xtralis™
The sooner you know™

Early, Accurate Safety Threat Detection Integrated for Transit Risk Management & Emergency Response

Ming He

Executive Director (Strategic Projects)
Xtralis Inc.
March 6, 2012
Arizona, USA

SUPDET 2012 - Suppression, Detection and Signaling Research Symposium, March 5-8, 2012

Topic

1. Transit Risk, Regulations & Performance
2. Engineering Methodology & Safety Codes
3. Early, Accurate Detection Design & Benchmark
4. Safeguarding Transit Operation Worldwide
5. Discussion & Summary



xtralis

Transit Risk, Regulations & Performance

Highest Ridership City (2010, Top 10 Countries)

	Country	City (Annual Ridership (bn))	Opened	Station/Length
1	Japan	Tokyo (3.161)	1927	285/316km
		Osaka (0.837)	1933	101/138km
2	Russia	Moscow (2.348)	1935	185/306km
		Saint Petersburg (0.777)	1955	65/110km
3	South Korea	Seoul (2.173)	1974	314/389km
4	China	Shanghai (1.884)	1995	285/425km
		Beijing (1.84)	1969	218/372km
		Guangzhou (1.64)	1997	134/235km
		Hong Kong (1.366)	1979	155/212km
5	USA	New York (1.604)	1904	468/369km
6	France	Paris (1.506)	1900	301/215km
7	Mexico	Mexico City (1.410)	1969	163/451km
8	UK	London (1.107)	1863	270/402km
9	Egypt	Cairo (0.805)	1987	53/65km
10	Brazil	São Paulo (0.754)	1974	64/74km

Rail Transit in USA (Q3, 2011)

	City	Weekday Ridership	Opened	Station/Length	Average Weekday Ridership/Station
1	New York Subway	7,820,700	1904	468/369km	16,711
2	Washington	1,003,100	1976	86/171km	11,664
3	Chicago	729,100	1893	144/173km	5,063
4	Boston	530,400	1897	51/61km	10,400
5	San Francisco	381,100	1972	44/167km	8,661
6	Philadelphia	300,000	1907	50/40km	6,000
7	New York (PATH)	259,100	1908	13/22km	19,931
8	Atlanta	246,500	1979	38/77km	6,487
9	Los Angeles	161,000	1993	16/28km	10,063
10	Miami	60,000	1984	22/35km	2,727
11	Baltimore	58,400	1983	14/25km	4,171
12	San Juan	37,900	2004	16/17km	2,369
13	Philadelphia (PATCO)	36,100	1936	13/23km	2,777
14	Cleveland	18,600	1955	18/31km	1,033
15	New York (Staten Island)	14,800	1860	22/23km	673

xtralis

Risk & Hazards

- With a train can pack up to 2000 passengers, many more in and around the station areas, a fire poses a highly hazardous condition to rail transit passengers, employees and emergency response personnel
- USA NTSB focus on areas that can complicate fire and life safety in confined locations, including emergency ventilation, evacuation communications & egress considerations
- High-current electrical equipment and faults, with large amount of equipment and cabling installed in compact spaces and concealed areas
- Security threats to service depots, trackside communication hubs, rail tracks and power-supply network from vandalism, theft, trespassing & terrorism
- Accumulation of flammable and toxic gases from routine operations, faulty equipment or underground gas leaks (natural or manmade)
- Friction fires caused by mechanical equipment failure which is often fuelled by a build-up of oil and lint
- Risk of incipient fire in enclosed, concealed and dusty spaces, unsupervised areas and unmanned operation such as driverless trains
- Mixed business use of commercial spaces in and nearby the stations

Transit Safety & Regulations

- FTA-USDOT Strategy "*Promote continuous improvement in safety, security, and emergency preparedness. Assess and target resources and assistance toward the most frequent types of accidents and security incidents and the most catastrophic risks to passengers, employees and transit property.*", with the key goals of

  (a) **Implement integrated** safety, security and emergency strategies

  (b) **Reduce severity** of incidents and risks to all

- The "all-hazards" concept (Risk-based Safety Assurance Process) is for all aspects of crisis management, including prevention, protection, response, and recovery

- Risk-based process includes elements of Data Collection & Analysis, Research & Technology Development, Standards Development, Safety & Security Program

Transit Safety & Regulations (Cont)

- UK Regulatory Reform (Fire Safety) Order 2005 simplified the obligations of both those responsible for fire safety in non-domestic premises and those responsible for enforcing fire safety legislation. The Order provides a similar level of protection to only 26 out of 49 provisions in Fire Precautions (Sub-surface Railway Stations) Regulations 1989
  - Recognize sub-surface railway stations unique circumstances that require some degree of "prescription"
  - Commonalities in fire safety improvement to all transit systems
- Standard on Fire Safety for Rapid Transit System (LTA, Singapore, 2001/2003) stipulates vigilant fire safety design & strategy
  - Protect life safety (commuters, employees, passengers & public in and around the rail system/infrastructure)
  - Minimize loss of property, loss of productivity & operation time
  - Facilitate orderly evacuation
  - Effective rescue operation and fire fighting

Risk Profile & Documented Safety Statistics

Recent insurance report on incidents and associated Detail Information Available (Heinrich Pyramid)

FTA 2003-08 Rail Safety Statistics in USA

- 14 passenger fatalities
- 19 worker fatalities
- 72 patron fatalities
- 382 public fatalities
- 1665 injuries to passengers (including 272 of these from fires)

Reported Fire Incidents (2003 to 2008)

Occurrences

Accident Type	2003	2004	2005	2006	2007	2008
Collision (non-RGX)	30	53	102	62	95	127
Derailment	35	29	27	31	58	71
Fire	12	31	11	12	27	25
Other	110	121	69	98	229	213
RGX Collision	253	262	435	148	333	556
Total	**440**	**496**	**644**	**351**	**742**	**992**

Caused by Equipment Failures

Accident Type	2003	2004	2005	2006	2007	2008	Total
Collision (non-RGX)	0	2	8	1	1	1	13
RGX Collision	2	0	0	0	1	1	4
Derailment	11	3	4	6	36	20	80
Fire	9	23	5	6	22	19	84
Other	1	7	1	8	22	20	59
Total	**23**	**35**	**18**	**21**	**82**	**61**	**240**

Fire Incident: Record only these fires caused at least $25,000 in property damage or cause an evacuation of a vehicle or a station for life safety reasons

Incidents with Consequences

- **Incidents caused operation interruption**
  - 10 Apr 08, a fire from an electrical feeder station shut down a major train line in Tokyo for more than 10 hours, affected 250,000 commuters
  - 23 Jan 05, a fire destroyed a signal relay room in Lower Manhattan, interrupted most services on some lines for a week
- **Small fires put life at risk**
  - The New York City Fire Department (FDNY) responded to 1,490 calls to the transit system in 2004, most originating as electrical fires
  - 07 Apr 05, a fire broke out in an underground electrical room in Harlem, leaving 600 passengers stranded between stations
  - 09 May 06, a fire in a tunnel (Montgomery and Embarcadero stations) in San Francisco started when wood debris underneath the tracks set alight by a spark, trigger evacuation
- **Bigger incidents create stampede**
  - 24 Oct 04, thick volumes of black smoke was suddenly released from two escalators in very crowded Beijing Station, the waiting hall was quickly filled with smoke
- **Catastrophic fires**
  - 11 Jun 81, 7 killed after a fire caused by a faulty escalator in Oktyabrskaya station, Moscow
  - 18 Nov 87, London King's Cross station fire killed 31 people

