Working in Confined Space -- the Marine Scenario A Scientific Seminar at HKIOEH on 29.6.2007

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Defining the scope

the measuring tape, putting something in the spot light

- Work (working) : definition in maritime law of Hong Kong – cargo handling, shiprepairing, shipbuilding, *shipbreaking*, marine construction
- Confined space : enclosed space, hatched cargo hold, compartment, ballast tanks, void space, tanks, double bottom, “gas safe space”;

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- The information provided are not for practical use and users must verify themselves for their accuracy, etc.
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Confined Space Design Guidance Documents:

- Guidance Notes for the Application of Ergonomics to Marine Systems American Bureau of Shipping, ABS April 2003. American Bureau of Shipping, ABS Plaza, 16855 Northchase Drive, Houston, TX 77060 USA

Confined Space Regulations:

- 29 CFR Part 1915 Subpart B - Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment.

Confined Space Standards:

- ANSI Z117.1-2003, Safety Requirements for Confined Spaces - This revised standard provides minimum safety requirements to be followed while entering, exiting, and working in confined spaces at normal atmospheric pressure.

General Confined Space References:

- *Complete Confined Spaces Handbook*, John F. Rekus, copyright 1994, Lewis Publishers - This book provides plant managers, supervisors, safety professionals, and industrial hygienists with recommended procedures and guidance for safe entry into confined spaces.
- Confined Space Entry, An AIHA Protocol Guide. 2nd Ed., AIHA Press 2001
  SOLAS Chapter II-1, Part A-1 Structure of Ships Regulation 3-6
  Access to and within spaces in the cargo area of oil tankers and bulk carriers (2002 rev.)
- Confined Space Safe Practice Rec. No 72, International Association of Classification Societies (IACS).
- Human Factors Conference, London, 27 - 29 September 2000, Royal Institution of Naval Architects - Human factors in ship design and operation provides an opportunity to reduce cost, improve safety, increase effectiveness and improve conditions on board ships. Details of papers presented at this conference are available at http://www.rina.org.uk/
- International Maritime Organization (IMO) www.imo.org - Safety of Life at Sea (SOLAS)

- International Maritime Organization (IMO) www.imo.org - Safety of Life at Sea (SOLAS) rule for merchant oil tankers and bulk carriers requiring permanent means of access (PMA) or alternate means of access to the cargo and fuel storage areas.
- Naval Sea System Command (NAVSEA), Carderock Division - web site describes the use of tank level indicators on Navy ships.
  http://www.dt.navy.mil/pao/excerpts%20pages/2003/August/Tank%20Level%20Indicators.html
- NAVSEA, Capital Investment for Labor - website describes the use of Navy tank monitoring system aboard Navy ships.
  http://www.navsea.navy.mil/
- NAVSEA, Corrosion Control Division, Beau Brinckerhoff 's presentation at the 2002 DoD Maintenance Symposium, describes Navy innovative, cost savings projects for Navy Shipboard Corrosion Maintenance.
  http://www.nsrp.org/panels/spc/downloads/future_navy_ship_corrosion_control.pdf
- NAVSEA, Corrosion Control Division, E.. Dail Thomas II's presentation describes Navy innovative cost savings projects for Navy Shipboard Corrosion Maintenance.
  http://www.usashipbuilding.com/
- Naval Safety Center website presentation describes the dangers, procedures, and equipment used for confined space entry of Coast Guard boarding team.
- NFPA 301 Code for Safety to Life from Fire on Merchant Vessels 2001 Edition
- NFPA 306 Control of Gas Hazards on Vessels 2001 Edition - guidelines for Marine Chemists and hazards of Confined and Enclosed Spaces aboard ships.
- NIOSH/NSRP Project - Ergonomic Interventions in the Building, Repair, and Dismantling of Ships, 2000, Stephen D. Hudock, Ph.D., CSP
  http://www.cdc.gov/niosh/ergship/ergship.html
- NIOSH Shipyard Ergonomics Project New Orleans, 2002
  www.nsrp.org/projects/deliverables/ase_912002.pdf
- NSRP [Shipyard] Ergonomics Guide Task 2.2 Rev. 0 Maritech Project 99-10, "World Class Manufacturing Model," John Horvath, Project Manager February 21, 2000
  http://www.nsrp.org/projects/project10/ergoguide.pdf
- OSHA Ship Repair website e-tool, "Confined or Enclosed Spaces and Other Dangerous Atmospheres"
  http://www.osha.gov/
- Safety and Health in Confined Spaces, Neil McManus, copyright 1999 Lewis Publishers - comprehensive review of all aspects of confined space entry including hazard assessment,

