

An Assessment of the Increasing Risk of Marine Oil Spills and the Existing Preparedness Capabilities in the Southeast Asian Region

Geeva Varghese
Senior Consultant
Oil Spill Response Limited

ABSTRACT 300143:

A rapidly growing economy has pushed the energy demands and has significantly increased the exploration and production activities as well as the shipping traffic over recent years in the Southeast Asian Region. Since the introduction of offshore exploration and production in the 1960's, Southeast Asia has gone through a remarkable transition from an onshore to an offshore focused region with more than 80% of oil production coming from offshore fields in 2011. Also the region has recently moved into deepwater exploration and production activities which now makes up more than 10% of the offshore production. With the rising production volumes, the transport of oil products has continuously increased both in volume and in number of ships used. This trend is expected to grow further with the investment in new refinery capacity of several Southeast Asian countries. All these factors have significantly contributed to the increased risk of marine spill incidents in the region.

An increased risk of oil spills necessitates an increase in the capability to respond and manage major oil spill incidents. Even though the Southeast Asian region has made some notable progress over the past few decades in terms of oil spill preparedness and response, the region's capabilities are arguably less mature compared to other parts of the world. Most of the countries in the region have been successful in establishing the elements of preparedness advocated by the OPRC (International Convention on Oil Pollution Preparedness Response and Cooperation) convention. But recent spill incidents and preparedness work in the region have revealed a need for greater collaboration between the government and industry stakeholders from oil, shipping and port industries, planning and preparing of major trans-boundary oil spill incidents and alignment of oil spill preparedness and response system of a country from the national to provincial level.

This paper examines the increasing risks of oil spills from the growing vessel traffic and exploration and production activities in Southeast Asia against the current level of preparedness in the region. In doing so, the author will share the experience gained from working on various oil spill response planning and preparedness projects with the Governments and industry in the region with lessons learned, current developments and recommendation for improvements.

INTRODUCTION:

The term "Southeast Asia" is used to describe the sub-region of Asia, consisting of the countries that are geographically south of China, east of India, west of Guinea and north of Australia. Although the definitions are found to vary slightly, most definitions include the area represented by about 11 countries including Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand Vietnam, Laos and East Timor. And the seas of

Southeast Asia include the South China Sea (SCS), the Gulf of Thailand, the Indonesian Sea and the Sulu-Celebes Sea.

Figure 1 shows the maritime geography of Southeast Asia with its major shipping routes. It is clearly evident that Southeast Asia is a distinctively maritime region. The sea dominates Southeast Asia, covering roughly 80 percent of its area. All the regional countries have extensive maritime interests as these seas serve as major arteries of communication and commerce with the rest of the world as well as other countries in the region. It is estimated that today more than half of the world's annual merchant tonnage traverses through the Southeast Asian seas. The seas are also an excellent source of revenue to the regional countries through fisheries, hydrocarbon extraction and tourism. In fact, close to 60 percent of Southeast Asian population live in or rely economically on the maritime zones.



Figure 1 The Countries of Southeast Asian Region with Major Shipping Routes

The region is also famous for its rich marine environment. The waters of Southeast Asian seas are recorded to have the highest levels of marine life diversity for the world's marine ecosystem. The region is home to the Coral Triangle, a roughly triangular area of tropical marine waters of Indonesia, Malaysia, Papua New Guinea, Philippines and Timor Leste, which is one of the most important centres of marine biodiversity. These waters are home to at least 500 known species of corals (around 75% of the known global total) and at least 2500 known species of reef fishes (around 40% of the known global total). The rich biological reserves of these waters are estimated to support the subsistence and sustain the lives of over 120 million people. Table 1 provides an indication of the region's rich marine diversity compared to few other key marine environments of the world. In addition to the rich

marine ecosystem, the region also has a number of designated UNESCO World Heritage Sites, Ramsar sites, stretches of mangrove ecosystem and other sensitive habitats along the coastlines.

