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Appropriate technology for oil spill management in developing nations*

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Abstract: It has been estimated that some 6 million tonnes of crude oil is routinely transported by tankship around the world's oceans on a daily basis. Despite the introduction of stringent operating and safety regimes there remains the possibility of an incident occurring that could threaten the waters and shorelines of countries that are in the vicinity of these routes. Shipboard and international contingency plans assume a level of preparedness which may be limited in some of the countries that lay along these shipping lanes.

Although the probability of significant oil pollution incidents occurring whilst the vessel is on the high seas is minimal, they have occurred, some with considerable impact on the areas concerned.

Whilst the majority of countries have some form of mutual aid and agreements in place and a number have access to equipment stockpiles, there are still a significant number of areas where there is heavy reliance on local resources.

This paper addresses ways in which countries with limited resources can best be prepared for an oil spill and some of the challenges, which this entails.

INTRODUCTION

This paper's title presents an opportunity to review approaches to spill response throughout the world not only as it suggests in developing nations (see [1]).

The following criteria has been proposed for 'appropriate technology' for developing nations:

- Is it acceptable to local people, the users of the technology?;
- Do they/we (or will they/we) use it effectively?;
- Does it make full use of local materials, skills and ingenuity?;
- Does it take into consideration any local factors such as geography and climate that may affect its usefulness?;
- Does it use renewable sources of energy wherever possible, and is it economical in the use of nonrenewable sources of energy?;
- Does it fit in with the local social and cultural environment?;
- Can they/we afford it?;
- Can it be easily understood and repaired?;
- Were local people involved or consulted in its planning. Design, selection and adaptation?;
- Does it represent a labour-saving or cost-saving advance over the existing technologies?;
- Does it provide local employment?;
- Does it help people to gain self-respect, confidence and the ability to make their/our decisions?;
- Does it help people to become more self-reliant and so have more control over their/our own lives?;
- Does it contribute to the long-term development of their/our community?.

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Adapted from: *Outreach* no. 74, 'appropriate technology', UNEP, Kenya [2]

Clearly, these criteria can be applied wherever a spill response is needed. The paper discusses variation in risk and points out that some developing nations have a significant oil spill risk due to passing traffic, but have little or no oil production and thus limited oil spill response infrastructure. Given the typical two to three days needed to arrange international response, there is a need for appreciation of what can be done in the initial response phase. IMO/UNEP provides support to developing nations to develop an appropriate organisation. This response should rely on a realistic appreciation of spill response and on organisation ability and not necessarily on high tech/expensive equipment.

The paper discusses some of the possible techniques available to developing nations.

OIL SPILL RISK ASSESSMENT

A study recently carried out by the International Tanker Owners Pollution Federation [3], found that there was considerable variation in the risk of major oil spills from tanker traffic in the developing nations. Factors contributing to the risks include high traffic density, bad weather conditions and navigational obstacles, these, individually or in any combination could result in a grounding, collision, fire or explosion that could result in a major oil spill. Moller & Santer nominate countries in the Mediterranean and Caribbean as combining high risk with limited response capability. One could add to these:

- South African Coastlines;
- West Coast of India;
- Areas of South-east Asia;
- Areas of South America.

Particularly vulnerable areas are those with no significant oil production and thus little oil spill response infrastructure. In any case even where exploration and production activities in developing countries does occur, there is sometimes little more than a tier 1 capability based on their perceived vulnerability and past experience has shown that maintenance of this equipment does not have a high priority.

REGIONAL RESPONSE

There are a number of national, regional and international response organisations operating around the world, although most of them are area specific. The two most notable exceptions are Oil Spill Response Limited (OSRL) in the United Kingdom and East Asia Response Pty Ltd (EARL) in Singapore. Both these organisations operate transport aircraft and have a 24-h response, however, depending where the incident occurs, it could be 48–72 h before first arrival. This presupposes that the area concerned has an airport and infrastructure able to deal with the amount of heavy equipment required for such operations.

Over the years the International Maritime Organisation (IMO) and the United Nations Environmental Programme have been active in promoting regional agreements, aimed at the developing countries ability to deal with a major marine pollution emergency (Table 1). The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) in general terms requires governments and industry to work together to promote active regional agreements aimed at the developing countries ability to deal with a major marine pollution emergency, through development of its national contingency plan (NCP).

As can be seen from Table 1, almost every region of the world has these arrangements, however, within these regions there are areas that, only have basic requirements providing national focal points and a framework contingency plan. Most of the world is not driven by the requirements of USA's OPA 90 (and perhaps cannot afford it!). The lack of technical and financial support particularly with the developing nations, makes it extremely difficult for them to carry out training and exercise programmes or to acquire adequate stocks of equipment. Even when equipment is made available, lack of technical expertise and other, more pressing priorities can result in less than adequate maintenance and equipment being pressed into other important duties.