Enclosed Spaces – Cap415C(2)

- "enclosed spaces" (圍蔽艙位) means all those spaces, other than excluded spaces, which are bounded by the ship's hull, by fixed or portable partitions or bulkheads, or by decks or coverings other than permanent or moveable awnings. No break in a deck, nor any opening in the ship's hull, in a deck or in a covering of a space, or in the partitions or bulkheads of a space, nor the absence of a partition or bulkhead, shall preclude a space from being included in the enclosed spaces; and for the purposes of this definition "excluded spaces" (免除艙位) means any of the following spaces-
- (a) that part of an enclosed space within an erection opposite an end opening and extending from the opening to an athwartship line at a fore and aft distance from the opening equal to half the breadth of the deck at the line of the opening. Such end opening shall have a breadth equal to or greater than 90 per cent of the breadth of the deck at the line of the opening and shall extend from deck to deck or to a curtain plate of a depth not exceeding by more than 25 millimetres the depth of the adjacent deck beams, as specified in figure 1 of Schedule 2 hereto:
- Provided that-
- (i) where at any point the width of the enclosed space, because of any arrangement except convergence of the outside plating, as specified in figure 3 of Schedule 2 hereto, becomes less than 90 per cent of the breadth of the deck at the line of the opening, the excluded space shall extend only to an athwartship line intersecting that point, as specified in figures 2 and 4 of Schedule 2 hereto;
  (ii) where the opposite ends of 2 enclosed spaces are separated by a gap, which is completely open except for bulwarks or open rails and of fore and aft length less than half the least breadth of the deck at the gap, then no part of the enclosed spaces shall be excluded, as specified in figures 5 and 6 of Schedule 2 hereto;
- (b) a space under an overhead deck covering open to the sea and weather, having no other connection on the exposed sides with the body of the ship than the stanchions necessary for its support. In such a space, open rails or a bulwark and curtain plate may be fitted or stanchions fitted at the ship's side, provided that the distance between the top of the rails or the bulwark and the curtain plate is not less than 0.75 metres or one-third of the height of the space, whichever is the greater, as specified in figure 7 of Schedule 2 hereto;
  (c) a space in a side-to-side erection between opposite side openings not less in height than 0.75 metres or one-third of the height of the erection, whichever is the greater. If the opening in such an erection is provided on one side only, the space to be excluded from the volume of enclosed spaces shall be limited inboard from the opening to a maximum of one half of the breadth of the deck in way of the opening, as specified in figure 8 of Schedule 2 hereto;
  (d) a space in an erection immediately below an uncovered opening in the deck overhead, provided that such an opening is exposed to the weather and the space excluded from enclosed spaces is limited to the area of the opening, as specified in figure 9 of Schedule 2 hereto;
  (e) a recess in the boundary bulkhead of an erection which is exposed to the weather and the opening of which extends from deck to deck without means of closing, provided that the interior width is not greater than the width at the entrance and its extension into the erection is not greater than twice the width of its entrance, as specified in figure 10 of Schedule 2 hereto;
  (f) notwithstanding the provisions of paragraphs (a) to (e) inclusive, any space listed in those paragraphs which fulfills at least one of the following conditions shall be treated as an enclosed space-
- (i) the space is fitted with shelves or other means for securing cargo or stores;
  (ii) the openings are fitted with any means of closure;
  (iii) the construction provides any possibility of such openings being closed;