Incident Management with a Desirable Outcome

- 9:13am 24 Feb 07 Hong Kong, NAC015 train stopped at the middle section of Tai Lam Tunnel due to abrupt fire and explosion of the rooftop transformer on the train
- Within 1 minute, Early Warning Air Sampling Smoke Detector (ASD) detects fire accurately, alarm signal to the West Rail Command Center
- Emergency procedure is immediately in action
  - Stop all trains on the affected line with train NAC004 already in the tunnel, less than 1km away from the scene
  - Activated the exhaust system to discharge smoke to the north, so passengers can escape to the south along the shortest path
- In the incident, only 6 people were hospitalized due to smoke inhalation or panic
- The temperature-sensitive optical fibers in the tunnel did not issue any alarm signal

xtralis

Performance: Transit Operators’ Perspective

- **Safe**: always improve “prevention”, strengthen “reaction”
- **Quality**: always improve “On-time” rate, increase “capacity”, maximize “satisfaction”, enhance “mobility”
- **Resourceful**: target “investments” (reduce costs/increase revenue)
- **Maintain** and **Enhance** company Image

Desirables to achieve performance goals:

- Early , accurate detection of incidents to prevent
- Closed loop reaction to manage incident development in real time
- Avoid unnecessary interruption to operation (false alarms, low Escalator Availability)
- Increase capacity with minimal change to existing infrastructure
- Maximize customer satisfaction when incidents can be prevented from developing
- Spend minimum on ongoing service yet still maintain high system performance
- Prevent customers/employee accidents or injuries from happening

Engineering Methodology & Safety Codes

What is Performance-Based Design (PBD)?

- **A Risk-Informed Alternative Fire Safety Solution**

= Building/Life Safety & Risk Management

Providing a building & asset protection solution that complies with the performance requirements of a code, and the needs of business continuity and risk management other than by reason of satisfying the deemed-to-satisfy provisions

"thinking and working in terms of ends, not means"

Plain Language

"**A cost effective building safety solution that meets qualitative** (e.g. suitable, available and better) **and quantitative** (e.g. 60 seconds detection time, intelligent, logical and procedure) **performance criteria of fire safety requirements**"

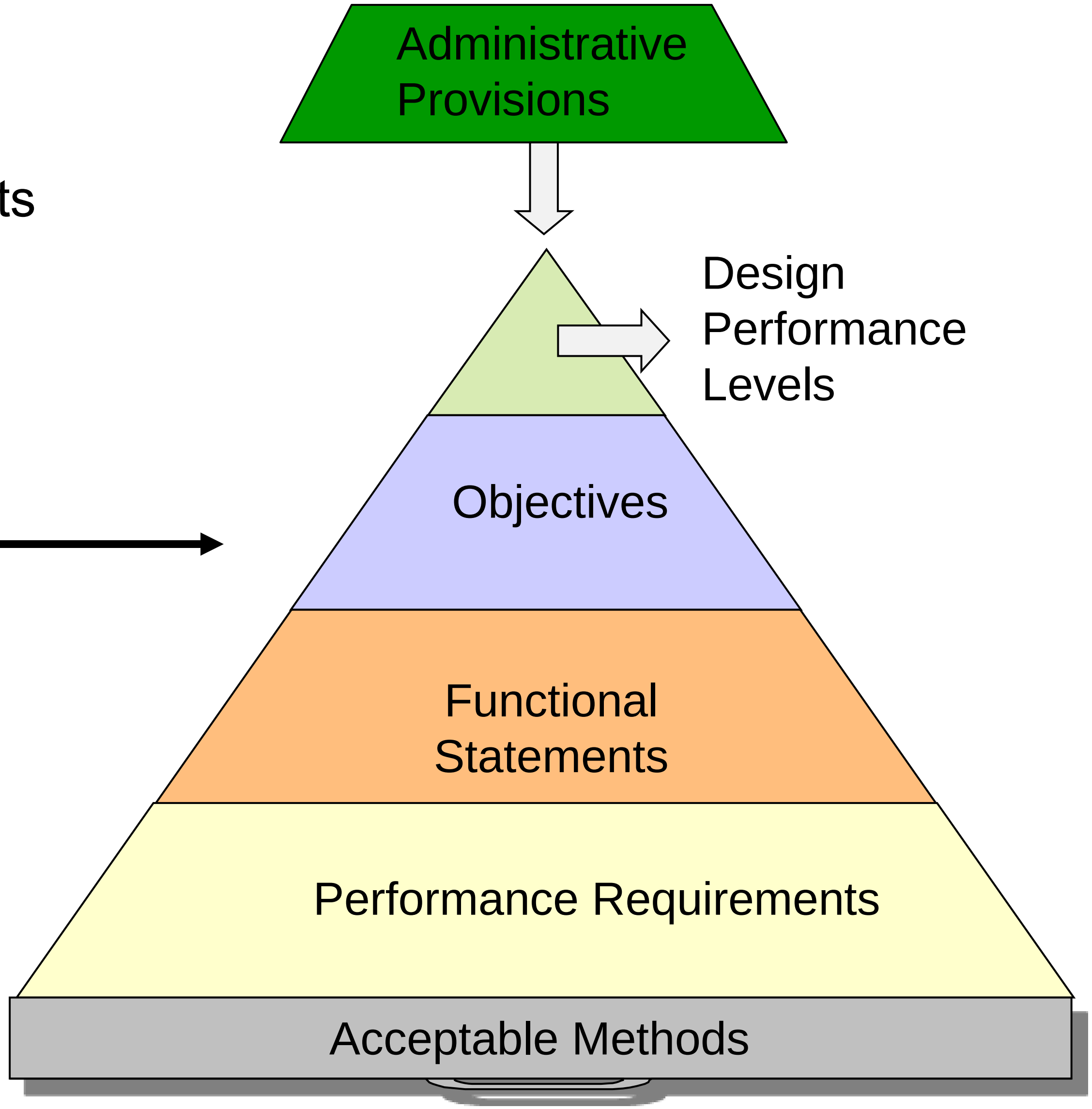
A PBD Model for Transit Safety

Regulations (criteria)
NFPA 130
Metro operator's requirements
AHJs input

Guidance Level

Compliance Level

Regulations (evidences)
NFPA 130
Site specific needs
AHJs approval



Regulations & Evidences of Compliance

- Examples of safety requirements/criteria (for the engineers) in UK Railways (Safety Case) Regulations:

  1. The duty holder should describe significant unique or unusual risks, the nature of these risks and the risk control systems / workplace precautions that have been implemented to reduce these risks to a level that is as low as reasonably practicable.

  2. The Safety Case should summarise how to ensure passengers and members of the public have safe access and egress to and from the stations.