Table 1 Biodiversity in Southeast Asian Seas

	Marine Fish Species Diversity	Hard Coral Species Diversity
Southeast Asia	2,500	400-500
Great Barrier Reef	1,500	395
Caribbean	500-600	100-200

(Source PEMSEA, 2001)

The rich and diverse maritime resources of the region are facing some serious environmental concerns and challenges as the pace of development accelerates and the populations continue to expand in the region. The Southeast Asian countries have averaged an economic growth rate of more than five percent per year over the past decade. Evidently, the growing economy has pushed the energy demands (Figure 2) and has significantly increased the exploration and production activities as well as the shipping traffic over recent years in the region. This paper takes a closer look at the growing risk of marine oil spills from the increasing exploration and production activities and shipping traffic in the region. The emphasis is on the increasing risk of oil spills against the current levels of preparedness in the region.

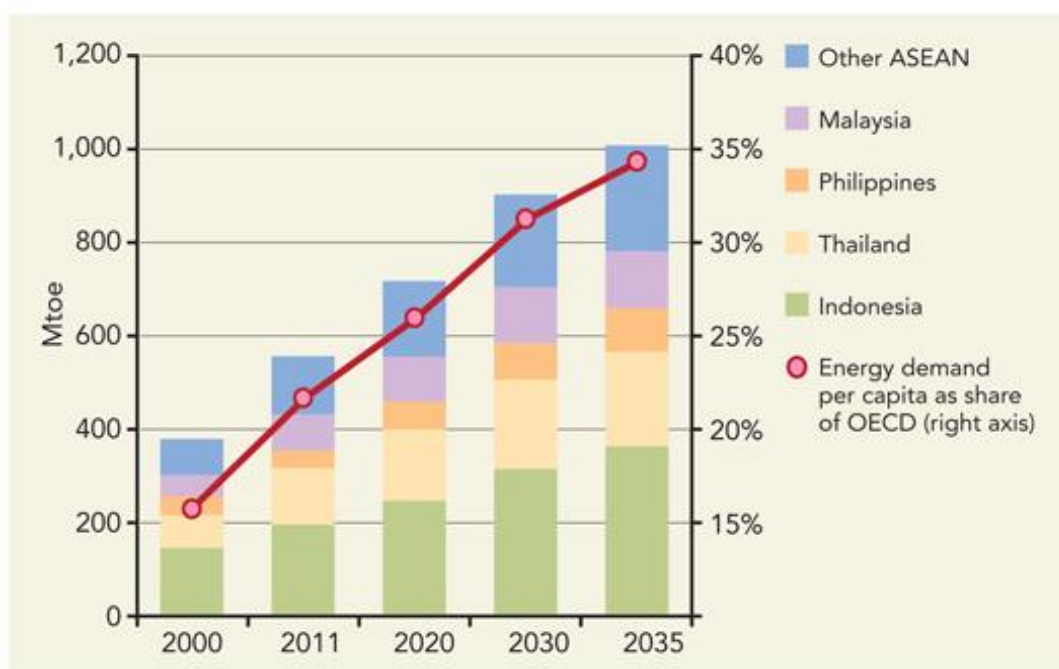


Figure 2 Growth in ASEAN Primary Energy Demand (Source IEA, 2013)

SOUTHEAST ASIA – EXPLORATION, PRODUCTION, STORAGE and PROCESSING:

Oil and gas exploration and production activities play a critical role in Southeast Asia's economic and social development. The region has been engaged in oil and gas production since early 1900's. While a primarily onshore focused region in the beginnings, offshore exploration and production was introduced in the 60s. In 1965, the offshore represented just 2% of total production, rising to 50% by 1985 and by 2011 more than 80% of oil and gas production came from offshore fields. Currently, many of the basins within the Southeast Asia region, both onshore and offshore, are considered to be relatively mature. Based on IEA analysis, at the end of 2012, Southeast Asia had 12.9 billion barrels in proven oil reserves accounting for 0.8% of the world total. In 2012, Southeast Asia's oil production was 2.5mb/d with Indonesia being the primary contributor (36%), followed by Malaysia (27%).