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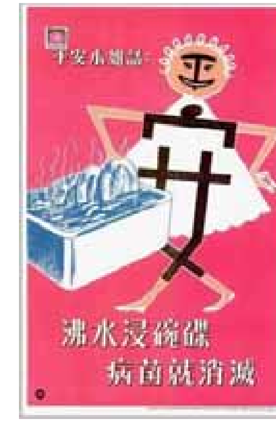
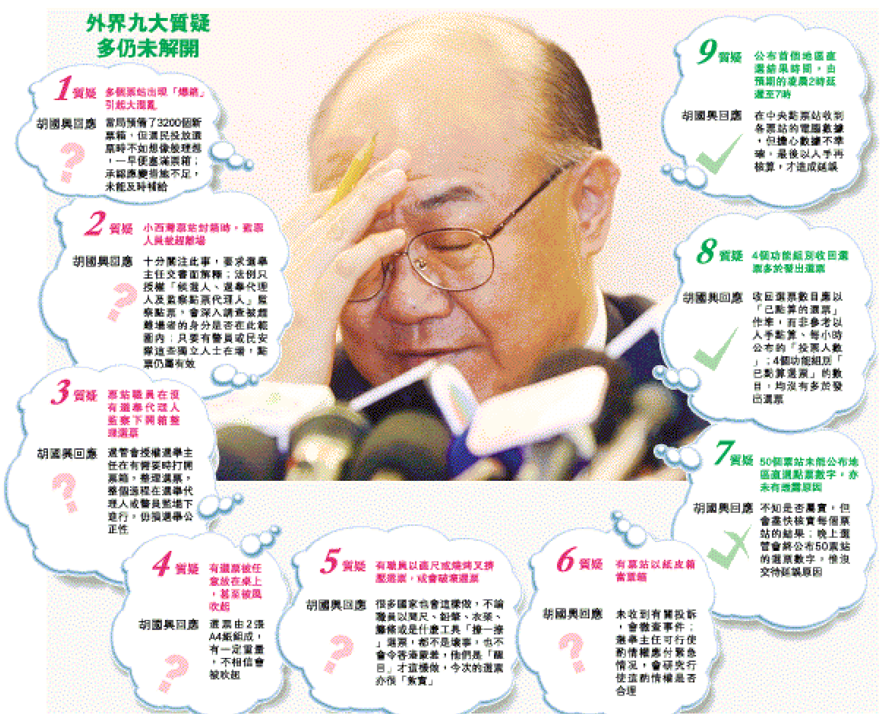

安
沸水浸碗碟
病菌就消滅


安
先有清潔的手
才有清潔食物


外界九大質疑
多仍未解開
1 質疑 多個票站出現「爆箱」引起大混亂
胡國興回應 當局預備了3200個新票箱，但選民投放選票時不如想像般理想，一早便塞滿票箱；承認應變措施不足，未能及時補給
2 質疑 小西灣票站封箱時，監票人員被趕離場
胡國興回應 十分關注此事，要求選舉主任交書面解釋；法例只授權「候選人、選舉代理人及監察點票代理人」監察點票，會深入調查被趕離場者的身分是否在此範圍內；只要有警員或民安隊這些獨立人士在場，點票仍屬有效
3 質疑 票站職員在沒有選舉代理人監察下開箱整理選票
胡國興回應 選管會授權選舉主任在有需要時打開票箱，整理選票，整個過程在選舉代理人或警員監場下進行，以確保選舉公正性
4 質疑 有選票被任意放在桌上，甚至被風吹起
胡國興回應 選票由2張A4紙組成，有一定重量，不相信會被吹起
5 質疑 有職員以直尺或燒烤叉等壓選票，或會破壞選票
胡國興回應 很多國家也會這樣做，不論職員以間尺、鉛筆、衣架、籐條或是什麼工具「撥一撥」選票，都不是壞事，也不會令香港蒙羞，他們是「醒目」才這樣做，今次的選票亦很「紮實」
6 質疑 有票站以紙皮箱當票箱
胡國興回應 未收到有關投訴，會徹查事件；選舉主任可行使酌情權應付緊急情況，會研究行使這酌情權是否合理
7 質疑 50個票站未能公布地區直選點票數字，亦未有透露原因
胡國興回應 不知是否屬實，但會盡快核實每個票站的結果；晚上選管會將公布50票站的選票數字，惟沒交待延誤原因
8 質疑 4個功能組別收回選票多於發出選票
胡國興回應 收回選票數目應以「已點算的選票」作準，而非參考以人手點算、每小時公布的「投票人數」；4個功能組別「已點算選票」的數目，均沒有多於發出選票
9 質疑 公布首個地區直選結果時間，由預期的凌晨2時延遲至7時
胡國興回應 在中央點票站收到各票站的電腦數據，但擔心數據不準確，最後以人手再核算，才造成延誤

