ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

WASTE RECYCLING FOR SUSTAINABLE DEVELOPMENT – THE CASE OF OBSOLETE OIL AND GAS PRODUCTION STRUCTURES IN ASIA PACIFIC WATERS (COUNTRY PERSPECTIVES)

VOLUME II

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PREFACE

The main part of this four-volume series comprises a set of papers commissioned for two seminars: the Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone held at Bangkok from 6 to 10 February 1989, and the ESCAP/CCOP/LEMIGAS Seminar on the Removal and Disposal of Obsolete Offshore Installations and Structures in the Exclusive Economic Zone and on the Continental Shelf, held at Jakarta from 25 to 28 May 1992. The Seminars were organized jointly by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) and supported by the Government of the Netherlands and the International Institut voor Energierecht, University of Leiden, the Netherlands, as well as the United Nations Development Programme and the Government of Indonesia. Preparation of the manuscript for publication was undertaken under the ESCAP natural resources and energy programmes.

The idea of the seminars (the first of a series of activities planned under the ESCAP marine resources programme), arose as a direct consequence of the realization that the United Nations Convention on the Law of the Sea might have some economic implications for coastal States with mature offshore oil provinces where the status of already existing installations might be affected, and also for coastal States contemplating offshore oil/gas operations in the future, where the economics of such operations might also be affected.

The main problem for both States and the industry appears to be that removal obligations represent a cost to operators and Governments at a time when there are diminished revenues available from declining oil/gas provinces, and are thus considered an unacceptable (sometimes even unanticipated) burden.

The question may be asked: are there any revenue-generating uses of such structures after their useful life for oil and gas extraction?

The answer is a qualified "yes" in some cases, and such applications are described. These, in turn, might mitigate the burden of removal costs of those installations where such uses cannot be found, and strict enforcement of removal guidelines is perhaps warranted.

This collection of papers is not intended as a definitive guide, for while all authors and participants in the Seminars agreed on the existence of problems as identified above, there was really no agreement on solutions, coastal States realizing that they would have to derive policies and a legal framework (national legislation) that would capture their unique circumstances, while being in broad agreement with given guidelines once these become effective under the United Nations Convention on the Law of the Sea regime. The four volumes in the series give an overview (volume I), country perspectives (volume II), industry perspectives (volume III) and, finally, the evolution of an applicable legal framework (volume IV). Only industry seems to have solutions – at a cost.

These volumes are the culmination of a joint effort between the natural resource and energy programmes of ESCAP and the participating institutes and organizations. The series of seminars and this publication would not have been possible without the outstanding cooperation of everyone involved.

The secretariat has attempted to draw some more general conclusions at the end of the first volume.

The present volume is the second in a four-volume series on the subject of offshore oil and gas production structures. The first volume contained analytical studies, while the present volume contains an assessment of actual conditions in each of the countries participating in two seminars organized, in 1989 and 1992, respectively, by ESCAP and several collaborating organizations. The titles of these two seminars are as follows:

Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone (February 1989).

ESCAP/CCOP/LEMIGAS Seminar on the Removal and Disposal of Obsolete Offshore Installations and Structures in the Exclusive Economic Zone and on the Continental Shelf (May 1992).

The subject of what to do with obsolete offshore production facilities has become timely again for two reasons:

(a) A number of these structures will be reaching the end of their economic lifetime in the second half of the 1990s;

(b) The imminent entry into force of the Third United Nations Convention on the Law of the Sea on 16 November 1994 after the deposition of the sixtieth instrument of ratification or accession with the Secretary General on 16 November 1993. In this regard the rights and obligations of States in implementing the provisions of the Convention under Article 60 which relates to installation and disposal of structures in the exclusive economic zone have to be realized by effecting appropriate national legislation.

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OPENING ADDRESS BY SUYITNO PATMOSUKISMO, DIRECTOR GENERAL OF OIL AND GAS, MINISTRY OF MINES AND ENERGY, INDONESIA

It is a great pleasure for me to be here with all of you today, to attend this ESCAP/CCOP Seminar on Removal and Disposal of Obsolete Offshore Installations and Structures in the Exclusive Economic Zone and on the Continental Shelf.

