

AAIB SINGAPORE

- **A department of Ministry of Transport**
- **Independent of regulatory and judicial authorities and aviation services providers**
- **Investigation authority to fulfil Singapore's Annex 13 obligation**

Note: Other agencies may carry out their own investigations (e.g. Coroner, CAAS, Police)

AAIB Manpower

- **Present strength –
8 investigators + 2 support staff**
- **Long term plan (2020) -
14 investigators + 4 support staff**

Part-time Investigators

- **12 volunteers (specialists in their own field) to help investigate specialised areas - from other government agencies, research agencies, universities, aero-medical community**

Investigation Cooperation

- MOUs with **Australia** ATSB, **Brunei** DCA, **Cambodia** SSCA, **Canada** TSB, **China** CAAC, **France** BEA, **Germany** BFU, **Japan** JTSB, **Korea** ARAIB, **Qatar** CAA, **Russia** Interstate Aviation Committee (MAK), **UK** AAIB, **US** NTSB
- **ASEAN** regional MOU
- MOU covers:
 - Assistance - manpower / equipment / facilities
 - Training
 - Observer attachment

Investigation Training

- ✈ **Basic investigation techniques course (SAA)**
- ✈ **Investigation management training (SAA)**
- ✈ **In-house orientation/on-the-job training**
- ✈ **Training in advanced / specialised areas (SAA, ATSB, NTSB, SCSi, USC, Cranfield)**
- ✈ **Training in handling the media/NOK**
- ✈ **Seminar / Conference attendance**

Investigation Training (Cont'd)

- ✈ **Review of foreign investigation reports and safety information**
- ✈ **Crash exercises**
- ✈ **Investigation exercises**
- ✈ **Attachments to foreign investigations**

Observer Attachments for Experience



BA B777, Heathrow, 17 Jan 08



XL Airways A320, Perpignan, 27 Nov 08



Adam Air B737, 1 Jan 07



PMT Air AN-24
25 Jun 07



UPS DC-8, Philadelphia
7 Feb 06



Garuda B737, Yogyakarta
7 Mar 07

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Events hosted by AAIB

- **Chief Aircraft Accident investigators Programme, 2007**
- **ISASI Annual Seminar, 2007**
- **ICAO Asia Pacific Regional Accident Investigation Workshop, 2008**
- **Informal Meeting of ASEAN Chief Aircraft Accident Investigators and Senior Investigation Officials (incl. dialogue session with ECAC investigators), 2008**
- **APEC Capacity Building Workshop on Air Accident Investigation, 2010**
- **International Accident Investigation Forum, 2010**

Coming Events in 2011

- **AAIB Workshop on Underwater Search of Flight Recorders, 20 – 21 July**
 - 1 day sharing of experience
 - 1 day of sea search exercise
- **ICAO Asia Pacific Regional Accident Investigation Workshop, 27 - 30 September**
 - incl. basic and advanced flight recorders training



Planning for Sea Search and Recovery Operations - A Small Investigation Agency's Perspective