Scientific Method

- Karl Popper: further proof
- Objective: identify hazards to human in c.s.
- Review of literatures: docs, rules & regs
- Tests: examine the bulk & corners
- Conclusions: the threads & threats
- Discussion : open floor

Ship Design & Operation

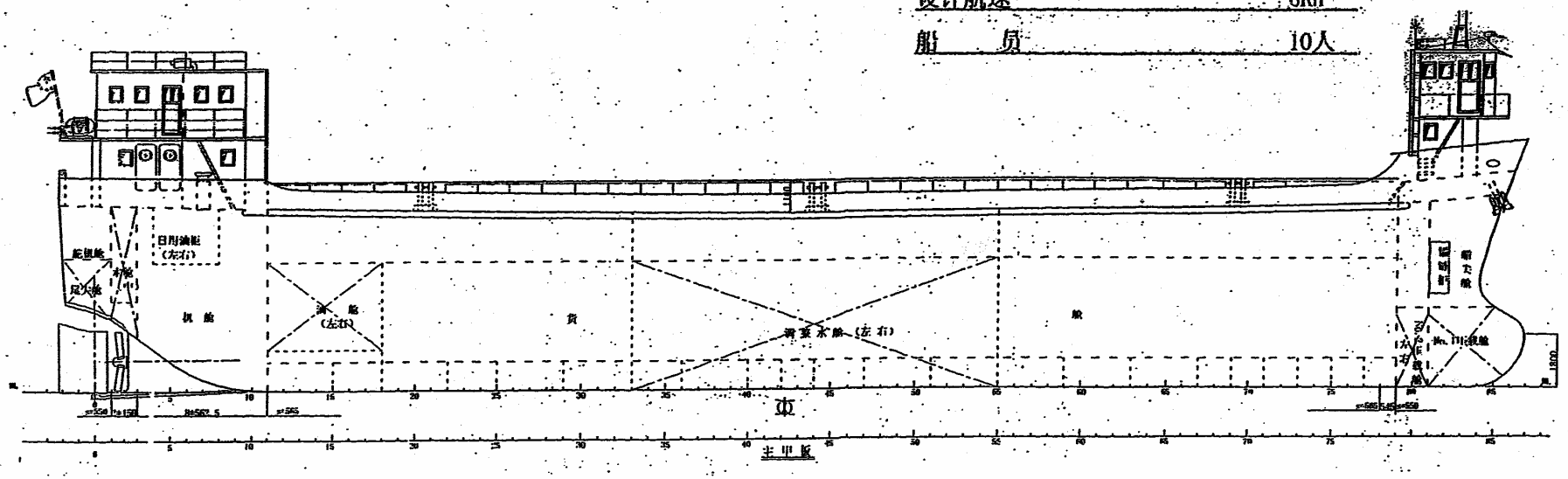
- Classification societies : rules for design
- Certificate of construction etc.
- Merchant Shipping Ord/Reg: flag of quality, laissez-faire attitude, lack cohesiveness in maritime prowess
- International Health Regulations (2005): Port Health Office of DoH/HKSAR (MDN99/07: SSCC & SSCEC replaced DC & DEC as ship hygiene documents wef 15.6.07)
- Disinfection/fumigation : methyl bromide, for example
- Gas free certificate: entry, hot work /cold work (asphysiation, injurious fumes or explosions)