Table 2 Oil Production by Country (kb/d)

	1990	2012
Brunei	152	140
Indonesia	1539	889
Malaysia	635	674
Philippines	5	34
Thailand	54	393
Vietnam	52	356
Rest of ASEAN	15	17

Note: kb/d = thousand barrels per day (Source: IEA, 2013)

Despite each country's petroleum industry being in variable stages of maturity, indicating a broader theme of declining productions, countries in the region have started focusing on a number of alternatives to counter the trend. These include conducting exploration activities in deeper waters, investment in enhanced oil recovery (EOR) projects and the development of marginal fields.

With the advancement in technologies the region has moved to deepwater production in the recent years. Discovery potential still exists within deeper waters where there has been relatively little exploration to date. For deeper waters, the prospect for oil and gas discoveries mainly exist within the regions of Indian Ocean west of India, parts of South China Sea adjacent to the Pacific Ocean and small localized basins north and east of Borneo. Significant discoveries in the recent past for the region include the offshore Sabah region for Malaysia.

The key discoveries during the period 2002-2005 have led to three large projects presently under development: the Kikeh field, the Gumusut-Kakap field and the Malikai field. Also, with new incentives being released by the governments in the region (e.g. Malaysia, Indonesia) to attract investments for exploration and production in deepwater, these activities are expected to grow more in the coming years.

Also as the energy consumption increase with the economic growth many countries are seeing a surge in the number of oil and gases projects over the recent years (Table 3). For example, Indonesia's total primary energy consumption grew by over 50% between 2001 and 2010 and recent reports from Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas) indicates that 13 oil and gas projects are planned to produce in 2014 with a number of additional development plans currently under review for approvals. Another two countries that is expected to contribute to the Southeast Asia's exploration and production scene are Myanmar and Cambodia. Myanmar till now is relatively under-explored due to economic sanctions imposed by the United States and EU. With the changing political landscape, the country's oil sector is also expected to grow. For Cambodia, while the country has been granting oil and gas concession for sometime, the exploration is only just starting and may hold the potential for additional oil output.

Table 3 Southeast Asia Conventional Drilling Activity

Year	Onshore	Offshore
2007	101	143
2008	100	108
2009	112	108
2010	102	128
2011	116	117
2012	91	142

(Source: Deloitte Petroleum Services Group)

The increasing demand for hydrocarbons in the region translates to development of the downstream infrastructure (export, terminals, refineries etc) as well. Southeast Asia is seeing a new wave of investment in refining and petrochemical sector with billion dollar projects being planned and commenced in Vietnam, Indonesia, Malaysia and Myanmar. The key example in this regard would be that of Vietnam's. Until now, Vietnam only had one refinery (Dung Quat) to supply the country's demand for oil products. This is expected to change by the Vietnam government's approval and award of EPC contracts for billion-dollar refining and petrochemical complexes. Currently there are five ongoing refinery and petrochemical projects in Vietnam including PTT Nhon Hoi Refinery and Petrochemical Complex, Nghi Son Refinery and Petrochemical (NSRP) complex project, Long Son Petrochemical complex project, Nam Van Phong Refinery and Vung Ro Refinery. And with the investment in new refinery capacity for several Southeast Asian countries, the need for increased marine transport for both import and export of liquid cargo will continue.

Finally with the increase in exploration and production activities offshore, the production volumes are expected to increase leading to more storage requirements (there are close to 20 FPSOs in operation in the Southeast Asian Seas) and marine loading operations become consequently more frequent adding to oil spill risk profile of the region.

SOUTH EAST ASIA – SHIPPING INDUSTRY:

A look at the map of Southeast Asia (Figure 1) clearly indicates the importance of maritime transport to the economies of Asia, specifically the transit through the southern South China Sea, the Java Sea and the Straits of Lombok and Makassar. Many littoral nations of the South China Sea are heavily reliant on maritime transport owing to the lack of well-developed land transport infrastructure. The maritime transport mode is more important to this region than to most regional economies. Most of the region's domestic trade and virtually all coastal and intraregional trades move by sea.