Table 1 Regional arrangements

Regional area	Convention/protocol/plan	Member organisations
Wider Caribbean	Convention/protocol/sub-Regional contingency plans (islands)	REMPEITC-Carib, Curacao, Netherlands Antilles
Mediterranean	Convention/protocol	REMPEC-Malta
Persian Gulf/Kuwait action plan area	Convention/protocol	MEMAC-Bahrain
Red Sea/Gulf of Aden	Convention/protocol	Equipment stockpile Djibouti
South-east Pacific	Convention/agreement/ regional contingency plan	Secretariat (CPPS)
West/Central Africa	Convention/protocol	
Eastern Africa/Indian Ocean	Convention/protocol/Indian Ocean subregional plan under consideration	Sub-regional Centre for Indian Ocean islands under consideration
South Pacific	Convention/protocol	Action plan secretariat SPREP
South Asian Seas	Action Plan/Draft regional contingency plan	
East Asian Seas	MOU—OSRAP	UNEP Action plan steering committee COBSEA Sub-regional centre, DAVO, Philippines Coast Guard
North-west Pacific	Action plan/NOWPAP project (UNEP/IMO)	
North Sea	Bonn Agreement Combating Manual serves as regional contingency plan	Technical Committee (OTSOPA)—joint exercises
Baltic Sea	Convention (Annex) Combating Manual serves as regional contingency plan	Combating Committee—joint exercises
Black Sea	Convention/protocol/ regional contingency plan under development	Emergency response working group Emergency response Activity Centre (Varna Bulgaria)

Moller & Santer [3] suggest that there is a 'widespread preoccupation with specialised equipment, it is often forgotten that successful oil spill response is primarily dependent on a realistic attitude and basic organisation. Such commodities are not necessarily in short supply in developing countries and much can be achieved using nonspecialised local resources.' This particularly applies to shoreline cleanup.

In the industrialised countries we tend to think of technology as the mass of 'things' that we have come to associate with our modern life, however, these are the artifacts of technology, not technology itself.

A moments reflection will have us add that knowledge and skills of application are at least, or probably more important than the mere artifacts.

Similarly, appropriate technology is sometimes only associated with developing nations, however, it's principles should be applied world wide. There have however, been instances where developing nations have, from financial necessity, had to differ from the industrial nations in the way they deal with problems.

RESPONSE OPTIONS

In very broad terms the response options open for consideration by the industrialised nations are open sea, near shore and shoreline response. Depending on a variety of factors such as weather, sensitive areas, type of oil, availability of equipment and personnel, it may not be possible to mount any of the accepted cleanup responses within the open sea or near shore zones and even if responses were attempted, accepting their limitations, we are faced with a shoreline cleanup.

On rare occasions it has been known for oil spills to occur in conditions that have taken the oil away from the shore where it has dispersed naturally. In such circumstances the only action required was to carefully monitor the slick to ensure that conditions remained favourable and kept the oil offshore.

Unfortunately, in the majority of cases, oil spills will threaten the shoreline. More often than not the high profile associated with such events compels organisations to be seen to be doing something, even if it is unproductive. Removing the pollutant from the sea and restoring the marine environment to its prespill condition is the optimum course of action, the use of a boom to concentrate the oil coupled with a recovery device to remove it appears to provide the solution. Unfortunately there are a number of drawbacks associated with this response option.

The effectiveness of containment booms designed to reconcentrate the slick is governed by the weather and speed of response, it was estimated that during the Exxon Valdez incident that the slick had spread to cover an area of 12 sq. km in the first 12 h. If sufficient boom was available it would have been logistically impossible to deploy it in the time for it to work. The thickness of the oil in which a recovery device is deployed will govern the performance of the particular unit, assuming that the oil recovered will relate to the claimed 'name plate' recovery capacity, and this is not taking into account adverse weather conditions. So for a developing nation, the prospect of capital intensive containment/recovery equipment which is only effective only under favourable conditions, is not an optimum solution.

One alternative to containment and recovery is to enhance oils tendency to disperse naturally under the influence of wind and sea state by the application of dispersant. The correct application of this material to an oil that is amenable to dispersion will cause the oil to disperse through the upper layers of the water column where it can more rapidly degrade naturally. To work, dispersants have to be applied with appropriate equipment and to avoid adverse impacts should only be applied where there is adequate water volume and exchange to ensure optimum dispersion. The application of dispersants can be from surface vessels such as fishing vessels, tugs or similar vessels of opportunity. This method is slow and as it is very difficult to see oil from such a platform, a lot of effort can be wasted applying dispersant in the wrong place. The alternative is to spray dispersants from aircraft ranging from agricultural aircraft to large cargo aircraft however, be it from vessels or aircraft, adequate direction is essential and best done from a spotting aircraft. Since spraying aircraft may be available (or more readily flown in) and require minimum infrastructure, appropriately sited stockpiles of dispersant and the planning to apply them is a cost effective option.

One other possibility is that of adapting plastics (often used for packaging) to make absorbent booms, snares, pom-pom arrays and the like. These are usually 'off the shelf' items and are quite expensive. They are readily deployed from small craft and most effective for small spills, 'polishing' activities, etc. Their manufacture and stockpiling rather than importing, could be an appropriate use of local labour, also having the added advantage that they would be less likely to suffer from pilferage.