Allow me on this occasion, on behalf of the Government of Indonesia, to welcome participants to this Seminar, particularly those who have come from abroad. Aside from the Seminar, I can assure you that there are many other interesting places to visit in this country.

I would like to convey my appreciation to the organizers of this Seminar for inviting me to share my views with the participants.

In line with the subject of this Seminar, my address today is related to the removal and disposal of offshore installations and structures in Indonesian offshore areas, which I hope will provide some contribution to the deliberations during this Seminar; it will of course, be limited to the Indonesian experience and expectations.

As you may know, Indonesia is an archipelagic country consisting of more than 17,000 islands, with approximately two thirds of the area covered by water and a land area of 2 million square kilometres. Therefore, the natural resources of the offshore area are vital and play a strategic role in the sustainable development of the country.

After 1965, and especially after the introduction of a more pragmatic fiscal policy by the Government, many oil companies were attracted to explore for possible oil accumulation in the offshore areas based on Petroleum Law No. 44/1960, under production sharing arrangements.

Shortly afterwards, in August 1971, the first commercial offshore oil field production came on stream. Currently, almost 30 per cent of the total crude oil production comes from offshore areas. At present there are about 370 offshore platforms located in the Java Sea, offshore Kalimantan, offshore Natuna and in the Straits of Malacca. In the future, it is expected that the greater portion of Indonesia's oil and gas production will come from offshore fields, based on the estimate that two thirds of the hydrocarbon resources are accumulated in the offshore sedimentary basins.

Most of the Indonesian offshore fields are in shallow water and range from 10 to 300 feet. Almost all platforms in Indonesian waters are still producing, with a few exceptions, such as three in Maxus fields and two in PERTAMINA Poleng field. One of the top side structures of these platforms has been removed and relocated on a new jacket at a different location, and the other decks in Maxus fields are in the process of planning to remove and relocate them for other uses, such as for water injection.

As you are probably aware, the removal and disposal of offshore platforms have recently become an international concern and most of the countries are in the preliminary stage of developing regulations and procedures for such removal and disposal.

The general practice is to remove all structural elements after petroleum production has ceased and return these to shore for salvage or scrap. In a few instances, offshore structures have been towed to deep water and dumped or placed in specified locations to serve as artificial reefs to enhance living resources.

In compliance with the 1958 Convention on the Continental Shelf, the current United States regulatory requirements governing fixed offshore structures (offshore platforms) in the outer continental shelf (OCS) stipulate their complete removal to a depth of 15 feet below the sea floor.

The United States Department of Interior is considering changing these rules. Some people argue that the complete removal of OCS platforms is not beneficial to local biological communities. The United States currently has more than 4,000 platforms and the number of platforms to be removed will soon increase dramatically.

In the international arena, the United Nations Convention on the Law of the Sea, which may enter into force, provides for the International Maritime Organization (IMO) to develop new international guidance on such matters as the disposition of offshore platforms. However, the United States and some other industrial countries have not yet ratified that Convention.

Independently, the United States Department of Interior is preparing procedures for the disposal of offshore platforms and will probably prepare a technical basis for their national position for international negotiation.

With regard to the offshore installations, using the reference as outlined in the Geneva Convention of 1958 on the Continental Shelf, Indonesia issued Law No. 1 of 1973 regarding the continental shelf, and Government Regulation No. 17 of 1974 regarding the supervision of oil and natural gas exploration and exploitation activities in offshore areas.

Under a provision in Law No. 1 of 1973, in order to ensure the safety of sea communication and offshore facilities, the Government designated certain areas as "prohibited areas" and "restricted areas", which are prohibited or restricted for general sea traffic and fishery.