主尺度 Coaster "Hui Jin Qiao 18"

SKETCH B

NOT TO SCALE

总　　长	49.98m
垂线间长	47.20 m
型　　宽	15.80m
型　　深	6.00 m
设计吃水	3.60 m
排水量	2436t
装载集装箱	120TEU/空箱180TEU
主机功率	350Kw*2
设计航速	8Kn
船　　员	10人



Local Vessels

- Dumb steel lighters, oil/water barges (tankers), pontoons, yachts, fishing boats, flat top barges, containerised waste carrier, tug boats
- river trade vessels, sand barges, near coastal vessels, coastal vessels
- (see pictures: ship_types)

“Confined Space/Enclosed Space”

- Safe atmosphere – hot work not in an atmosphere containing flammable vapours, flammable gases or explosive dusts. (Cap 548, s42)
- Breathable air in BA (EN132) – dry O2 23.14%v, N2 75.52%v, CO2 0.05%v, Ar, H2, Ne, He, Kr, Xn. No odour of oil, threshold 0.3mg/m3, Water content < 50mg/m3 for 200bar, 30 mg/m3 for 300bar
- Wearer : 40 l/m consumption rate

international breathing air standards

Item	United Kingdom		European-Draft	Germany	Holland	USA	Canada	AUS/NZ	domnick hunter Breathing Air Purifiers
	BS 4275 1997	BCAS GS901031: 1990	prEN 12021 1997	DIN 3188 1984	P112-1 1985	ANSI/CGA G-7-1 1989 OSHA Grade D	Z180-1 -M85 1985	AS/NZS 1715:1994	
Nitrogen		Not Specified				19.5-23.5%	Not Specified		
Oxygen	20-23%	18-24%	21 ± 1%	20-21%	20-21%	approx. 21.5%	19.5-22.5%	19.5-22%	
Carbon Dioxide	500ppm	<500ppm	500ppm	1000ppm	1000ppm	1000ppm	500ppm	<800mg/m³	300ppm
Carbon Monoxide	5ppm	<5ppm	<15ppm	30ppm	5ppm	10ppm	5ppm	10ppm	<5ppm
Oil Mist	0.5mg/m³	<0.5ppm	0.5ppm	Not Specified	0.1mg/m³	5mg/m³	1mg/m³	1mg/m³	0.003mg/m³
Pressure Dewpoint	5°C below lowest temp.	At least 5°C below minimum temp.	At least 5°C below minimum temp.	-51°C pdp	-51°C pdp	10°F below. lowest temp	pdp at 5°C below system	100mg/m³	-40°C pdp
Halogenated Hydrocarbons	<10% OEL	<10% LTEL	<10% LTEL	Not Specified	Not Specified	Not Specified	5ppm	Not Specified	Not Specified
Solid Particles	<10% OEL	<LTEL Respirable Dust	<LTEL	Not Specified	Not Specified	Not Specified	1mg/m³	Not Specified	0.01mg/m³
Odours	None	None	None	None	Not Specified	No pronounced odour	None	No nauseous odour	None
Nitrous Oxide Nitrogen Dioxide Sulphur Dioxide	<10% OEL	<10% LTEL	<10% LTEL	Not Specified	Not Specified	Not Specified	<10% TLV	Not Specified	<10% LTEL

SOLAS Convention 1974

- Safety of life at Sea

- **Chapter II-2 - Fire protection, fire detection and fire extinction**
  Includes detailed fire safety provisions for all ships and specific measures for passenger ships, cargo ships and tankers.