- Examples of Compliance (for all stakeholders):

  1. The aspects that make a railway station unique and significant findings of the risk assessment

  2. The implemented control measures as well as the cooperation of all stakeholders to minimise risk

  3. How the duty holder assesses the impact of temporary activities or obstructions on access / egress routes, or ways to respond quickly if there is a sudden dramatic increase in the number of people on, or using, the station

NFPA 130: Widely Adopted Code in the Industry

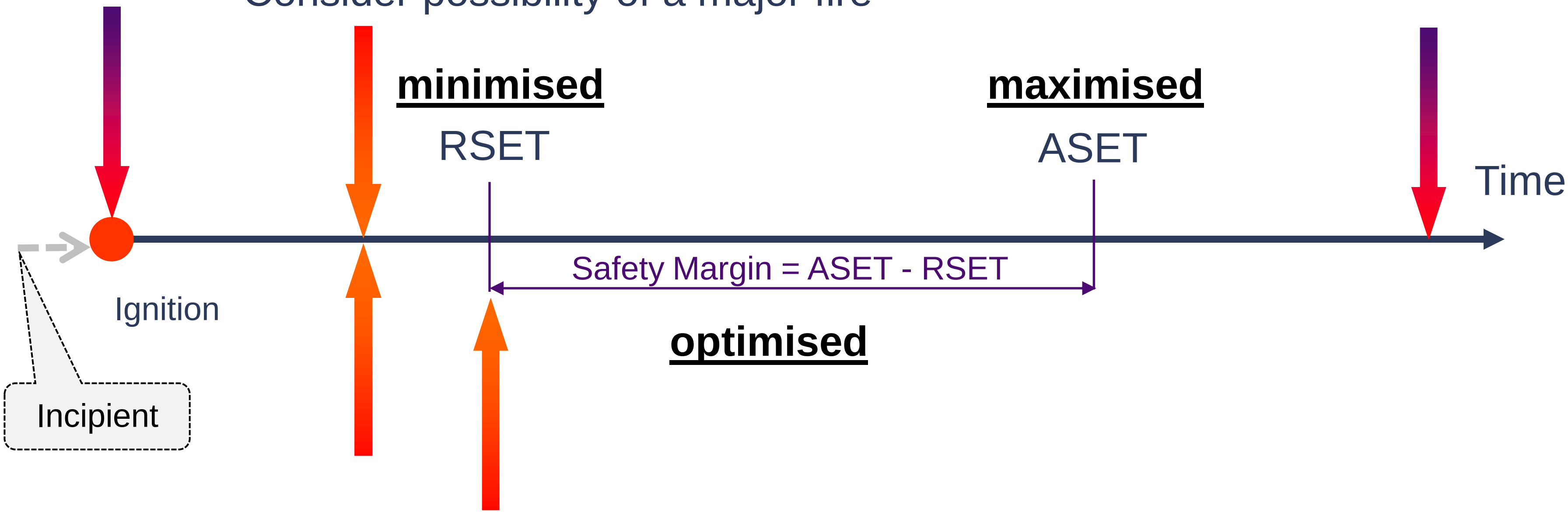
Early, Reliable Smoke Detection Underpins Critical Aspects of Transit Safety

- Use of Smoke Detection & Actuation
  - Fire compartmentation, smoke-tight separation in non-public areas & public areas
  - Electrical substations, generator rooms & other plant rooms, stores, refuse storerooms
  - Enclosed staircases, electrical shafts, commercial spaces (≤100m^2)
  - Actuating smoke control, station/tunnel ventilation, fire shutters/doors, directional signs
  - Protecting critical operation (e.g. signaling systems, communication & OCC)
- Design Safety Margin to Meet Qualitative Requirements
  - Selecting egress route with assured tenable conditions (through smoke sensing)
  - Emergency ventilation to its full capacity within 180s & time-of-tenability
  - Escalators movement control, max. travel distance to an exit from platform ≤ 91.4m
  - Exit capacity calculation with the assured availability of escalators, exits, etc.
  - Max 4 min platform evacuation time, 6 min point of safety time
  - Station Occupant Load calculation vs Total evacuation Time

Building & Life Safety

Key Strategies

- Reduce fire starts – Ability to detect "incipient fires"
- Keep fires small – Early disruption of the fire growth curve
  - Early detection, investigation
  - Control (e.g. manual suppression)
  - Automatic fire suppression
- Consider possibility of a major fire



Life Safety: Available Safe Evacuation Time, Required Safe Evacuation Time

No “Safety Margin” for Human Factors

Time Line	Tsim Sha Tsui - Admiralty, Hong Kong (9:12am, Mon 05 Jan 04)	Junganglo - Daegu, South Korea (9:52am, Tue 18 Feb 03)
0M	Fire started, passengers moving to rear train (only 1/3 of normal load due to holidays). A brave MTR employee was happened to be next to the arsonist	Train 1079 on fire 12S: train entered Junganglo, passengers disembarked 17S: CCTV screen got “The Fire Alarm” Display but was ignored by operators
2M	Burning train entered Admiralty (instructed by OCC) Less than 200 people on the platform allows for a quick evacuation & assess to train	2M17S: Subway station fire detection alarmed, Train 1079 fire grew 2M42S: Train 1080 departed Daegu 3M37S: Smoke filled up Junganglo 3M57S: Train 1080 approached Junganglo
4M	MTR employees used Portable Fire Extinguishers to control fire	4M10S: Safety doors shut by a fire sensor 5M17S: Driver of Train 1080 was informed the emergency by OCC 6M17S: Power is shut off by fire sensors. Train 1080 stopped, fire spread from train 1079 to 1080
8M	Firemen arrived	Firemen arriving, fire fighting
3H30M17S		Fire controlled
Casualties	14 injured	Reported 198 dead,147 injured

Early, Accurate Detection & Performance Benchmark

Managing Fire Risks Through Advanced Technology

- **Detect early & reliably is desirable but a challenge**
  - Incipient fires in enclosed, concealed and dusty spaces that are monitored adequately or otherwise could develop rapidly
  - Building architecture like large open spaces with little compartmentation, tunnels and platform areas where air movement from drafts, air-conditioning and train motion interfering with the normal dispersion of smoke
  - Foreign, less certainty on fuel loads and combustibles
  - High airflow and unpredictable smoke propagation
  - Mixed business use & occupants profile
- **Balance of investing TODAY and Life Cycle Cost TOMMOROW**
  - Low cost option for 1st Install verse long term reliability & suitability
  - Significant cost associated with False and nuisance alarms
  - Maintenance with “hidden” costs (replacement & liability)
- **Technology-enabled system functions**
  - Orderly and staged evacuation
  - Consistently trained staff as integral part of prevention program
  - Human behaviour, incident prediction and interaction
  - Fire Services attendance, supported with real-time situational data
  - Design flexibility to cater for change of operation, occupancy type & load

Use of Early, Accurate Detection

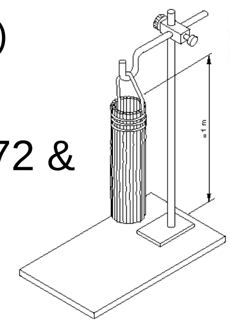
Area	Characteristics	Use of Early and Reliable Detection
Stations	Concourses, waiting halls with high ceiling Public areas where costly dual detection systems are used due to unreliable conventional detection technology	• Station fire and security system is designed to meet local jurisdictions, often use Risk-informed, Performance-Based Design method to calculate safety margin and tenability on the basis of a reliable, quantifiable detection system (e.g. International Fire Engineering Guidelines) as well as Risk Management and Business Continuity codes (e.g. NFPA1600)
Platforms	Underground platforms where gases and vapors accumulate Enclosed and semi-enclosed platforms in railway stations	• Overall Rail/Metro safety requirements as per government regulatory bodies and life safety codes (e.g. NFPA101), meet quantitative requirements (e.g. NFPA130) • A critical point of intersect approaching train and passengers both on the platform and on the train, and longest distance to safe exits in a confined space
Air-handling and Exhaust Systems	Areas like Exhaust vents underneath and around the platforms, Workshops, Tunnel exhaust vents and Enclosed railway station platform Areas	• Early detection systems control HVAC in stage to purge smoke, buy time for evacuation • Smoke can be directed upstream in a tunnel and/or drawn away from refuge compartments • Exhaust excessive fumes resulting from stationary trains in semi or fully enclosed areas • Manage air quality when integrated with gas level monitoring
Substations	High-voltage devices, cables, switch gear and batteries, control and command (C&C) equipment for catenaries power Feeding	Critical to uninterrupted operation of the entire Rail/Metro network. Codes and standards for Power Industry may be used as guidelines for the design of a early fire detection system
Traction, Trackside Energy Center	Hosting low-voltage, power-feeding equipment for signal and on-field lighting	Protected by early warning detection system and can be monitored from OCC remotely
Operations Control Center (OCC)	The heart of incident and emergency management, housing equipment, communication and critical cablings, etc.	Early detection of an incipient fire prevents unnecessary power or system shut-down so all key controls and emergency response systems are available 24/7. Operation include Remote alarm verification, Passenger emergency intercoms and Pre- and post-incident data analysis
Switch, Auxiliary Electrical Rooms	High-current hazardous electrical equipment and densely-packed cables	Early warning detection system detects incipient fires commonly found in these areas. Detector is installed outside the protected areas for easy service and maintenance access
GSM-R/CCN Shelters, Signalling Cabinets	Hosting GSM-R equipment and CCN repeaters along the track	Good practices on the use of early warning detection in Telecommunication protection should be followed, e.g. NFPA76
Cable Tunnels, Service Ducts	Unmanned areas but with potential fire risks and rapid fire spread Special service access is required for tunnels and ducts.	Dusty service ducts and tunnels can be protected with an early warning detection system without nuisance alarms or excessive maintenance costs. When toxic gases may be present, oxygen deficiency is likely to occur, an integrated gas monitoring is ideal.
Battery Rooms	Batteries and UPS equipment as backup power supplies to mission critical equipment	Integrated with hydrogen gas detection, an early warning system can monitor both fire and gas in a battery-charging or UPS room.
Train	Train carriage, electrical cabinets, under-carriage equipment, Train HVAC	High-voltage electrical systems and fuel loads brought aboard (e.g., newspapers, food wrappers) increase the risk of fire

