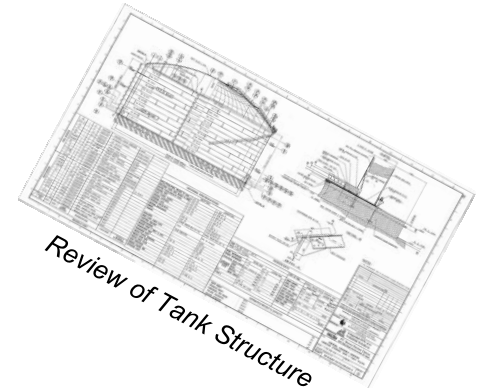
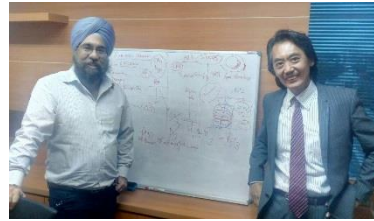
Overall Architecture



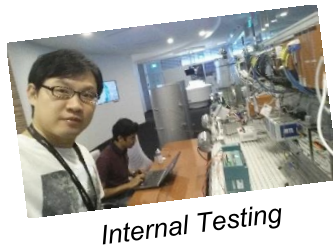


Sharing the Upper System Graphic concept

Ammonia Leak Detection-Innovation Cycle Partners



Ammonia Leak Detection
Early Warning
Specific Localized Information
Insulation Health
Tank Reliability Measurement
Real Time - Always On



■ OBJECTIVES

- To calculate the consequence of acute ammonia poisoning accident which can be caused by the leak of liquefied ammonia storage tank, so as to provide theoretical basis for working out the counterplan of accidents.

■ METHOD:

- The amount of liquefied ammonia to be reserved, the pressure and temperature inside the tank based on the physical chemistry principle, the evaporating amount to be calculated; and using the diffusion model, the size of ammonia cloud, percentages of life threatening hazard and depth range of the poisonous gas to be calculated. The working Parameters of HAZOP Study.

■ POSSIBLE OUTCOMES HAZOP DISASTER SIMULATION:

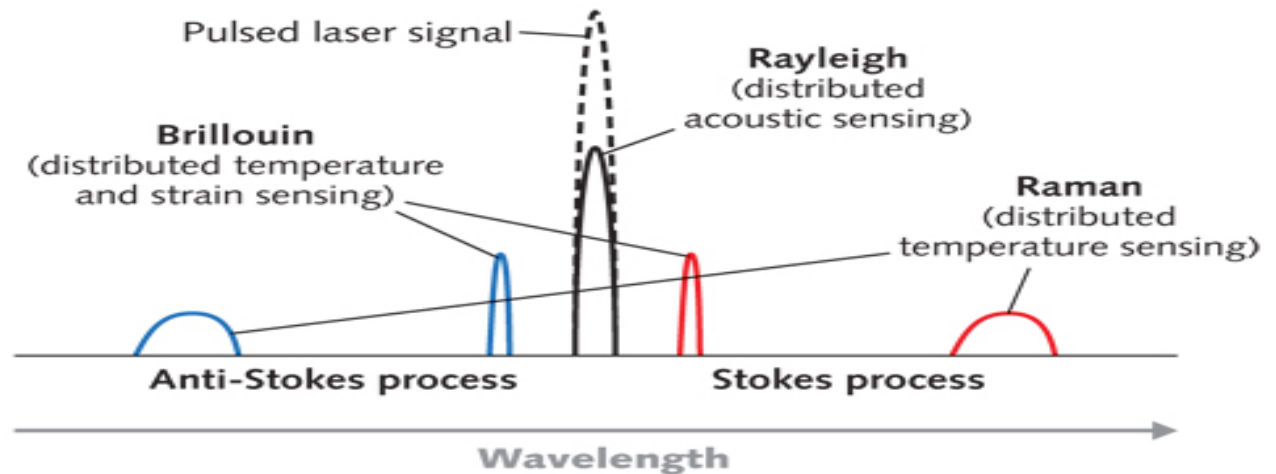
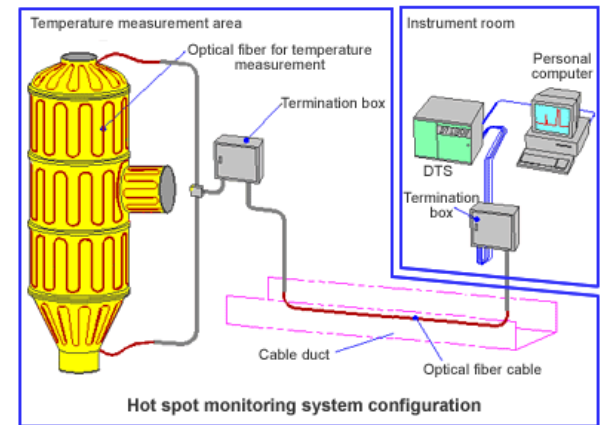
- Assuming the leaky tank had liquefied ammonia 20,000 t, the pressure and the temperature were 2.5 MPa and 30 degrees C respectively, the evaporating amount and the size of ammonia cloud calculation. The radiuses, of the ammonia released cloud of severe, moderate and mild hazard were 108 m, 216 m, 370 m respectively; if the exposed time was 60 min, the percentage of death would be 50%; if the exposure time was 5 min, the percentage would be 10%; if the exposure time was 2 min, the percentage would be 2.5%. When the stable degree of circumstance was C, the wind speed was 2.3 m/s and the outside concentration of the cloud was 4000 mg/m³, dimension of cloud in X axis was 1782 m and in Y axis was 188 m.
- Time of response if MOST IMPORTANT and RELEVANT PARAMETER. DTS Provides highest possible Early Warning System and hence helps in MITIGATION.