David Lim

Senior Investigator

Air Accident Investigation Bureau Singapore

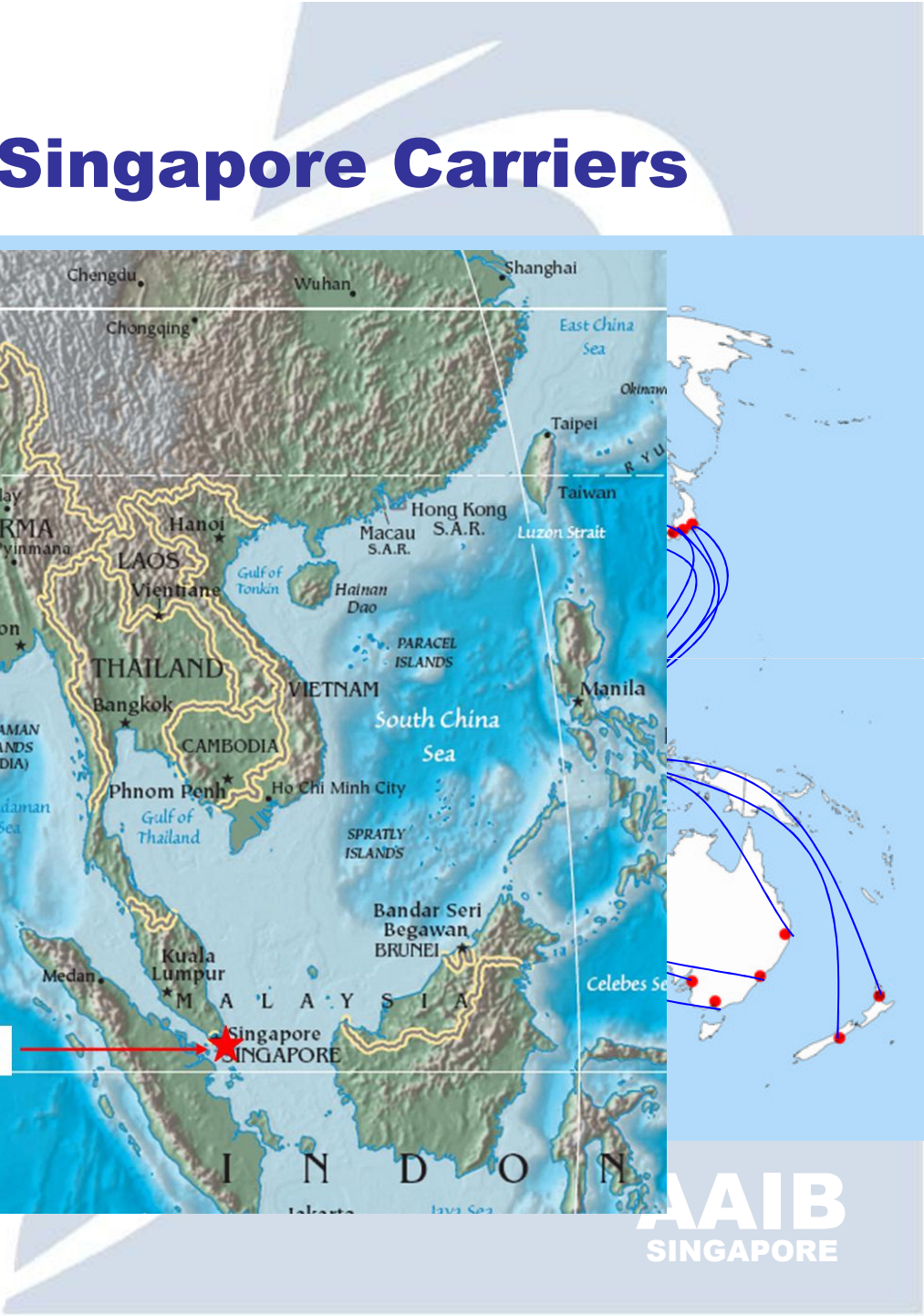
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Outline

- ✈ Introduction
- ✈ Singapore's experience in sea accident investigation
- ✈ AAIB Task Force
- ✈ AAIB's Sea Search Deployment Plan
- ✈ Coordination
- ✈ Resources
- ✈ Sea Search Exercise
- ✈ Recent ICAO Annex amendment proposal

Singapore Carriers

A map of Southeast Asia and surrounding regions, including China, Taiwan, and the Philippines. The map highlights Singapore as a central hub, with a red star and a red arrow pointing to it from the left. Blue curved lines represent flight routes originating from Singapore and connecting to various cities in the region, including Bangkok, Kuala Lumpur, Medan, Hong Kong, Macau, Shanghai, Taipei, and Manila. The map also shows major bodies of water like the East China Sea, South China Sea, and Gulf of Thailand, as well as islands like Taiwan and Luzon.



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Air France Flight 447

- ✈ Are we able to direct and manage a search and recovery operation for an aircraft that has crashed into a deep ocean far away from Singapore?
- ✈ Do we have enough investigators to be deployed in the high seas for a search and recovery operation?
- ✈ Are our investigators able to survive working in high seas for an extended period?
- ✈ Will we be able to muster the necessary manpower and equipment resources to conduct a sea search and recovery operation?



Earlier sea accident investigation experience

SilkAir MI185 on 19 Dec 97 (1/3)

- ✈ Indonesia NTSC led the investigation
- ✈ Strong tidal currents and murky waters made the search challenging
- ✈ Wreckages were small and they settled and got buried in the mud at the bottom of the river
- ✈ Visibility underwater was so poor that divers searching for bodies or aircraft parts practically had to do so by touch



SilkAir MI185 on 19 Dec 97 (2/3)

✈ Singapore deployed the following resources:

- 2 naval vessels
- 1 Fokker 50
- 1 Hercules C130
- 2 Super Puma helicopters
- Over 90 divers from Singapore Navy took part

Dredger turns up more debris



The first day of dredging the crash site at the Musi River produced more than 100 bags of debris. — Picture by TAN LAI HOCK of Lianhe Zaobao.