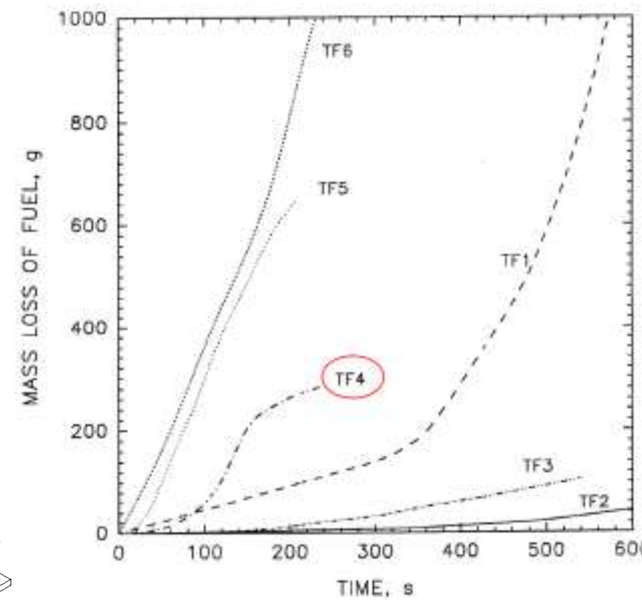
Use of Early, Accurate Detection

Area	Characteristics	Use of Early and Reliable Detection
Lift Shafts, Elevators, Escalators	Moving parts with excessive heavy loads during the peak hours form critical paths for evacuation	Fire risks include debris build-up and rubbish in elevator shafts, overheating of lint and paper and oil build-up on the moving parts of escalators. Early detection of a fire incident to prevent stampede through orderly management of the incident and monitoring of egress routes to ensure tenable conditions.
Train Depot/Garage, Maintenance Base	Workshops and garages for trains, closed areas for spare catenaries equipment, critical areas lit 24/7 and protected by alarms displayed at the supervision center. Presence of toxic exhaust gases or petrol spills	Large open spaces with usually simple steel structure housing significant rail assets. Fire compartmentations are difficult and risk of fire incidents is high due to hot-works, high-voltage electrical equipment, power supplies and switch cabinets. Conventional detection technology often cause false alarms in such challenging environments.
Data Centers and Server Rooms	All business critical data, control and processes must be secured continuously	Impairing the operation of these facilities affect business operations - from bad publicity, loss of revenue, service interruption to penalty and litigation. Design of early warning detection system can refer to codes for Datacom facilities (e.g. NFPA75)
Connected Commercial Areas & Pedestrian link	Significant fire risks due to mixed business use, retail with large crowds in underground confined areas, major egress routes for station emergency evacuation	Early warning detection is crucial to balance maximum retail space with safety of occupants. Building and fire codes, coupled with risk assessment to implement early detection for wide range of applications (e.g. fire shutter doors control)
(Underground) Bus Terminus	High risk of fire due to running bus engines, disposed cigarette butts coupled with significant fire loads. Air quality is usually a concern from EPA & OH&S	Early detection of a fire is ideal, especially where bus terminus exits also serve as egress routes for emergency evacuation. Combined it with gas measurement can address early fire detection and environmental condition monitoring at the same time
Logistics and Storage Facilities	Serving railway lines for stock, freight and rail express service	Building code and local fire safety directives can be applied for early warning detection system design (e.g. NFPA5000, Shanghai Fire Bureau Directive)
Rail and transit tunnels, link to other forms of transport	All forms of tunnels where smoke detection is needed Airports through Airport Express Rail, warehousing and distribution through roads and seaports	Underground tunnels usually are the only escape routes , design of early and intelligent detection system with ventilation control , capable of real time fire progression monitoring to facilitate safety evacuation and fire fighting mission
Rail/Metro Station, Infrastructure Perimeters and Trackside Security	Diversified indoor and outdoor environments require central monitoring from a number of locations at different access and control levels, fast and high resolution video transmission and video analysis to support business operation, incident detection, identification/management, evacuation procedures, security threats and continuous event assessment	• SMART Closed-circuit television (CCTV) ; • Access control • Train onboard security systems • Protecting perimeters of power stations and high security areas • Crossing of prohibited zones detection • Intelligent video analytics and object detection through advanced camera features • Protecting the rail track way from approaching persons • Central monitoring and Remote Incident Management

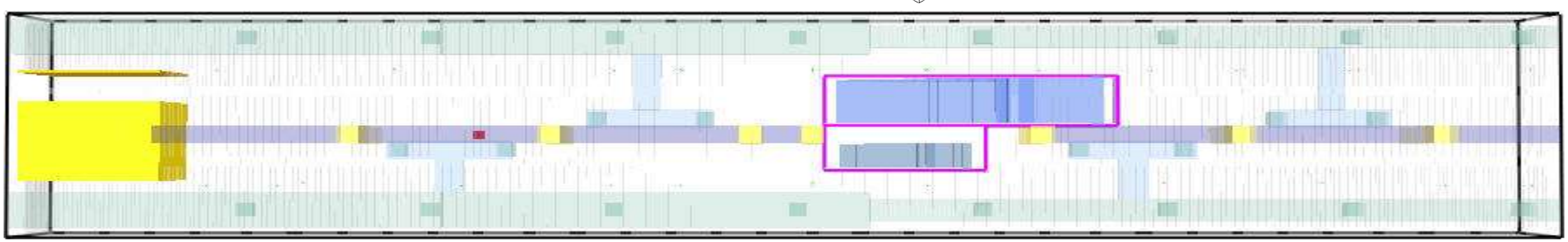
Risk Scenarios & Early Detection Benchmark

- Engineering tool: NIST CFD FDS5.5
- Main objects: columns, stairs, beams and ductwork in the ceiling void
- False ceiling with various openings
- Still-air environment
- Test fires
  - EN54-20 TF3 Fire (smouldering cotton wicks)
  - EN54-20 TF4 Fire (flaming PU foam)
- Benchmark Performance: Codes (e.g. NFPA 72 & NFPA 130) and evacuation modelling