The Straits of Malacca and Singapore is the main shipping channel between Indian Ocean and Pacific Ocean. About one-quarter of the world's traded goods and a quarter of all oil carried by sea passes through the straits annually. Oil is transported mainly from Persian Gulf suppliers to Asian markets such as China, Japan and South Korea. In 2006, an estimated 12 million barrels per day were transported through the straits comprising 14.3 percent of world oil demand. It is estimated that around 26 tankers pass through the Singapore Strait daily.

The straits are likely to even busier in future due to increasing trade flows and energy demands in Asia. The trend of increasing traffic is apparent from traffic data reported via the Malacca Straits Ship Reporting System, or STRAITREP. STRAITREP is a mandatory ship reporting system in the Straits of Malacca and Singapore adopted by the IMO. STRAITREP is aimed at improving the navigational safety in the Straits of Malacca. STRAITREP data from 1999 to 2007 indicate that traffic in the Malacca Straits increased by 61% within the eight year period.

The growth of ports in Southeast Asia reflects the growth of regional trade (Figure3). Seaborne trade and ports have generally grown at a higher rate than regional economies. Container ports in the region now account for an estimated 30 per cent of the world's trans-shipment traffic. According to statistical data published by ISL, the port traffic in Asia have recovered following the 2010 crisis with new record volumes in all major Asian port regions.

Area #1	Year	Goods Loaded				Goods Unloaded				
		Oil		Dry Cargo	Total Goods Loaded	Oil		Dry Cargo	Total Goods Unloaded	
		Crude	Products *3			Crude	Products *3			
Asia Region	Japan & Israel (Developed Market-Economy Countries)	1970	0	0	42	42	170	30	235	436
		1980	0	0	84	84	216	35	362	613
		1990	0	1	82	83	201	82	441	724
		2000	0	4	126	130	215	49	542	807
		2010	0	25	148	173	191	110	480	781
		2012	0	16	164	180	193	125	508	826
	Western Asia (Developing Countries)	1970	589	66	3	658	0	1	13	14
		1980	801	55	12	867	9	5	55	68
		1990	464	75	31	569	16	7	107	130
		2000	855	106	63	1,024	7	9	122	137
		2010	720	153	184	1,057	30	56	344	430
		2012	784	154	220	1,167	24	50	307	477
Southern and Eastern Asia (Developing Countries) *5	1970	35	24	103	161	60	24	86	170	
	1980	96	48	184	329	119	32	236	387	
	1990	111	92	299	502	154	43	443	641	
	2000	76	107	805	988	376	170	1,030	1,577	
	2010	187	186	1,665	2,038	622	277	2,510	3,409	
	2012	121	244	1,845	2,210	693	282	2,944	3,919	
Sub Total : Asia Region	1970	624	90	149	863	251	55	355	920	
	1980	897	102	280	1,280	344	72	653	1,069	
	1990	575	168	412	1,154	371	132	991	1,494	
	2000	931	217	994	2,142	598	228	1,694	2,521	
	2010	907	364	1,997	3,268	843	443	3,334	4,620	
	2012	905	414	2,238	3,557	907	466	3,849	5,222	

Figure 3 World Sea borne trade by Country Groups in million tons
(Source: International Association of Ports and Harbours (IAPH))

RISK PROFILE AND STATE OF PREPAREDNESS IN THE REGION:

Risk is an inherent part of any operations and can be defined as the interaction of hazard and sources to produce consequences with a given likelihood. From an oil spill context, evaluating the risk requires the consideration of two factors namely, the probability of spill occurring (likelihood) and the consequences, as stated by the following equation;

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

The previous sections of this paper have clearly highlighted the increasing vessel traffic and oil and gas exploration and production activities in the Southeast Asian region. While this paper has not tried to establish explicit quantitative relationship between the increase in related activities and the risk of a spill at this point, it can be clearly argued to be a likely factor. Comparing this increased likelihood against the rich marine ecosystems and the economic reliance of the region's countries on its resources, a picture of the potential risk of spills develops.