- HSE Early Warning is Essential
- HSE Response should be Timely
- HSE Detection should Measured and Specific
- HSE Systems need to be designed Ground Up
- HSE has to be Need Specific

Tank Inspection Methods

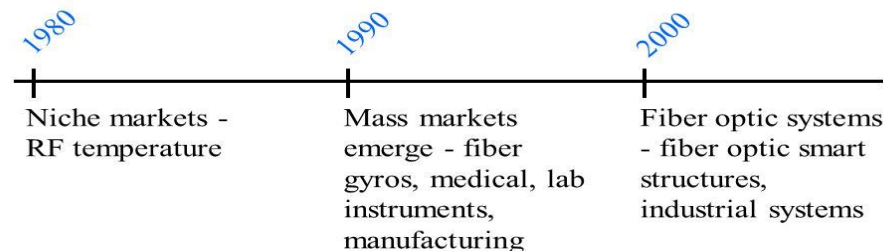
Method	Advantages	Disadvantages
Magnetic Testing	High sensitivity. Exact length measurement.	Internal access necessary. No depth measurement. Surface preparation needed.
Ultrasonic Testing	Inspection during operation. Possible to indicate length and depth.	Less sensitive than MT. Necessary to remove insulation. Limited areas available.
Acoustic Emission	Inspection during operation.	Less sensitive than UT. Requires mechanical stress to hear noise.
Field Signature Method	Inspection during operation. Measure changes in crack sizes.	Not yet proven technology. Relative method, not possible to detect old cracks.

- Hot Spot Detection(TEMP. Dependent)
- Hot Spot Detections (STRAIN Dependent)
- Localised Response for Repair & Rectification
- Early warning signal for Disaster Prevention
- Insulation Quality Detection
- Tank System Energy Conservation
- BOG Dead Spots Detection – Temp Dependent
- Planned Maintenance and Rectification



- Hazard: the property of a substance or situation with the potential for creating damage
- Risk: the likelihood of a specific effect within a specified period complex function of probability, consequences and vulnerability.
- Known Risk can be Mitigated , Early Information is Important