SilkAir MI185 on 19 Dec 97 (3/3)

✈ Lesson Learnt:

- Importance of inter-agency coordination and cooperation
- Importance of having adequate sources of fund to support such operation

AAIB sea search capability enhancement

- ✈ AAIB contacted or visited the following investigation agencies:
 - Canada
 - France
 - Taiwan
 - The United Kingdom
 - The United States
- ✈ AAIB meet salvage companies to understand their investigation capabilities

Adam Air B737 on 1 Jan 07 (1/3)

- ✈ AAIB investigators were invited by NTSC to help search for the Adam Air B737 that had gone missing over Makassar Strait
- ✈ A total of 6 missions were conducted at multiple locations

Baruna Jaya IV



Discussion on search location



Adam Air B737 on 1 Jan 07 (2/3)

- ✈ Listening for the pinger signal (37.5 KHz) was challenging:
 - Exercise was daunting and time consuming due to sea conditions, noise environment, etc.
 - Sea sickness - make it hard for the investigators to concentrate on the task
 - Difficult to control the rubber dingy when currents are strong – affect the accuracy of the location and bearing of the signals which might be recorded



Adam Air B737 on 1 Jan 07 (3/3)

✈ Lessons Learnt:

- The need to have appropriate communication equipment for use in remote areas
- Honing of ULB detection skills





AAIB Task Force on Planning for Underwater Search and Recovery of Recorders

Set up in July 2009

Mission of the Task Force

- ✦ Develop and enhance AAIB's sea search operational capabilities
- ✦ Review the way the AAIB would tackle sea search endeavour in these aspects:
 - Coordination
 - Resources Available
 - Training

Identified Approaches

- ✈ To draw up a deployment plan that can readily be modified to suit the circumstances
- ✈ To strengthen coordination with relevant domestic agencies and organisations to enhance cooperation in the use of their resources and personnel in times of need
- ✈ To acquire all the necessary sea charts
- ✈ To acquire the necessary search equipment (e.g. ULB detector, GPS, compass, triangulation software) and train investigators in their use
- ✈ To enhance the proficiency of Airport Emergency Service's divers in the use of ULB detectors
- ✈ To take part in realistic sea search exercises



Sea Search Deployment Plan

Search and Recovery Team (SRT)
Investigation Support Team (IST)

Search and Recovery Team (SRT)

Sea search team responsible for:

- ✈ Plan and conduct search pattern, review search results and revise search area with either ROV or divers
- ✈ Surveillance, mapping and appraisal of underwater wreckage site
- ✈ Recovery of wreckage from water with support from commercial salvage companies
- ✈ Evaluate search operations and to recommend to IIC when the search effort should be stopped

SRT Manpower/Logistics Structure

SRT be lead by AAIB investigators and consists of the following:

- ✈ MPA hydrographic expert to provide maritime expertise
- ✈ Divers (from Military/Salvage operators) to assist in the search of the pinger signals from the sea surface
- ✈ Airline technical personnel and experts from aircraft and engine manufacturer to assist in wreckage identification
- ✈ Experts from foreign investigation agency to provide technical advise on sea search operations
- ✈ Navy vessel and Air Force RSAF aircraft for extended search of debris

Investigation Support Team (IST)

Operations command centre to provide:

- ✈ Logistics support to SRT
- ✈ Coordination with other agencies (including the agencies of the SAR State)
- ✈ Coordination on victim identification and examinations
- ✈ NOK and media handling
- ✈ Wreckage storage, identification and reconstruction
- ✈ Regular briefing on updates

IST Manpower/Logistics Structure

Apart from AAIB staff, IST will also comprise the following:

- ✈ Pathologists to assist in victim identification
- ✈ MFA staff to assist in getting diplomatic clearance, handling of NOK, etc.
- ✈ MINDEF personnel to coordinate with SRT
- ✈ SAR specialist
- ✈ Accredited Representatives from foreign investigation agencies and their advisers