The Southeast Asian region has had numerous oil spills for the past few decades. The shipping lanes of the region are one of the most used lanes of the world. Tanker incident statistics from ITOPF is a good information source to assess the oil spill risk from vessel traffic in the region. When comparing the number of oil spill incidents for the last decades at a global level an apparent decrease in the number of incidents is evident. Unfortunately the same cannot be stated regarding the Southeast Asian region. A closer look at ITOPF (Figure

4) statistics reveals that the number of incidents has remained approximately the same for the previous two decades for the region. This suggests that there has been no significant decrease in oils spills from tanker traffic in the region.

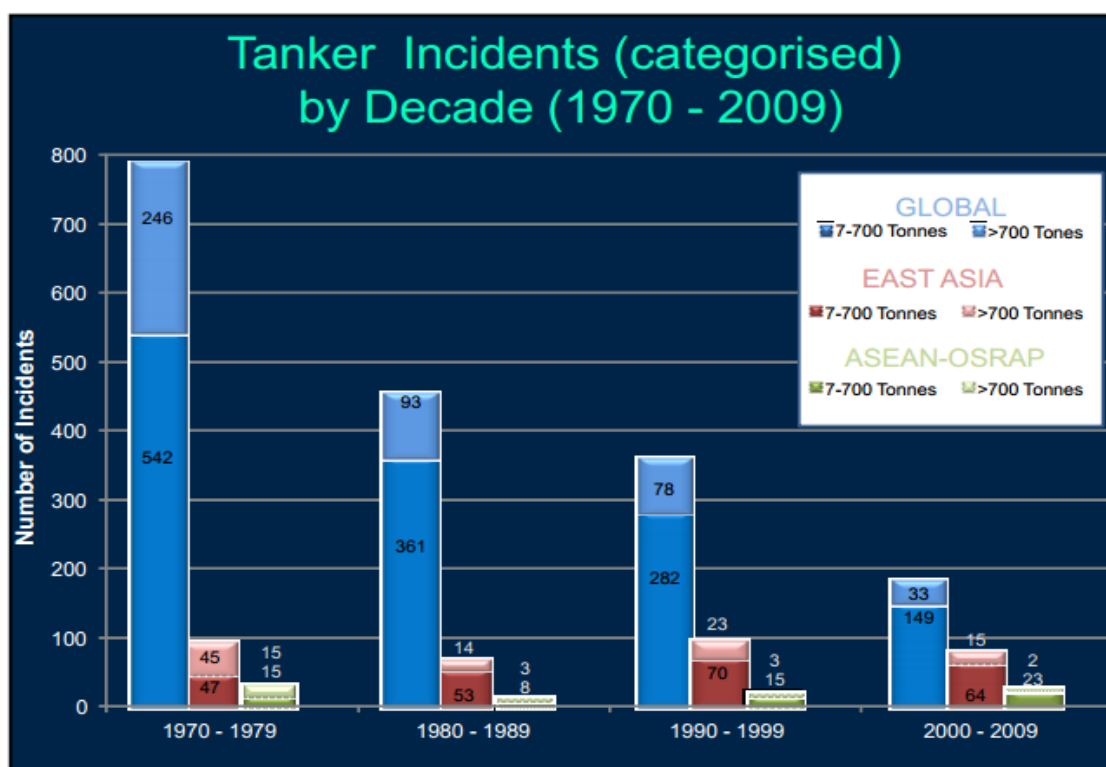


Figure 4 Comparison of Tanker Incident Statistics
(Source: ITOFP)

With regard to statistics on oil spill incidents from offshore oil and gas activities very little to no information is available while investigating public media and industry or research publications. If recent reports are any indication, there seems to be an increase in the incidents lately. A Single Point Mooring (SPM) oil spill incident in Thailand (2013), pipeline spill in Malaysia (2010) and an offshore pipeline leak in Philippines (2013) include the list of some of the most recent oil spill incidents from offshore oil and gas activities in the region. In any case, these spill incidents provide a useful indication in the assessment of oil spill risks from the current activities in the region against the existing levels of preparedness.