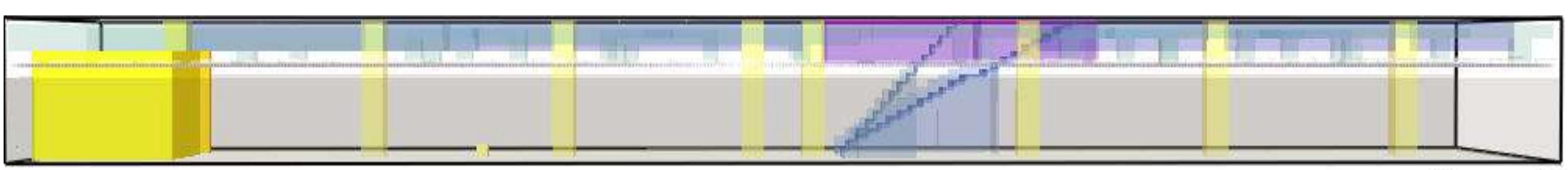




Top view



Elevation view



Test Case 1: Metro Platform

- Test Program
  - Beijing Metro
  - Time/condition: Aug - Sept 2009 (Non-operation), Mar - Apr 2010 (in operation)
  - Installation period: 20 months, all seasons
- Organizations
  - China Academy of Building Research
  - Beijing MTR Construction and Management Co. Ltd.
  - Beijing Fire Bureau
- Objectives
  - Smoke detector type selection, suitability and consistence in public area of a metro station
  - Detection performance and design for platform areas with hollow ceiling or similar structure
  - Effects of piston wind and subway station HVAC system on fire detection performance
  - Long-term reliability of fire detector operation
- Tested Detector Type
  - Air Sampling Smoke Detector Type
  - Spot-type detectors (optical and multi-criteria)
  - Beam projected-type smoke detector

xtralis

How Quickly Small Fires Develop

Different Combustibles, Different Smoke Characteristics

TF3 (Cotton wicks)

TF4 (PU foam)

Test Case 2: Train Depot

- Test Program
  - Guangzhou Metro
  - Time/condition: Jul 08 to Oct 09
  - Installation period: 16 months, all seasons
- Organizations
  - Guangzhou Metro Corporation
  - Guangzhou Fire Bureau
  - Design Institute of Guangzhou Metro Corporation
- Objectives
  - Evaluate detection technology to replace problematic conventional detectors in train depots
  - Detector stability tested over a 16 month period with smoke tests in all weather conditions
  - Long-term reliability and performance consistency of detector operation
- Tested Detector Type
  - Air Sampling Smoke Detector (ASD)
  - Beam Projected-type Smoke Detector

Train Depot Fire Tests

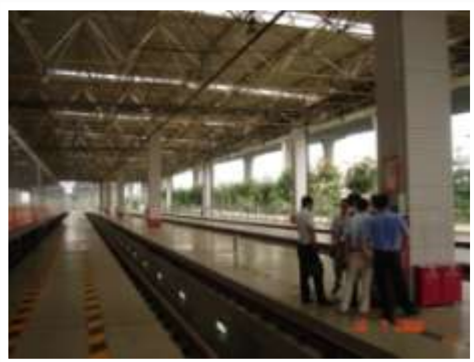
Installation Site



Test Location

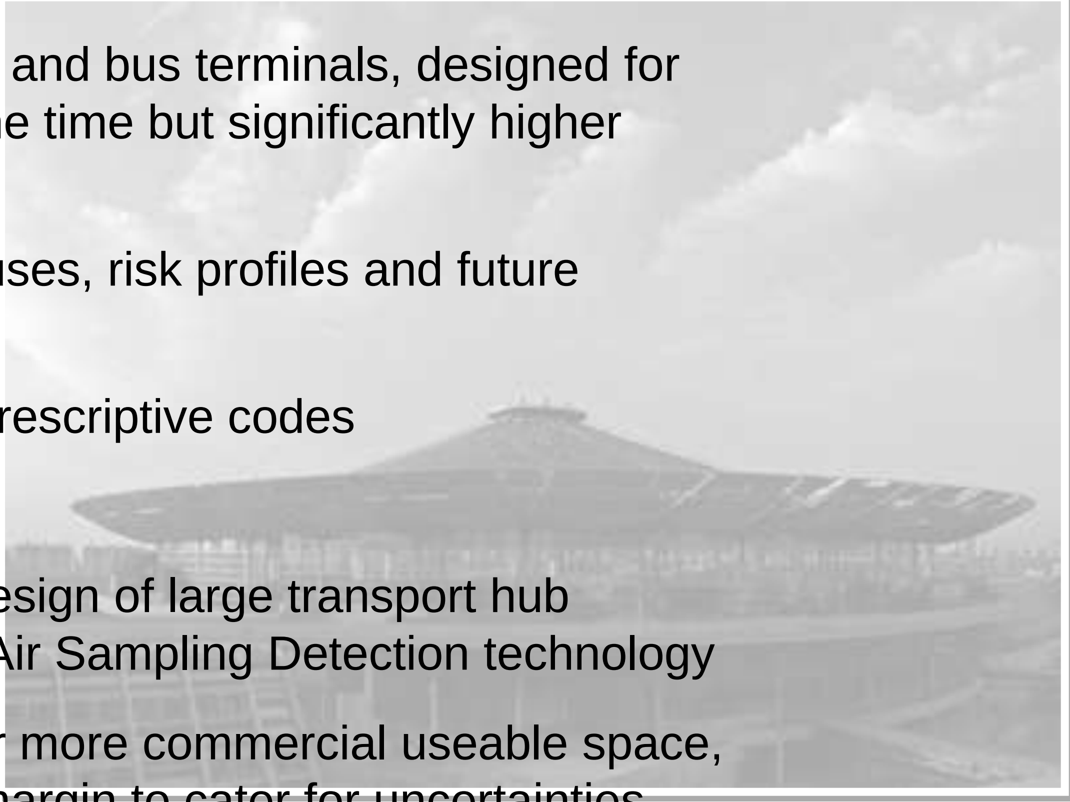


Early Warning Detection Alarm


Shanghai South Railway Station & Transport Hub

- The largest transport hub in China at time (2005)
  - Structure diameter exceeds 260m
  - Integrated railway, metro and bus terminals, designed for over 10,000 people at one time but significantly higher during peak seasons
  - Multi-purpose business uses, risk profiles and future population growth
  - Cannot be designed to prescriptive codes



- **Solutions?**
  - 1st Performance-Base Design of large transport hub incorporating advanced Air Sampling Detection technology
  - Early detection allows for more commercial useable space, sufficient design safety margin to cater for uncertainties without over engineering
  - Easy and non-interruptive maintenance