Coordination

Coordination with relevant domestic agencies and organisations

✈ Singapore CAA / SAR Coordinator



✈ Maritime Port Authority



✈ Military/ Police



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✈ Salvage companies



✈ Tentage Companies



Mobilisation Exercises

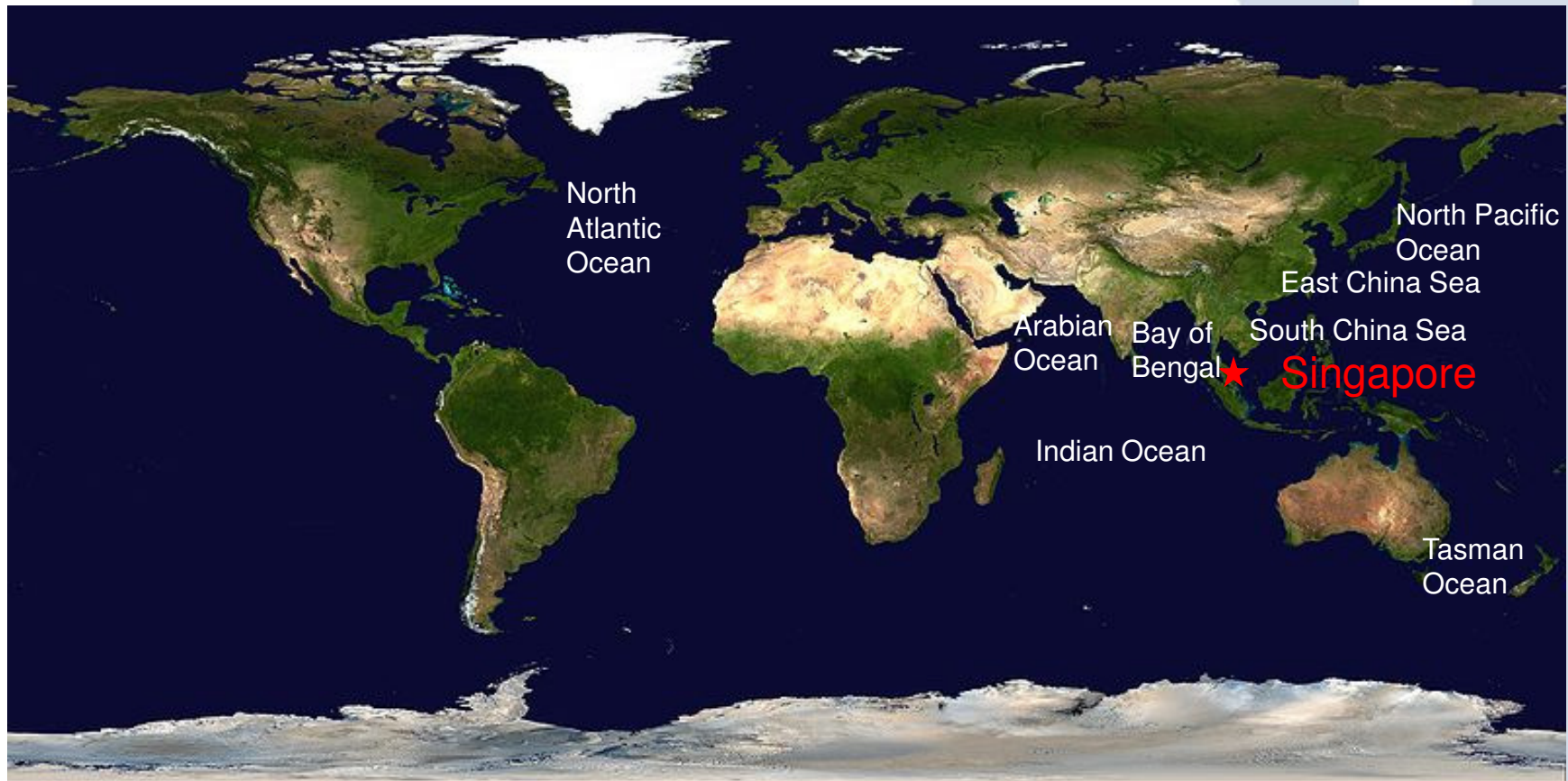
- ✈ To validate the coordination plans that have been devised
- ✈ Two to three exercises are held every year, one of which would correspond to a sea crash scenario
- ✈ 300-400 participants from various agencies