The purpose of preparedness is to take early actions that will minimize the impact of a future disaster. In the case of oil spills, the aim of preparedness is to prevent or reduce the adverse environmental and socio-economic impact to the stakeholder community. While the term “preparedness” is widely used, the activities necessary to be well prepared are rarely defined. It can be said that a complementary profile on oil spill preparedness contains information on measures taken to meet the threat of oil spills by the countries in the region concerned. While different preparedness assessment approaches of varying dissimilarity is used globally by different regions and countries, most assessment methods include considering at least four preparedness aspects including 1) National actions 2) Developing baseline Information and establishing scientific support 3) Response capability and 4) Coordinating ability.

National Actions refers to a number of measures including the designation of a competent national authority to deal with marine emergencies, the preparation and adoption on national oil spill contingency plans, participation in regional or multilateral oil spill response agreements and the ratification and implementation of relevant international conventions. The national regulatory frameworks set up by the governments are a critical element to the oil spill preparedness capability development and ensure adequate social and environmental safeguards. In Southeast Asia the observed reality is that this framework can vary dramatically by country depending on the institutional setting and capacity. Some countries framework is established but institutional capacity is lacking. Some countries the framework is still in the early stages of development with few countries not having established national oil spill plans and implementing bodies. With the increasing risk profile for the region, for countries that have not yet developed national oil spill contingency plans there is an urgent need to do so with clearly defined institutional arrangements, roles and responsibilities. Also recommended is the ratification of relevant international conventions such as MARPOL, OPRC 90, CLC 92 and Fund 92 Convention among the countries in the region to strengthen the oil spill preparedness levels. Adoption and implementation of these international conventions have been instrumental for the significant advances in oil spill preparedness and response around the world. Ratification of these international conventions and legislating corresponding national laws and regulations that would allow for their implementation is expected to enhance the region's oil spill preparedness in a similar manner. The table below gives the current status of Southeast Asian countries ratification of IMO's conventions and protocols relating to the coastal and marine environment.

Table 4 Ratification status of IMO Conventions in Southeast Asian Countries

Convention	MARPOL				CLC		FUND			OPRC	Bunker Oil	
	73/78 Annex I/II	Annex III	Annex IV	Annex V	Annex VI	Conv	Prot	Conv	Prot			Prot
						69	92	71	92	03	90	01
Brunei	86					D	02	D	02			
Cambodia	94	94	94	94		94	01		01			
Indonesia	86					78	99	D				
Malaysia	97			97		D	04	95	04		97	08
Myanmar	88											
Philippines	01	01	01	01			97		97			
Singapore	90					D	97		97		99	06
Thailand	07										00	
Timor-Leste												
Vietnam	91						03					

(Source: International Maritime Organization)

Numbers represent year of ratification/accession D – Denounced; Conv - Convention; Prot - Protocol

Establishing baseline information for environmental and socio-economic impact analysis from oil and gas activities and establishing the necessary scientific expertise regionally is another required step towards responsible and accountable policy making in relation to marine oil pollution in Southeast Asia. For marine oil pollution the degree of ecological damage occurring in any given area depends mainly on the kind of oil spilled, the proximity of spill to the shoreline, the configuration of the shore and the weather at the time of the spill. The impact on biota of the inter-tidal zone and reef flats to oil pollution is suspected to be greater than any other marine estuarine community. This is of particular concern in Southeast Asia owing to the economic importance of the biological resources of this zone to the subsistence communities. Currently there is a lack of availability of information on the level of petroleum hydrocarbon pollutants present in the coastal waters and baseline information on unpolluted ecosystems. This lack of comprehensive knowledge and information coupled with the fragment nature of data that do exist makes it difficult to know what exactly to plan for. Also, the lack of baseline information makes it practically impossible to establish and demonstrate the environmental and socio-economic impacts from marine oil pollution making it harder to define any damages and obtain compensation from polluters in the event of an incident.

Also within the Southeast Asian region, the transnational aspects of marine environment and pollutants, the similarity of ecosystems and insufficient research and expertise indicate a need for regional cooperation. It is also urgent to standardize the analytical methods used in marine pollution research and monitoring within the region and to adapt to the tropical context of Southeast Asia. Identifying priority areas and resources for protection through detailed oil spill risk assessments supported by spill trajectory modelling and predictions and establishing sensitivity maps are some recommended actions for the region. Equally important are programmes to upgrade the skills of the existing manpower in the region and train more people to conduct research and monitoring, develop regional scientific support and expertise and coordinate the exchange of scientific data which will lead to responsible and accountable policy formulation to control marine pollution for the region.