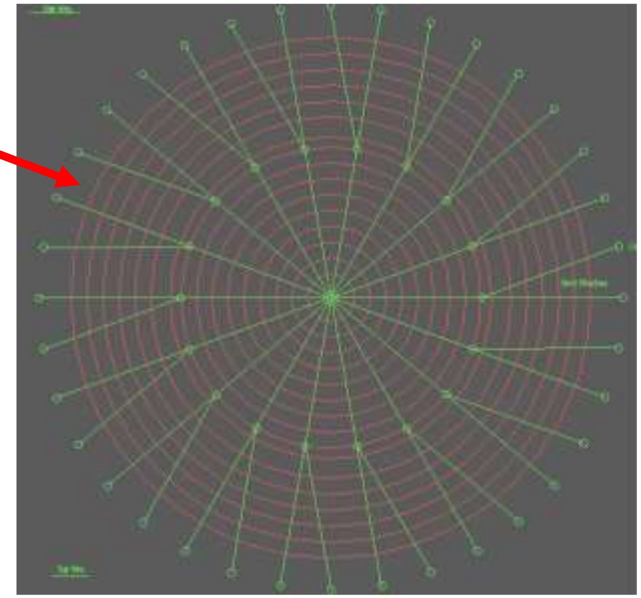
Detection System Design Challenges

Space, Architectural Structure

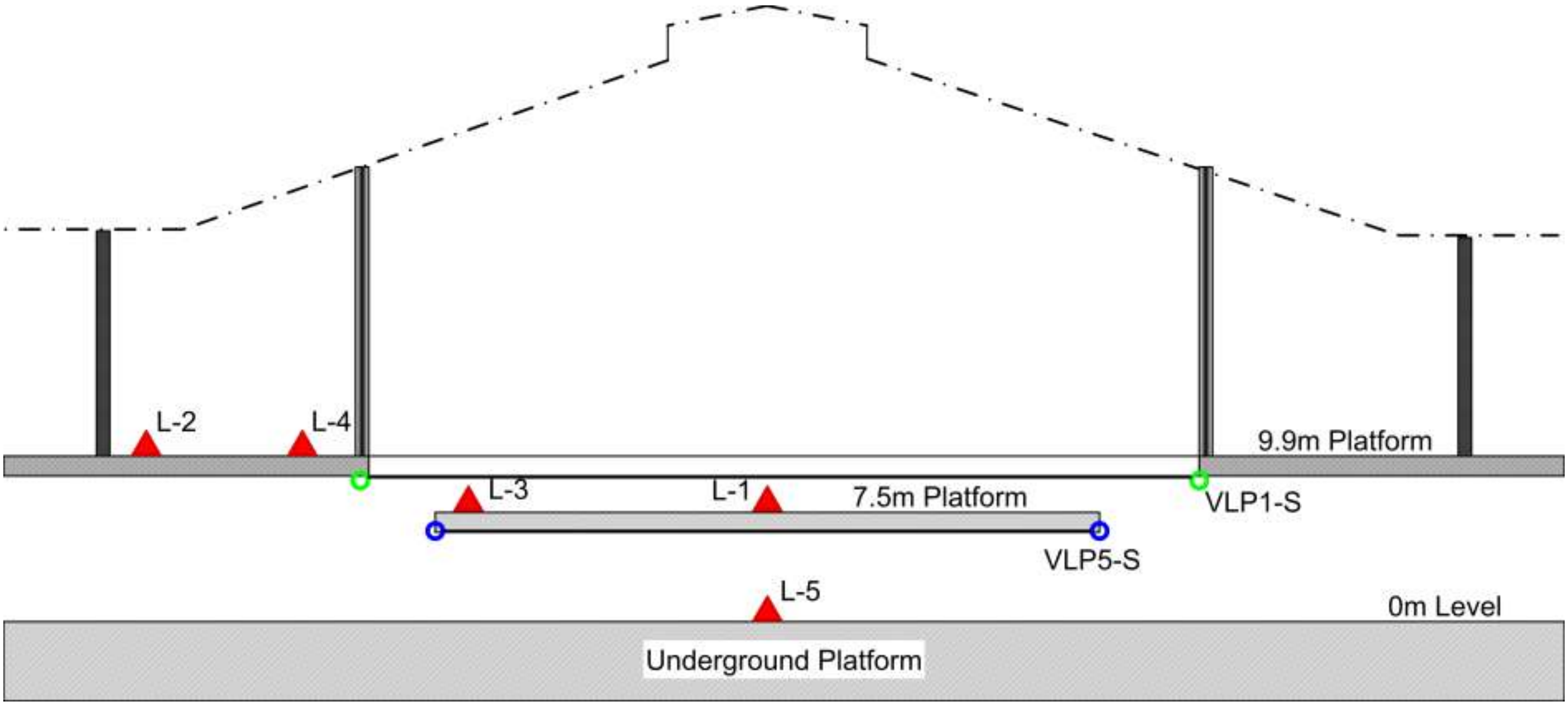
Cables
“ducts”

Complexity

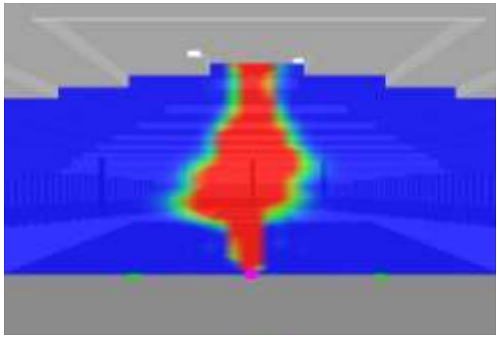
ASD Sampling
Pipes



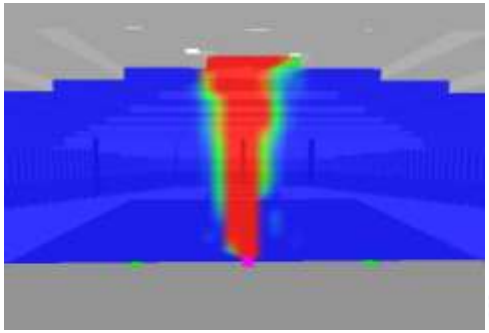
Detection Performance Evaluation: Large Open Spaces