In article 21 of Government Regulation No. 17 of 1974, offshore oil and gas mining installations, including abandoned wells which are no longer used, should be demolished entirely within the period as determined by the Director-General of Oil and Gas, properly and ensuring safety to the workers as well as surface and subsurface navigation. With the developments in the United Nations Convention on the Law of the Sea, the aforementioned provisions may have to be reviewed and modified, to ensure optimum utilization of the unused installation. With regard to the removal and disposal of obsolete offshore installations, this has not been clearly stated in the existing production sharing contracts, but the production sharing contractors have been well aware of the consequences involved. Therefore, the existing regulation may have to be reviewed and formulated by the Government, together with other related government agencies, for possible implementation in the future.

Indonesian offshore oil and gas fields will start reaching the end of their economic life in the near future and therefore Indonesia needs to look at the various options available to overcome the potential problems.

The purpose of this Seminar is to exchange views and ideas and to discuss various options to develop unified requirements for the removal and disposal of offshore platforms. This will give us the basis on which to discuss and learn the international rules, which will probably be formulated over the next few years.

Ten or 15 years ago, people did not even think about the necessity of removal and disposal of offshore platforms. Today, they are considering means of removal and disposal at the original design stage of offshore platforms. The future generation of offshore platforms and installations should be designed considering the possibility of removal or reuse in the future, with its related aspects such as economics, ease of transportability, safety and also environmental considerations.

As mentioned earlier, Indonesia has 370 offshore platforms and many other offshore installations, such as floating production storage and offloading facilities, buoys, free standing drill column, temporary mudline suspension, subsea completion template and pipelines. Most of these installations will require to be removed and disposed of. There will be a huge cost associated with this removal, depending upon the method of removal and option of disposal chosen.

There are some of the important aspects to be considered and I hope this Seminar will discuss various aspects of platform removal and disposal such as the technical, economics and financing, legal, environmental and also safety aspects.

The policy for removal and disposal of offshore platforms should take into consideration the cost of removal versus public benefit, liability aspects, safety and freedom of surface and subsurface navigation, possible alternative uses and potential interference with other uses of the sea and the sea floor.

With these brief remarks, allow me to officially open this Seminar. Once again I would like to convey my appreciation to all of you for participating and contributing your valuable time and views to develop unified requirements for the removal, disposal or other possible uses of offshore installations and structures.

REGIONAL OVERVIEW: ABANDONMENT OF OFFSHORE OIL RIGS*

Throughout the 1980s, there has been considerable interest in the problems associated with the abandonment of offshore oil and gas installations in the North Sea and the Gulf of Mexico. However, discussion of these issues in the Asian countries has only just begun, despite the existence of almost 1,000 offshore production structures and the certainty of extensive removals in the 1990s. Concern is now mounting as Governments appreciate that the costs of removal will fall largely upon their shoulders, not least because of the extensive role of the national oil companies in petroleum development. Nor is there much comfort to be sought in the fact that the waters are shallow and the costs of abandonment much less than those in the North Sea. For the developing countries in Asia the resource available to deal with the problem will also be much less than those available to the North Sea States.

Very few countries in the Asian and Pacific region have provisions in their petroleum legislation, or, as far as is known, in their petroleum contracts, specifically aimed at controlling the removal of offshore petroleum installations. The exceptions are Australia and Thailand: in both cases there are detailed systems in place governing removal, although they differ considerably in style and substance. Most other countries have restricted themselves to little more than conventional requirements on well-plugging and good oilfield practice. None the less, the flexibility offered by a contractual framework supported by broad legislative provisions is illustrated by the case of Brunei Darussalam, where a number of abandonments have already taken place, as has an experiment in the use of petroleum structures as artificial reefs.

Existing rules

Of the two countries with a legal regime specifically aimed at dealing with removal, the Australian one reflects the predominance of the private sector, unusual in the region. All operations are conducted by private companies and the Government is restricted to a regulatory/fiscal role. The Petroleum (Submerged Lands) Act 1967 empowers the government authorities to direct the removal or partial removal of installations, but does not specify and standards for removal. It is up to individual producers to make preparations for the meeting of costs, but if a company fails to remove, the relevant authority may authorize such action as is necessary to remove the structure, sell any remaining material, and sue in the courts to recover any remaining costs. Costs are not eligible for tax deduction, except under the Resource Rent Tax and some royalty regimes, but this matter is under review.