As risk assessments are completed and baseline information for analysing the environmental and socio-economic impact ascertained, the response capability for the region commensurate with the risk profile needs to be established. For the purpose of this paper, response capability is defined as the capacity to carry out on-water response and shoreline clean-up operations and the associated issues that may supplement or impede these operations. The most common approach to address oil spill risk and develop response capability is the Tiered Response approach. The Tiered Response Concept was first developed by the oil industry in the 1980's as a mean to ensure that appropriate response capabilities were available to deal with oil spills. Since then this has been recognized by the industry and government as international best practice. The designing of appropriate response capability under the tiered response approach starts with the risk assessment which will allow countries to define the boundaries between tiers and identify the required resources for each tier levels. In addition to establishing required resources, countries also have to implement necessary regulatory framework and policies that will supplement the use of these resources effectively in the event of a response. Of particular concern to the region are the policies concerning the use of dispersants as a response option in the event of an oil spill. Compared to other regions globally, there is a pronounced lack of planning regarding the use of dispersants as a response option and/or inconsistencies in the approach towards the use. Majority of the countries' policy lists mechanical recovery as the preferred option and the use of dispersants as the last resort. This is an impeding factor as successful dispersant operation

requires a timely response. Examples of national policy becoming an impeding factor are not the case for dispersants alone. In the author's recent experience while conducting a capability assessment workshop for a major oil company in the region, the significance of monitoring oil spills in the event of an incident was discussed. While assessing the resources available to carry out this option, it was pointed out that no helicopter or aircrafts were available for this purpose. The reason for this particular predicament, as explained by the representatives from the government who attended the workshop was that all the aerial operations in country are controlled by the military due to national security reasons and most of the areas are designated no fly zones. These instances points out the need of well crafted policies to supplement response capability and efficiency. Another important point to mention with regards to developing response capability is that the intention is not the proliferation of expensive and rarely used resources into every country; rather a tier based approach that will define and establish a minimum response capability with provisions to call upon and integrate more resources from other countries in the region in the event of large scale incidents.

Once the required in-country response capability is established, countries should focus on establishing appropriate mechanisms in the region to facilitate the transport and movement of equipment and personnel across international borders in the event of large scale incidents. These mechanisms can be in the form of regional bi/tri/multilateral agreements and plans between countries detailing processes and protocols to expedite the movement of resources and personnel across borders. Currently there exists regional agreements such as Sulawesi Sea Oil Spill Network Response Plan (1980, Indonesia, Malaysia and Philippines), The Brunei Bay Oil Spill Contingency Plan (1994, Malaysia and Brunei), The ASEAN Oil Spill Response Action Plan (1993, Singapore, Malaysia, Brunei, Indonesia, Philippines and Thailand) and the Joint Statement on Partnerships in Oil Spill Preparedness and Response in the Gulf of Thailand (GOT) (2006, Thailand, Cambodia and Vietnam). All of these regional plans (the list is not exhaustive) provide a basic framework that promotes cooperation and mutual assistance among countries in the region. However, currently these plans/arrangements lack detailed procedures or mechanisms that will facilitate effective trans-boundary movement of personnel or equipment. Including detailed information such as authorities to be notified, immigrations and customs requirements and necessary document to expedite the processes would be a recommended action for this problem. Also, as the Hebei Spirit incident (South Korea, 2007), which tested the NOWPAP Regional Contingency Plan, has demonstrated, conducting regular communication and tabletop exercises and organizing joint operational exercises with neighbouring countries are critical factors for the successful implementation of the regional agreements/plans in the event of any actual incident.

CONCLUSION:

With the increase in vessel traffic and oil and gas exploration and production activities the oil spill risk profile for the Southeast Asian region is changing. This paper has highlighted the increasing risk of oil spills in the region against the existing preparedness levels. Although an encouraging beginning has been made during the past decade towards tackling problems posed by marine oil spill pollution, much remains to be done. It is the opportune moment to make the necessary changes as the recent oil spill incidents have managed to capture the governments and policy maker's attention with respect to oil spill preparedness. By addressing the fundamental issues and strengthening the basic blocks of preparedness through a strong advocacy program the preparedness capability in the region can be further strengthened.