Slow T^2 fire

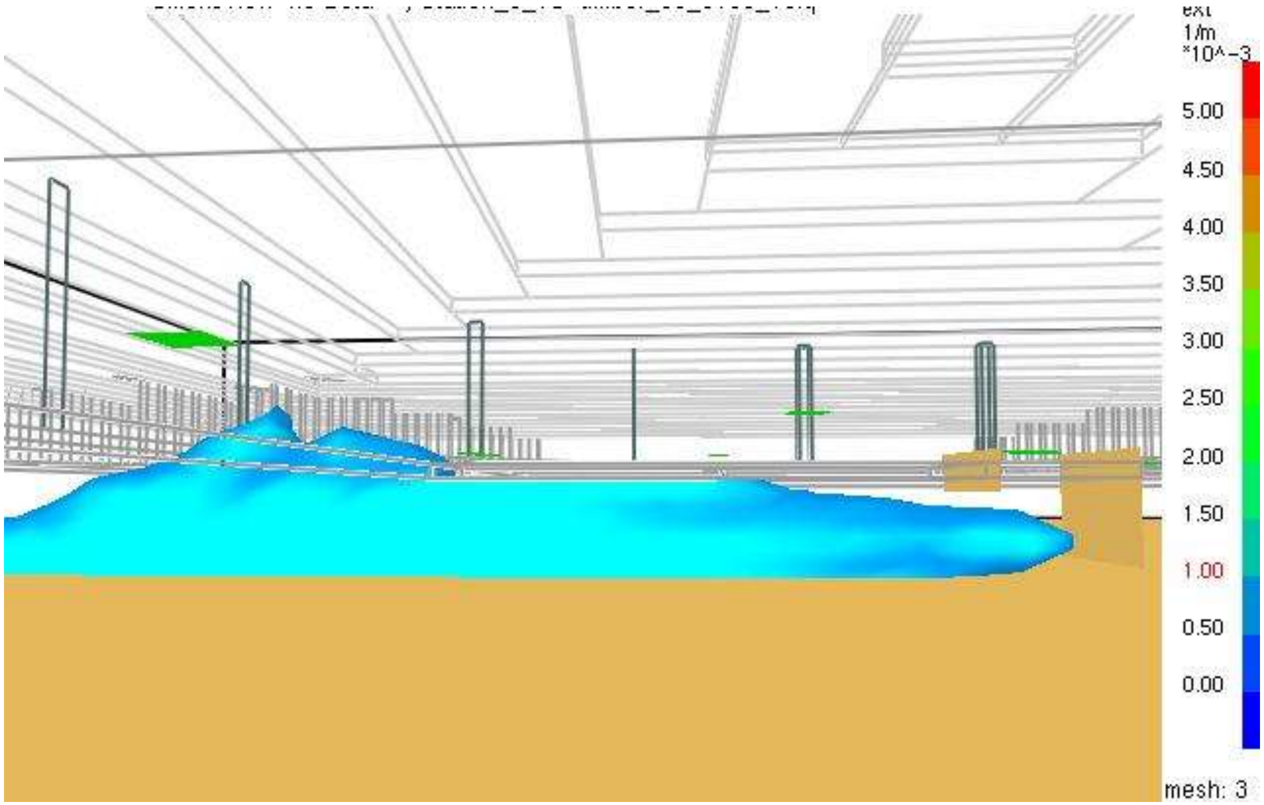


Fast T^2 fire



Performance Evaluation: Underground Platform

Wind	Alarm Time (seconds)			
	Normal		Worst-case	
	Alert	*Action*	*Alert*	*Action*
Yes	76	77	107	108
No	191	192	221	222



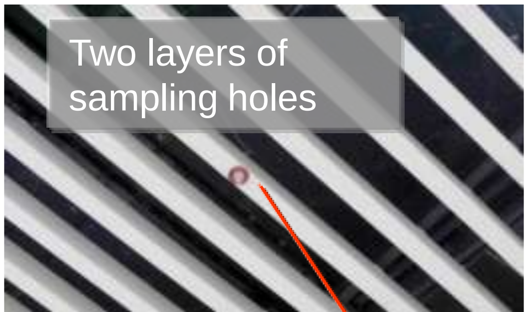
For big or small fires, ASD detection performance is consistent under the influence of strong wind on the platform

Local Codes and Reality

Attributes	Deemed-to-Satisfy (DtS)	Performance-based Design (PBD)
Compartment Size	Not covered	ASD ceiling detection is achieved with full coverage for early fire detection
Smoke Control, Detection and Tenability	Not stated	Designed to meet performance requirements based on credible fire scenarios commonly found in large transport hub
Travel Distances/Exit Widths	Not stated	Designed to meet performance requirements to allow maximum floor space for commercial use
Technology Fit	Not mentioned	Air sampling system (ASD) is assessed in comparison with other detection technologies
Emergency Planning	Not specified	ASD staged alarms to instigate an orderly evacuation
Unique Architect	Not covered	Consider smoke stratification, structure, fire locations, HVAC operation, etc.
Innovation	Not considered	ASD pipe network also cover cabling ducts (the columns supporting the ceiling structure)
Operational Issues & Ongoing Cost	Not considered	Address issues of possible false alarm with conventional detectors & maintenance access

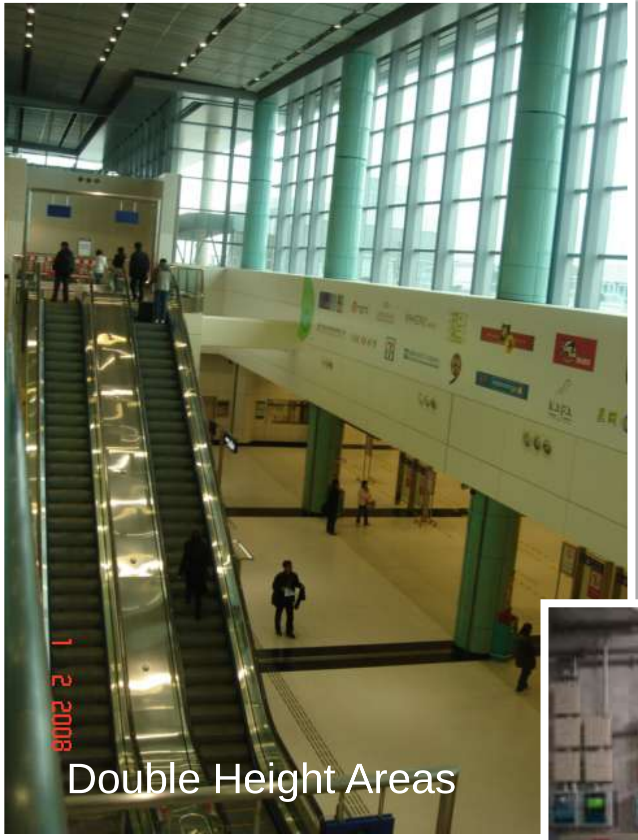
Safeguarding Transit Operation Worldwide