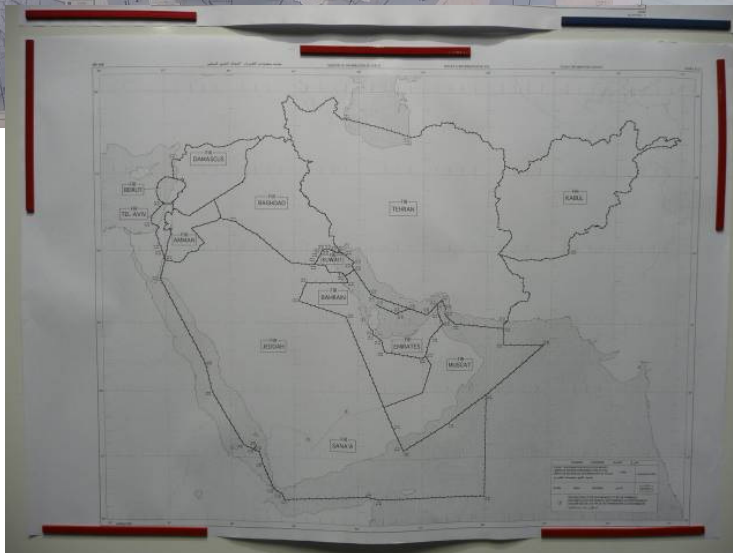


Resources

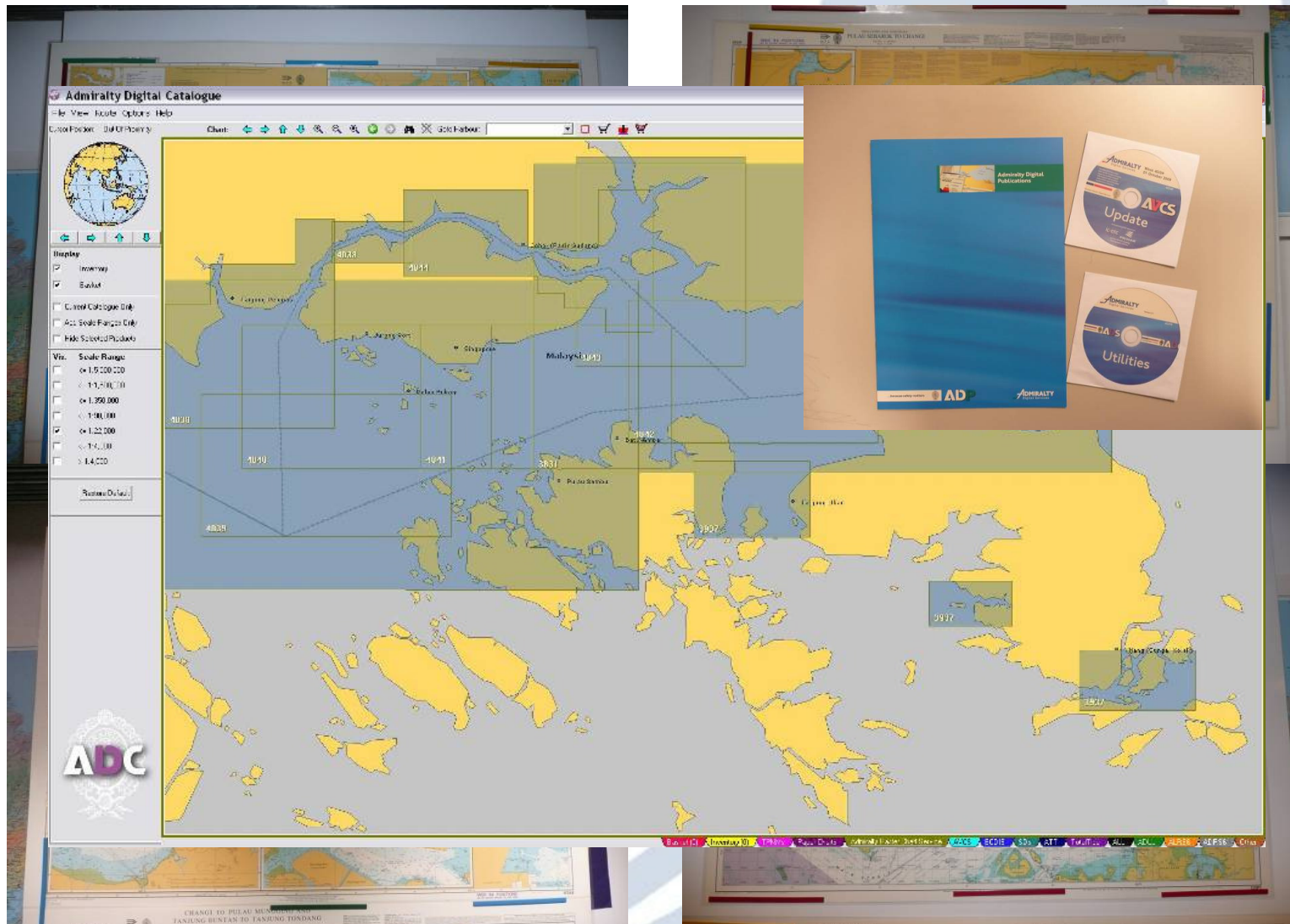
Identified Sea Regions



Flight Information Regions (FIR) Charts



Hydrographic Charts



Database

- ✦ AAIB set up a data system that can provide at least some preliminary information
 - Search and Rescue Authorities
 - State's Investigation Agency
 - Singapore Overseas Mission
 - Salvage Companies' Assets Distribution

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Flight Information Region

Bangkok FIR
Chennai FIR
Colombo FIR
Jakarta FIR
Kolkata FIR
Kuala Lumpur FIR
Male FIR
Melbourne FIR
Mumbai FIR
Yangon FIR
Phnom Penh FIR
Dhaka FIR

Search and Rescue Region

[Thailand SRR](#)
[India SRR](#)
[Colombo SRR](#)
[Indonesia SRR](#)
[India SRR](#)
[Malaysia SRR](#)
[Maldives SRR](#)
[Australia SRR](#)
[India SRR](#)
[Burma SRR](#)

[Bangladesh SRR](#)

[/Pakistan SRR](#) [/Oman SRR](#)