GLOSSARY:

ASEAN	Association of South East Asian Nations
CLC 92	International Convention on Civil Liability for Oil Pollution Damage
EPC	Engineering Procurement and Construction
EU	European Union
FPSO	Floating, Production, Storage and Offloading
FUND92	The 1992 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage
IEA	International Energy Agency
IMO	International Maritime Organization
ISL	Institute of Shipping Economics and Logistics
ITOPF	International Tanker Owners Pollution Federation
MARPOL	International Convention for the Prevention of Pollution from Ships
NOWPAP	Northwest Pacific Action Plan
OPRC	The International Convention on Oil Pollution Preparedness Response and Cooperation
UNESCO	United Nations Educational, Scientific and Cultural Organization
PEMSEA	Partnership in Environmental Management for the Seas of East Asia

REFERENCES:

The Nature Conservancy- Coral Triangle Facts, Figures, and Calculations: Part II: Patterns of Biodiversity and Endemism, December 16, 2008

The Nature Conservancy - Delineating the Coral Triangle, its eco-regions and functional seascapes. Report on an expert workshop, held at the Southeast Asia Center for Marine Protected Areas, Bali, Indonesia, (April 30 - May 2, 2003), Version 1.1 (June 2004)

An evolving ecosystem, Oil & Gas Financial, available at <http://www.ogfj.com/articles/print/volume-10/issue-12/features/special-report-singapore/an-evolving-ecosystem.html> (last accessed on 27 December 2013)

ERIA Study Team (2010), 'Current Status of ASEAN Transport Sector' in ASEAN Strategic Transport Plan 2011-2015, Jakarta: ASEAN Secretariat and ERIA, pp.3-1—3-95.

A.L,Brown, G.T., McDonald and R. A.,Hindmarsh, "Environmental Assessment Procedures and Issues in the Pacific Basin – Southeast Asia Region", Environmental Impact Assessment, Griffith University,1991.

Noer, John Halvard "Chokepoints – Maritime Economic Concerns in Southeast Asia", National Defence University, Institute for National Strategic Studies, October 1996.

IMO-UNEP Forum on Regional Arrangements for Cooperation in combating marine pollution incidents – Report, Jointly organized by the International Maritime Organization and the United Nations Environmental Programme, 30 September – 2 October 2002, London, United Kingdom

Johnson, Richard. "Assessment of Risk of Oil Spills from shipping in Southeast Asia" IMO/IPIECA Global Initiative Workshop, Jakarta, March 2013

MERRAC Technical Report No.5. Minimum Level of Preparedness for Response to Oil Spill in the NOWPAP Region, NOWPAP MERRAC, 2009.

International Energy Agency Southeast Asia Energy Outlook – World Energy Outlook Special Report September 2013

Description of STRAITREP, Maritime Port Authority of Singapore, available at [http://www.mpa.gov.sg/sites/port_and_shipping/port/vessel_traffic_information_system\(vtis\)/straitrep/description_of_straitrep.page](http://www.mpa.gov.sg/sites/port_and_shipping/port/vessel_traffic_information_system(vtis)/straitrep/description_of_straitrep.page) (last accessed on 3 December 2013)

Malacca Straits Transits hit all time high in 2013, by Lee Hong Liang, Seatrade Global, 10 February 2014, available at <http://www.seatrade-global.com/news/asia/singapore-handles-higher-box-throughput-in-february.html> (last accessed on 15 February 2014)

GEF/UNDP/IMO Regional Programme on Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) (2001) Environmental strategy for seas of East Asia, Draft Report

IPIECA, 2007, Guide to Tiered Response and Preparedness, Available online at www.ipieca.org

Review of Maritime Transport 2013, United Nations Conference on Trade and Development (UNCTAD/RMT/2013), Available on line at <http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=753> (last accessed on 20 December 2013)