  They include the following principles: division of the ship into main and vertical **zones** by thermal and structural boundaries; separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries; restricted use of combustible materials; detection of any fire in the zone of origin; containment and extinction of any fire in the space of origin; protection of the means of escape or of access for fire-fighting purposes; ready availability of fire-extinguishing appliances; minimization of the possibility of ignition of flammable cargo vapour.

Chapter IX - Management for the Safe Operation of Ships

- The Chapter makes mandatory the International Safety Management (ISM) Code, which requires a safety management system to be established by the shipowner or any person who has assumed responsibility for the ship (the "Company").

Seafaring

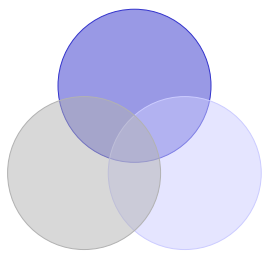
- Medical examination : hearing, sight, colour vision, general health
- Medical first aid guide prepared by ILO, WHO, IMO
- Standards of Training and Watchkeeping (STCW)
- Working hours : ILO convention 180 Article 5
  - (a) max not exceed (i) 14h in 24h (ii) 72h in any 7-day or
  - (b) min hours of rest not less than (i) 10h in 24h (ii) 77h in 7-day

SH advice: 30 years back

- Personal hygiene & protection : drink sufficient water, salt to avoid heat exhaustion, sensible shoes or boots, non-slip soles and reinforced toecaps, clothes : no loose flaps, head gear, finger rings removed, gloves, well washed hands, avoid infections of cuts
- → Changing area of concerns

Ocean-going : technology, global

- Local Vessels (Harbour / port limit) – local legislations with international perspective
- Labour Department (Land) – local legislations with international elements
- → prescriptive to descriptive
- → system approach
- → skills changed, rule changes, knowledge based
- → DoJ (US) attitude: criminalisation of seafarers / workers



MS(LV)(W)Reg, Cap548I

- Shipbuilding and Ship-repairing Safety Guide : Section III Entry into Confined Spaces
- → TLV, 8 hr daily exposure
- → toxic vapours : petroleum, benzene, H2S, others
- → lack of O2: CO2 discharge, H2 generation, steam, inert gas, rusting

MERCHANT SHIPPING (SEAFARERS) (ENTRY INTO DANGEROUS SPACES) REGULATION, Cap 478B, s2

- "dangerous space" (危險艙) means any enclosed or confined space in which it is foreseeable that the atmosphere may at some stage contain toxic or flammable gases or vapours, or be deficient in oxygen, to the extent that it may endanger the life or health of any person entering that space;

“Competent Persons”

- Gas free inspectors (marine, 295C, s21) : qualification, mentor, examination, fee, revalidation
- Person approved under Cap295B (General) : approved person, s108 (container repairs), s120 (hot work to tank wagon), s128 (hot work repair to tanks)
- Competent person under Cap59AE : 2-day training, risk assessment report
- Person trained in using the gas tester