Beijing Metro



Detector service away from public areas

Hong Kong MTR & Rail Network



Double Height Areas


Station concourses


Integral part of safety system


Large Railway & Transit Hub

xtralis


ASD pipes alongside heat cables for Early Detection


Tunnels in and around MTR network

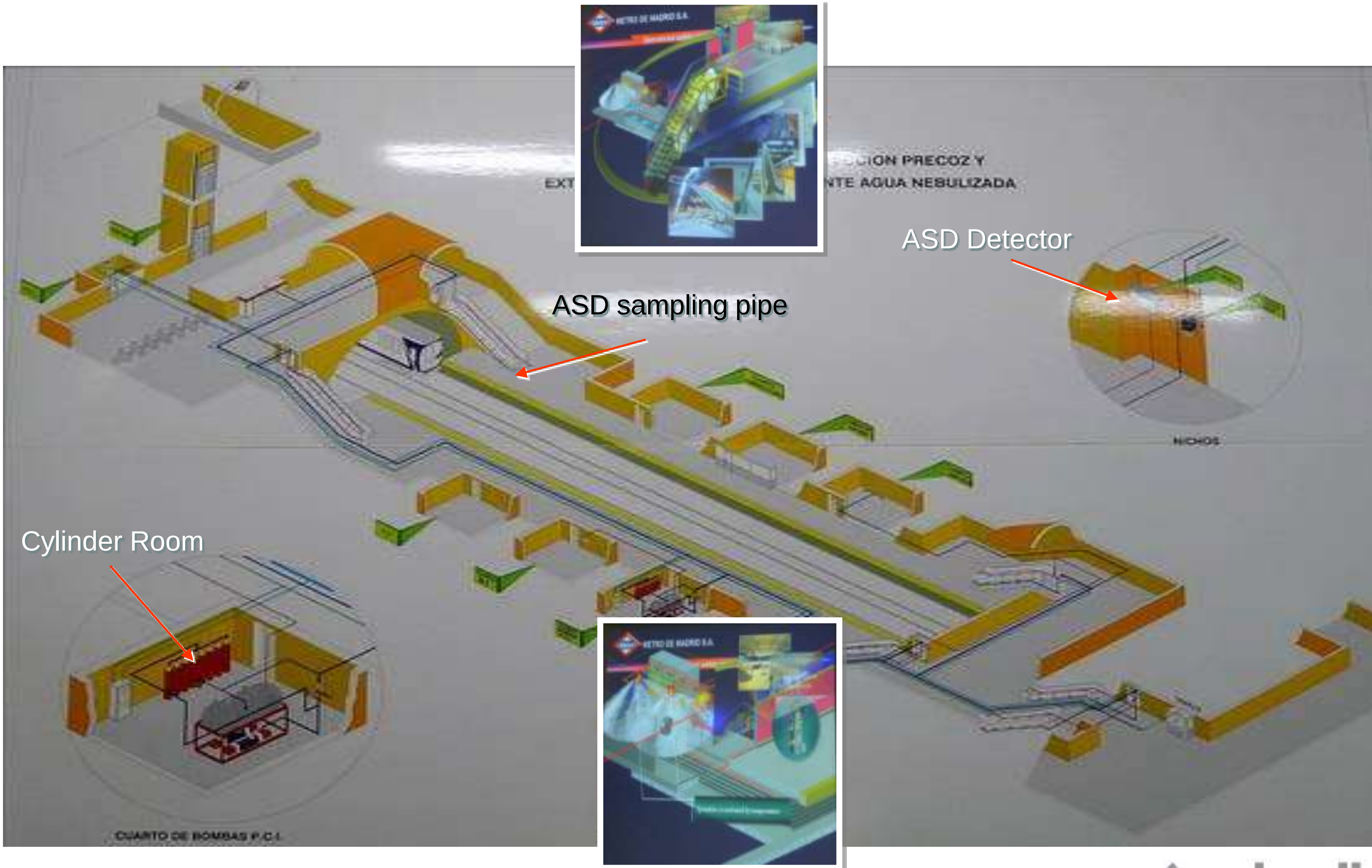

ASD Detector


Platform

Madrid Metro Fire Safety Strategy

- 8th largest metro network (by length) in the world, founded in 1919, 16 routes, 319 stations, 292.9Km since operation
- Over 450 commercial and retail facilities developed along with the stations, significant pedestrians in and around the stations
- All stations are equipped with escalators with more than 1500 escalators in operation
- Fire System Design Concept
  - Imperative to ensure absolute confidence toward the metro safety
  - Critically necessary to implement a very early warning and reliable fire alarm detection for orderly evacuation
  - Escalators are often used as the major (sometimes the only) instrument for evacuation, therefore, it is critical to have early smoke warning
- ASD Multi-Level Alarms and Corresponding Response
  - ***Alert***: Ticket office issues alarm, metro personnel attend the scene
  - ***Action*****:** Control Room issues an evacuation alarm
  - ***Fire1***: Disconnect elevator power supply
  - ***Fire2***: Activate a portion of the fire-extinguishing system

Early Detection & Suppression System Design



Examples of Protected Areas

Station monitoring

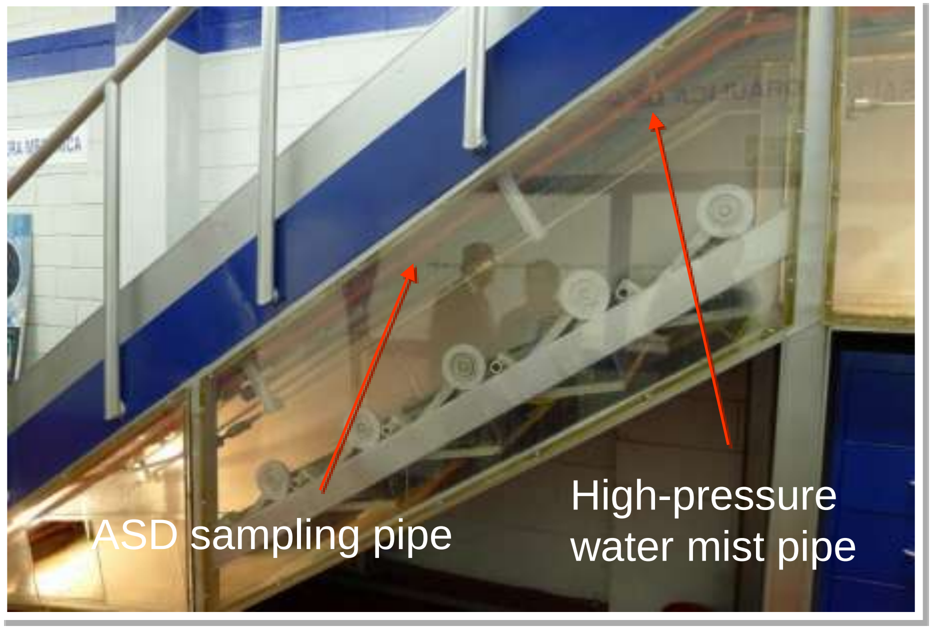
Remote display in Control room

Equipment room

Every station is equipped with one high-pressure water mist cylinder room

ASD inside Electrical cabinet


Utility Rooms: combined with CH_4, CO detection


High-pressure water mist pipe
ASD sampling pipe


Ascensor
Vestíbulo
Distribuidor
Elevator: combined with O_2, CO detection


Onboard Trains

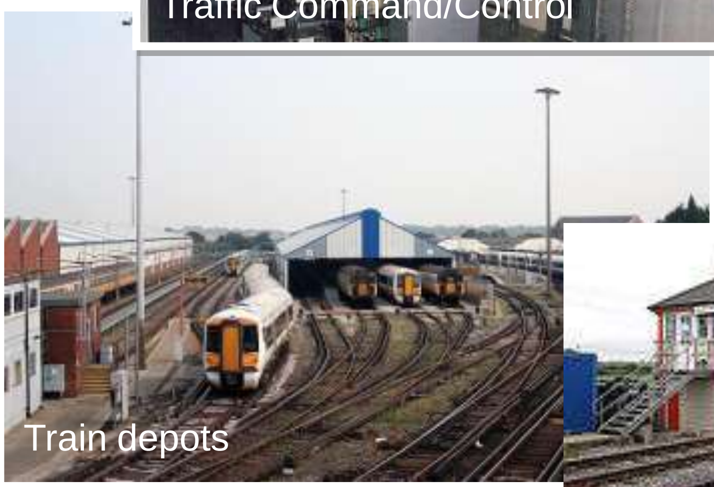
xtralis

Diverse Applications in Transit Systems Worldwide

Traffic Command/Control

Power Supply

Semi-enclosed station



Train depots

Trackside communication

Cable and Utility tunnel

Under platform exhaust

Discussion & Summary

Why Early, Accurate Detection Critical?

Unreliable or late detection results in real disasters

Human error is common

Distinguishing false alarms from real threats can be challenging

Triggering of suppression systems is expensive

- Underpin **good practice** in application of advanced technology to Detect early, Measure in real time, Respond to prevent and protect
- **Maintain or increase** design safety margin with greater certainty of sufficient safety in changing circumstances
- **Ensure** business continuity: Asset and Risk Management orientated to achieve an **optimal**, not minimal outcome
- **Key design considerations**: time (quick response), flexibility (innovative design), reliability (verifying measurement & suited for environment), effectiveness (fit-for-purpose), availability (intelligent detection)

Discussion

- **Political**
  - Critical focus on passenger and occupants safety
  - Use of new technology and engineering methods
  - Target investments
  - Reputation, socially responsible
- **Commercial**
  - Building owners vs management (operators)
  - Public liability
  - Improved service profile and reduced risk of potential loss
  - Differentiation, Cost
- **Regulations and practice**
  - Best practice, continual codes/standards development
  - Risk/Performance-Based Design & Safety Assurance Process
  - Government and AHJs “rules”

Summary

- Use of Early and reliable fire detection in Rail/Metro is paramount to life safety and business continuity
- Early detection and intelligent evacuation are key components of advanced and future fire safety system design
- Advanced engineering tools are used to aid Risk-Informed, Performance-Based Design of a fire safety system, achieving both quantitative and qualitative objectives
- Advanced detection technologies such as Aspirating Smoke Detectors are used as cost-effective solutions while providing the highest possible sensitivity detection of a fire incident in high risk areas and public spaces
- When used as an alternative to conventional detection technology, advanced detection systems meet and exceed performance expectation, value-added features are actively implemented

xtralis™
The sooner you know™

Questions?

Early, Accurate Safety Threat Detection

Integrated for Transit Risk Management &

Emergency Response

Ming He

Executive Director (Strategic Projects)
Xtralis Inc.