RESPONSE IN DEVELOPING COUNTRIES

The most significant difference is where labour is cheaply available but capital is not. In some instances these solutions can result in a more desirable outcome, e.g. for a sandy beach cleanup, for instance where there is a thin cover of oil the best environmental solution is to remove only a thin layer with minimum sand removal or disturbance from wheeled or tracked vehicles. This also reduces the volume of waste to be transported.

In the industrialised countries, the cost of large numbers of labourers carefully removing the minimum

of material is prohibitive and invariably mechanical plant is used with the consequent possible burying of oil in wheel ruts and multiplication of the waste disposal problem.

The introduction had a list of criteria proposed as appropriate technology. To this list could be added a question asking how interdependent is the technology? Put simply, what else does it need? To illustrate this, consider the use of containment booms. A boom may be part of a containment and recovery system, the system is required to;

- Identify where the thick slick is, which will usually need a spotter aircraft.
- Locate the boom appropriately, which will need hydrographic information, real time communication and boats or other means of deployment.
- Recover the contained oil, which needs a skimmer and its support platform.
- Hold and transport recovered oil, preferably without stopping the skimming operation. This could require a self propelled or towed barge or lighter.
- Unload and dispose of or recycle the oil.

A boom can, of course, be used more simply as a protective barrier or deflector, in which case it only needs anchors, a deployment system and an inspection schedule to ensure it works and continues to work.

Pearce in *New Scientist* just before the 1992 Rio Earth Summit [4], discussed the challenges of technology transfer to the developing nations and reported that the most critical need was:

> 'the training of people in skills and technologies to allow people to creatively adapt, innovate and invent new technologies appropriate to their needs and societies.'

He concluded that:

> '. . .the exchange of ideas between countries at similar stages of development, is a more promising model for successful technology transfer than blindly importing alien Western technologies. Looked at this way, indigenous knowledge is at least as valuable to Third World countries as Western scientific skills. The trick is to marry the two.'

Of course local solutions need testing and experience before being embarked upon. As in all areas of oil spill response, preparedness and planning are the priority issues, in this context ensuring that developing nations have the capacity especially training and organisation, to deal with the response as is appropriate to them. Taking into account local circumstances, as the IMO puts it:

> 'Local environment, social, economic and political considerations must be taken into account to reach a decision that is acceptable at the contaminated area' (from [5]).

The suggestion that there is an 'appropriate technology' for oil spill control in 'developing countries' that should be different from that of other nations presupposes very many factors.

- That developing nations are a homogenous group, they're not, and have variable climates, population distribution, geography, economic base, etc.
- That what works in 'developed' nations is not appropriate elsewhere.
- That the developed nations should nominate what is appropriate technology.

There is a history of imposed solutions in the developing nations which suggests that this is not the case. Each nation, or region, will have vastly variable needs dependent upon their geographic and demographic circumstances. The challenge is there however, to select from the developed world those technologies which are effective, both economically and environmentally and to reject the costly, but often limited value 'hi-tech' white elephants.

Having chosen appropriate technologies they then can be adapted to the needs of the developing nation. In many cases this may mean changing the western preoccupation with labour saving, but capital intensive machinery and replacing it with more effective but labour intensive techniques (as cited earlier, beach cleanup using hand tools is less disruptive than mechanical techniques). In the sheltered mangrove deltas of South-east Asia with their dense populations and littoral, boat based, lifestyle, access and thus possibly cleanup of the areas is much more readily available.

The priority must lie in having people from the developing nations trained and experienced in oil spill response techniques and theory so that this can be translated to local conditions.

Armstrong & James [6] suggest that the provision of grants, donation of equipment, training, provision of internships and work study opportunities by the industrialised nations and multinationals companies, can all be used to assist in this technology transfer.

As in any oil spill response, the key process is the development of an appropriate contingency plan with emphasis on the consultative process with as much input as possible from appropriate sections of a countries' population. This allows their capabilities to be used, and where there are significant areas of equipment/expertise identified as not available, these areas can either be filled or have an alternative strategy developed, taking into account the appropriate technology guidelines. This sort of exercise could also usefully feed back to contingency plans in industrialised nations!

CONCLUSION

Appropriate technology for oil spill management in developing nations relies on a realistic appraisal of the risk involved and the response capability available to the nation. That response capability is provided by the nation's own population and other local resources particularly for the first critical two to three days of a response and may vary from nation to nation.

REFERENCES

1 There are various ways by which we could attempt to define what is a 'developing nation'. We would suggest there is no one answer: one can base it on per capita income, on infrastructure provision, on education standards etc. All of these have some merit when determining why the needs of a developing nation should be different from most West European and North American nations. The World Bank suggests, the use of the term 'developed' and 'developing' is a matter of convenience and subdivide economies so that 'developing' economies are those with low and middle per capita income i.e. low less than $765 p.a. & middle less than $9385 p.a. The World Bank publishes a book titled *World Development Indicators* with 600 indicators for 209 economies. It is supplemented by the World Bank Atlas. *World Development Indicators* (1997) at <http://www.worldbank.org/html/lecdd/wdi/index.html>

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