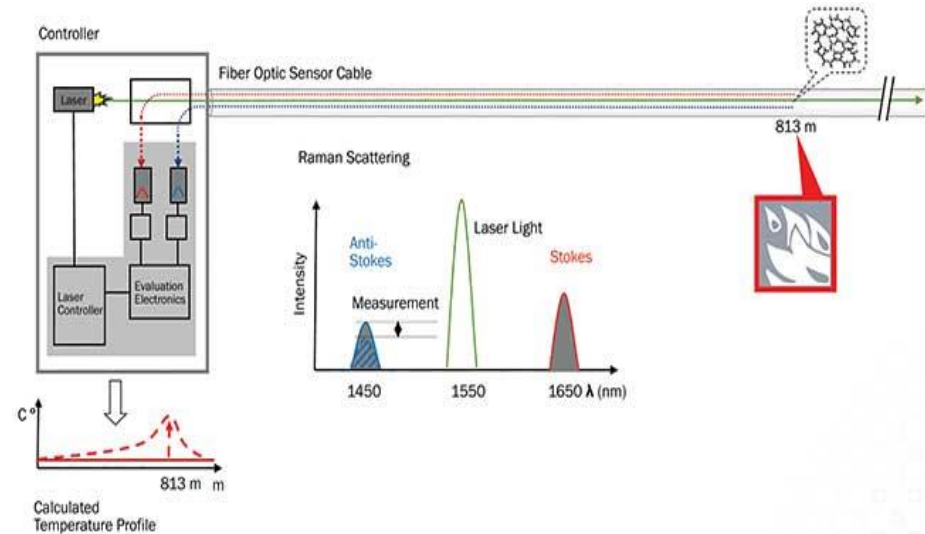
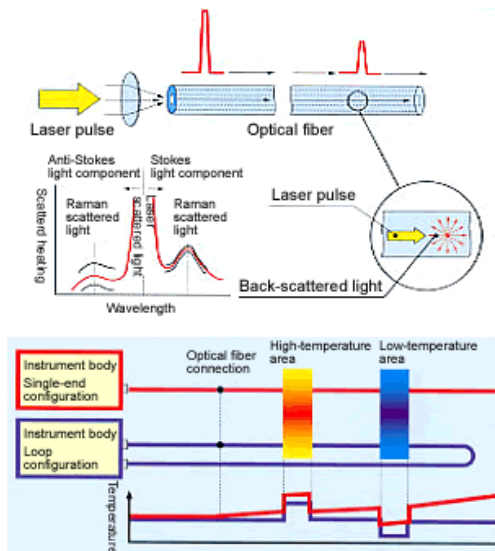
Fiber Optic Sensors Historical Trends





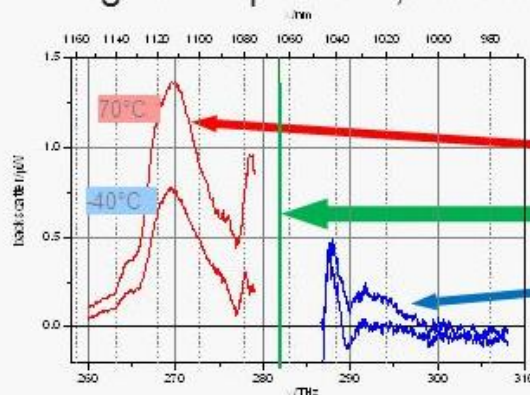
Innovation and Partnerships Go Together
Efforts are Collaborative and Teams are Essential
Bringing Together Ideas is Progress

SYSTEM DESCRIPTION (SPARE SLIDE)



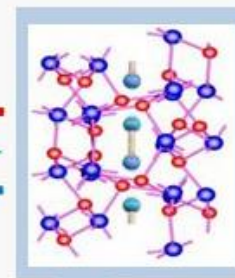
DTS Measurement Principle

Measurement of temperature through the evaluation of the backscattered laser light components, stokes and anti-stokes



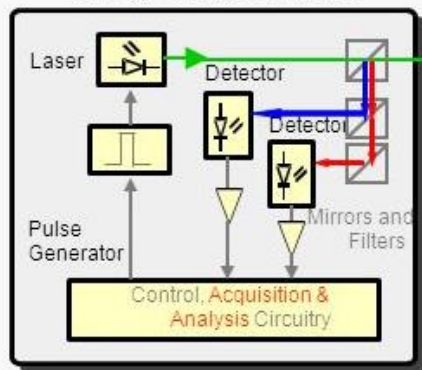
Raman Stokes

Raman Anti-Stokes



Temperature-dependent
lattice vibration

DTS Instrument



$$\text{Location} = 2 * t_R * v_L$$