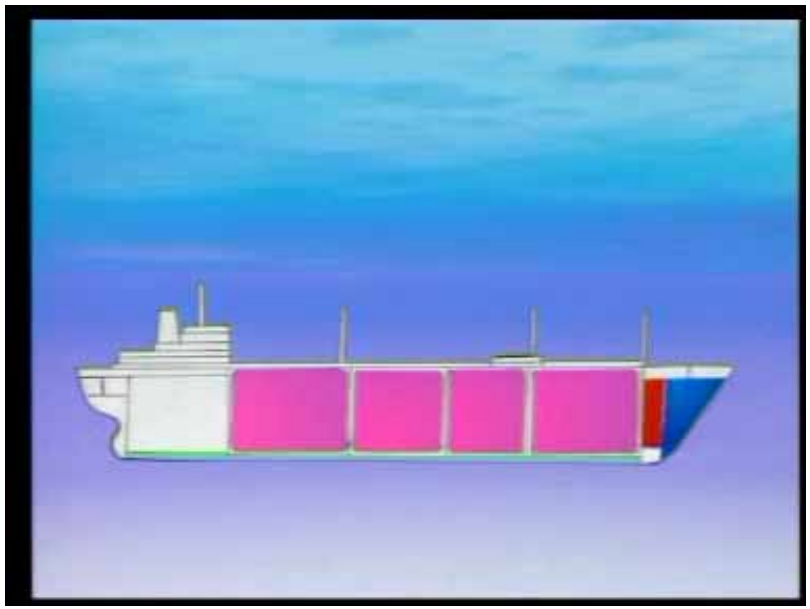
"confined space" (密閉空間) Cap59

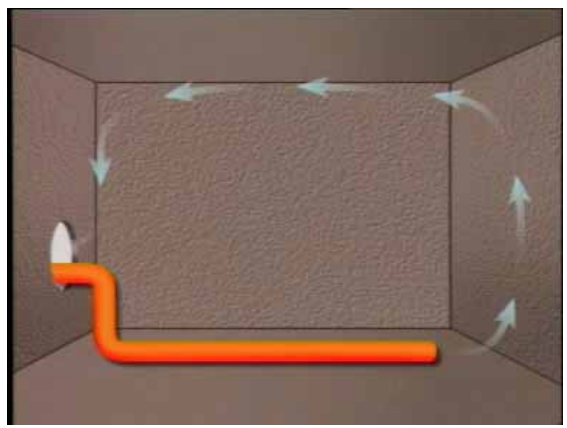
- means any place in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk, and without limiting the generality of the foregoing, includes any chamber, tank, vat, pit, well, sewer, tunnel, pipe, flue, boiler, pressure receiver, hatch, caisson, shaft or silo in which such risk arises; (L.N. 17 of 1999)

"specified risk" (指明危險)

- (a) serious injury to any person at work arising from a fire or explosion;
  (b) the loss of consciousness of any person at work arising from an increase in body temperature;
  (c) the loss of consciousness or asphyxiation of any person at work arising from gas, fume, vapour or the lack of oxygen;
  (d) the drowning of any person at work arising from an increase in the level of liquid; or
  (e) the asphyxiation of any person at work arising from a free flowing solid or the inability to reach a respirable environment due to entrapment by a free flowing solid. (L.N. 17 of 1999)

Screen Clips





From OSHC VCD “死亡陷阱”