State Investigation Agency

[DCA Thai](#)
[DGCA India](#)
[Colombo Civil Aviation Authority](#)
[NTSC](#)
[DGCA India](#)
[Malaysia DCA](#)
[Maldives Civil Aviation Dept](#)
[ATSB](#)
[DGCA India](#)
[Myanmar DCA](#)

[Maldives Civil Aviation Dept](#)

[Pakistan Civil Aviation Authority](#)

[State Secretariat of Civil Aviation](#)

[Oman DGCAM](#)

Overseas Mission

[Bangkok OM](#)
[Chennai OM](#)
[Colombo OM](#)
[Indonesia OM](#)

[Kuala Lumpur OM](#)

[Rep in Spore](#)

[Canberra OM](#)

[Mumbai OM](#)

[Yangon OM](#)

[Phnom Penh OM](#)

[Dhakar OM](#)

[Oman - Rep in Spore](#)

Geographical Facts of Bay of Bengal

Location South Asia
Countries India, Bangladesh, Myanmar (Burma),
Thailand, Indonesia, Sri Lanka
Max length 2,090 km; c.1,300 mi
Max width 1,610 km; 1,000 mi
Surface area 2,172,000 km²
Average depth 2,600 m ; 8,500 feet
Max depth 4,694 m ; 15,400 feet

Salvage Companies Assets Distribution

[SMIT Salvage](#)

[Svitzer Salvage](#)

Bangladesh

National SAR Agency: Director General, Department of Shipping

Address: 141 - 143, Motijheel C/A (8th Floor), Dhaka 1000, Bangladesh

Tel: +88029656128

Fax: +88029656169

E-mail: dgsc@dgsc.net.bd

The department of Shipping is responsible for coordinating Search and Rescue operations. Coast Radio Stations maintain a continuous listening watch on international distress frequencies

	Telephone +880	Fax +880	Others
CAAB HQ (Coastal - Search & Rescue SPOC)	2 891125 2 894705/6/7/8	2 893322	AFTN: VGHQYX VGHQYAYS
MRCC DHAKA	2 407643 2 405434		

BANGLADESH

Civil Aviation Authority

Flight Safety

Kumtola, Dhaka 1206

Bangladesh

Tel.: (880) 2 891122

Fax: (880) 2 893322

AFTN: VGHQYA

Telex: 632210 CCAAB BJ

Cable: CIVILAIR Dhaka

Overseas Mission

Dhaka, Bangladesh

Consulate of the Republic of Singapore - Bangladesh (Dhaka)

Consul Mr. TAN Kok Nam

House No. 15, Road No. 68/A

Gulshan-2, Dhaka 1212

Bangladesh

Email address:

singcon_dha@sgmfa.gov.sg

Telephone 001-880-(2) 988-0404, 988-0337

Telex 001-880-(2) 988-3656 (General Fax)

Other Information Emergency Contact: 001-880-(181) 941-2824, 001-880-(181) 956-7136



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SMIT Salvage Offices (<http://www.smit.com/sitefactor/page.asp?pageID=1097>)



Cape Town, South Africa
 Smit Amanda Marine (Pty) Ltd
 31 Carlisle Street
 Paarden Eiland, 7405
 South Africa
 P.O. Box 1339
 Cape Town, 8000
 Phone: +27 21 507 5777
 Fax: +27 21 507 5885
 E-mail: smitamanda.cpt@smit.com
www.smit.com/smitamandamarine

SMIT Terminals
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 Fax: +27 21 507 5885
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SMIT Transport

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 Cape Town
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 Cape Town, 8000
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 Contact person: Paul MacLons, Managing Director
 Phone: +27 21 507 5777
 Fax: +27 21 507 5885
 E-mail: p.maclons@smit.com
www.smit.com/smitamandamarine

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 Cape Town, 8000
 South Africa
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 Fax: +27 21 507 5885
 E-mail: terminals.africa@smit.com

SMIT Amanda Marine (Pty) Ltd
 18 Kobe Road
 Durban
 P.O. Box 21860
 Bluff, 4036
 South Africa
 Phone: +27 31 2741100
 Fax: +27 31 2061606
 E-mail: smitamanda.durban@smit.com
www.smit.com/smitamandamarine

SMIT India Marine Services
 Sapt Building, 2nd floor
 18, J.N. Heredia Marg, Ballard Estate
 Mumbai - 4000 001
 India
 Contact person: Shrikant Kejriwal
 Tel: +91 22 2261 2687
 Fax: +91 99676 24154
 E-mail: s.kejriwal@smit.com

Singapore
 Keppel Smit Towage Private Limited (Associated Companies)
 23 Gul Road
 Singapore 629356
 Phone: +65 66684222 / 68989222
 Fax: +65 66684333 / 68989333
 Telex: RS 23456 SALVORS
 E-mail: kst@keppelsmit.com.sg

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 E-mail: company.singapore@smit.com