Accident Cases Investigated

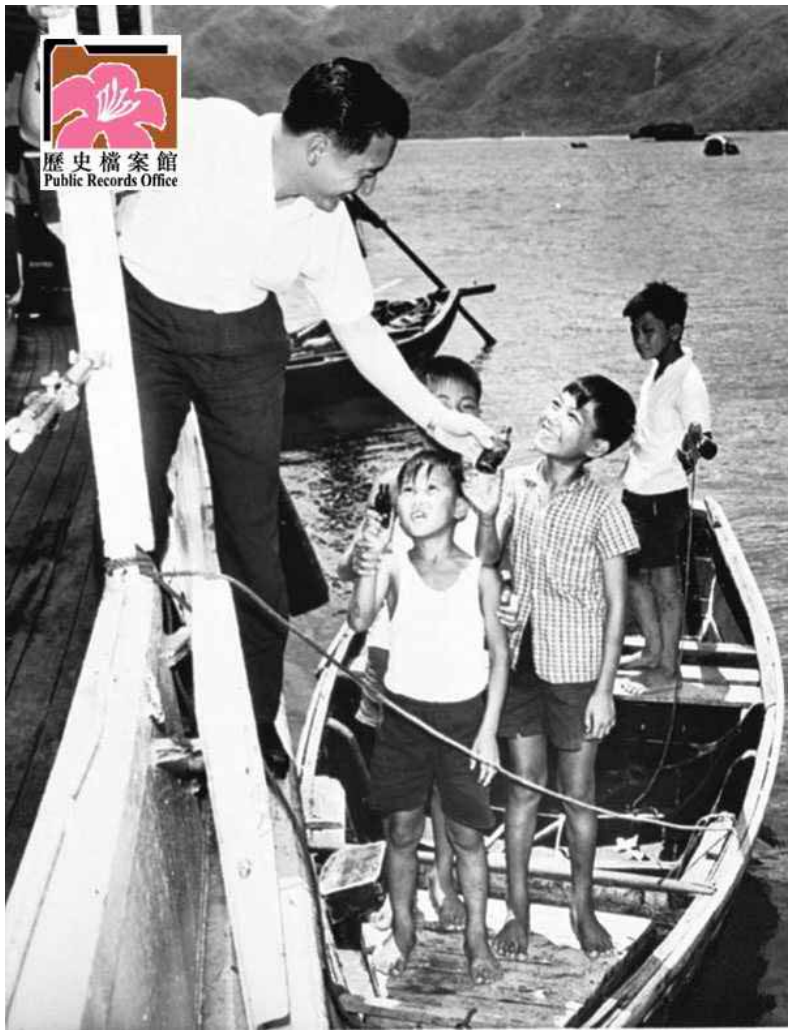
- 8 illustrative cases

- Exhaust gas,
- narrow cargo hold with moving load,
- bulk cargo hold (coal),
- water jet in double bottom,
- Folding hatch cover
- Accumulation of gases
- Using diesel engine in a hold
- Inside a mixer

Control of human behaviour

- Law and regulations (passive, man-made)
- Directions (stop, suspension, corrective)
- Marine Department Notices (instructive)
- Code of Practices
- Guidelines, Guides, Guidance Notes,
- Notices, Information
- Warning letters
- Safety pamphlets, leaflets, posters, Green Cross Articles
- TV / Radio, Newspaper, journals, newsletter
- Internet websites, passive, interactive
- Supervision, peer review, audit (i/e)
- Person in charge, employer, supervisor, worker

History of Health Education 健康教育




0
5
10
15
20
25
Oxygen level
寶貴生命要珍惜
注意空氣含氧量
空氣含氧量
21%
清醒
18%
不適
16%
暈眩
12%
失覺
10%
死亡
在通風不良或欠佳或
密封的船艙工作，
必須採取下列安全
措施：
㈠在進入船艙前，
測量艙內空氣的
含氧量
㈡若有多人一起在
密艙內工作，必須在
入口處用通風扇吹送
新鮮空氣入艙內
㈢工作中如感覺不適，
應立即離開船艙
海事處海事工業安全組
查詢電話：
八五二 四四七二

Testing for safe atmosphere

- Gas detector, gas sampler, gas analyzers,
- Sensor poisoning
- Life span of sensor
- Calibration, span gas, (outside the space)
-

Why take risks ?

- Hunch → Quick, short time exposure, strength, low concentration, less likelihood,
- Assumptions in the effect of ventilation: point of measurement, Brownian movement, diffusion
- Method of ventilation : air replacement, air changes, uniflow, turbulent flow, circulated flow, crossed flow, stratified flow, air volume, air streams, air speed,
- Time pressure : economy OR

Risk Taking Behaviour

- Tolerable risk, acceptable risk, trivial risk
- Lesson learned
- Ignition of a composite cylinder with plastic liner, Journal of ASTM International, Vol 3, No 5. [limitation of knowledge]
- Specifications for filament wound composite cylinders: life extension
- Failure mode, statistical data, safety factors (factor of ignorance)

Prediction

- Laws & regulations, review or lesson learned is looking back, not forward looking – disadvantage is “after the fact”, not before the happening; rulings tended to restrict, confine, prohibit, design the human out of the system, man-machine interface, human error…
- Risk by design : construction methods
- Think / act before leaping (preparedness)
- Yi-ching (understanding and monitor changes)
- CONCLUDED

Time is up, open your eyes
to the inner and outer spaces

Discussions

- Q & A
- Further explanation