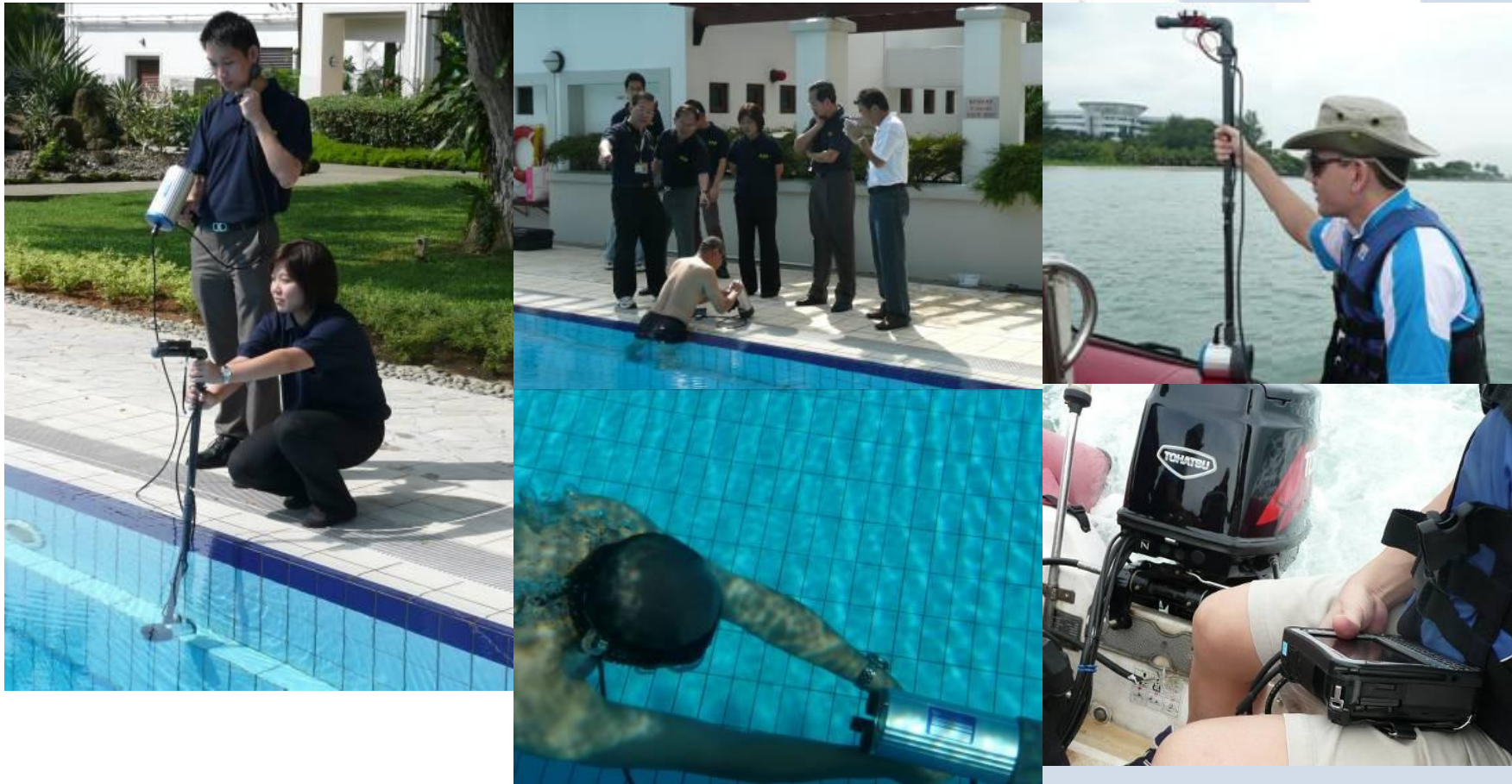
Asian Lift Pte Ltd (Associated Companies)

Acquisition of search equipment

- ✦ Basic equipment needed for search operation, as part of its effort to enhance its investigation capability



Training AAIIB investigators in the use of ULB detectors



Training of divers in the use of ULB detectors





Sea Search Exercise

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Importance of Sea Search Exercise

- ✈ Need to gain practical experience in the mobilisation and organisation of a sea search operation
- ✈ To appreciate the tasks involved in sea search operation
- ✈ Enable AAIB's investigators to learn more about sea search and recovery of wreckage
- ✈ To tap others' expertise and experience

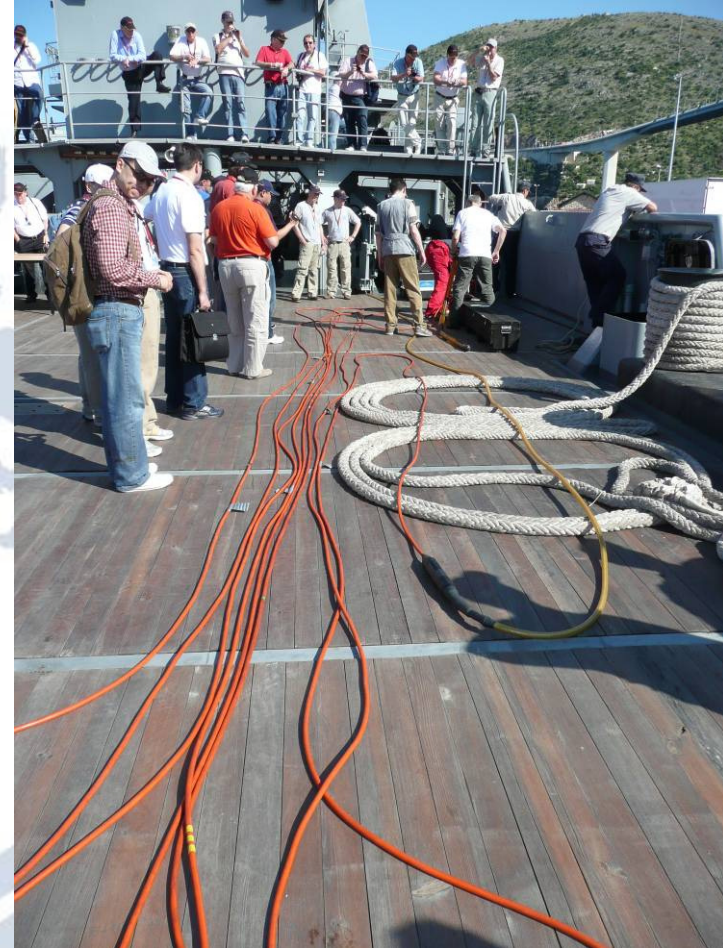
ECAC Workshop on Underwater Search of Flight Recorders

Dubrovnik, Croatia, Jun 09



ECAC Workshop on Underwater Search of Flight Recorders

Dubrovnik, Croatia, Jun 09



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CAAC exercise, Guangzhou, China.

Oct 09



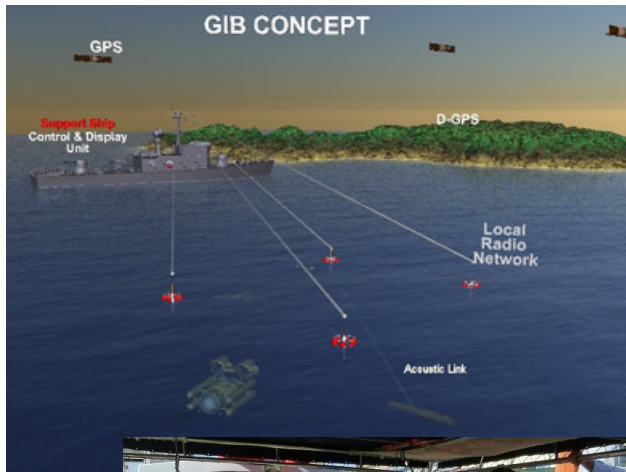
ASC Underwater Recovery of Flight Recorders Exercise

Taiwan, May 10



ECAC Workshop on Underwater Search of Flight Recorders

Larnaka, Cyprus, Oct 10



Cost Involved

Search and Rescue costs (approx) :

80 million €

Underwater search budget (approx) :

23 million €

(BEA / Airbus / Air France)



Lesson Learnt from Exercises (1/2)

- ✈ To work out an initial plan beforehand, and have a checklist to aid in planning a sea search. Although not all accidents are similar, the checklist will serve as a base line for the development of a better plan that would suit the situation.
- ✈ To plan for contingency funding and be prepared for a lengthy sea operation.
- ✈ To train investigators in ULB detection in different water conditions and environment (open sea, lake, swamp, salinity, etc) as these can compound the difficulties for the pinger signal detection.

Lesson Learnt from Exercises (2/2)

- ✈ To tie the hydrophone part of the ULB detector to a structure on the boat with a string. This will prevent losing the hydrophone in the event that the staff holding the hydrophone is broken by the strong sea current.
- ✈ To be prepared for motion sickness and not to drink or eat too much before going out to sea
- ✈ Latest technology can assist in the search operation, these technology was require additional funding and may be costly for any lengthy sea operations.



Conclusion

Moving forward

- ✈ Intra-agency coordination and cooperation framework within Singapore
- ✈ Continue to learn from other air accident investigation agencies that have vast experience in underwater search and recovery of aircraft wreckage and flight recorders experience.
- ✈ More regional cooperation and interaction in sea search planning and operation
- ✈ Possible joint organisation of sea search exercises for flight recorders



Thank You

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