Under Thailand's petroleum law, total removal is required and the offshore area has to be restored to its former state "as far as possible". The Minister has to be offered the structure on termination of production. The only company producing petroleum in the Gulf of Thailand is UNOCAL, while the exploration and production arm of the Petroleum Authority of Thailand (PTT), the State-owned petroleum company, is expected to commence production from the 'B' structure in 1990. UNOCAL has 43 structures in a maximum water depth of 70 metres and has made extensive studies of removal techniques and costs, although the first removals are unlikely to occur before 1993-1994. Removal costs are tax deductible.

Among the other Asian States, there is growing interest in finding ways of meeting abandonment costs. In Malaysia, for example, a comprehensive review of removal costs is being conducted by PETRONAS. Currently, there are 167 production structures, mostly in water depths ranging from 10 to 90 metres. While removal costs vary from 2 to 12 million US dollars per installation, the estimated cost of total removal is between 1 and 2 billion US dollars. By comparison, the Norwegian Petroleum Directorate has recently estimated the cost of total removal of 50 installations on or under construction on its continental shelf at US$ 5.8 billion (February

* *Source:* Petroleum Economist, June 1989 (by permission). This paper, by Peter Cameron, International Institute voor Energierecht, University of Leiden, the Netherlands, is based on work performed under an ESCAP contract financed by the Government of the Netherlands.

1989). Even with partial removal, the cost is a daunting US$ 3.5 billion (assuming that steel platforms are toppled *in situ* and concrete platforms are totally removed).

There is no provision in the Malaysian Exclusive Economic Zone Act 1984 for the removal of disused or abandoned platforms. However, section 6 of the Continental Shelf Act 1966 allows the Government to make regulations for the removal of installations located on the continental shelf which have become disused or have been abandoned. No regulations have yet been made but several total removals have already been carried out by Sarawak Shell/PETRONAS. For example, the West Lutong pipeline manifold jacket in 50 feet water depth weighing 200 tons, including decks, was removed at a cost of $M 1.1 million (US$ 0.4 m) and two single-buoy moorings (SBMs) have been removed in offshore Sarawak at a cost of $M 0.7 million (US$ 0.26 m) each.

The results of a recent cost-screening study by PETRONAS on three selected platforms and one SALM indicated that removal costs (exclusive of well abandonment costs) can be reduced by as much as 50 per cent if the topple *in situ* option is used in place of total removal. The topple *in situ* or partial removal options would leave 40-55 metres of clear water depth. The option of using non-explosive cutting techniques was thought likely to reduce costs by as much as US$ 670,000 in each case. In contract discussions, the issue of abandonment has already been addressed. In one recent case, the contractor is responsible for removal and disposal of offshore structures and must contribute 1.5 million Malaysian ringgit (US$ 0.55 m) annually to the cost of removal.

In Indonesia, the 319 light structures are located in shallow water, mostly offshore North Java and East Kalimantan areas that are important for shipping. A rough estimate of US$ 0.5 billion removal costs has been given by PERTAMINA. The production sharing contracts (PSCs) make no specific provision regarding the removal of offshore structures and platforms. Under the PSC system, all structures and installations are the property of PERTAMINA once they are brought into the country. Responsibility for removal seems to lie squarely with PERTAMINA subject to obtaining the approval of the various ministries which have jurisdiction. However, the purpose of the provision transferring ownership is, in the view of Indonesian officials, to provide the contractor with exemption from customs duty on imports and a recovery mechanism for the cost of investing the assets. The implication is that the transfer of ownership is, at least partly, a benefit to the contractor conceded by the Government. One wonders why, if that is the case, the Government did not simply introduce an important tax exemption for the petroleum industry. On the basis of these remarks, it would none the less appear that the issue of responsibility for costs is not so clear-cut as it seems.

Payment of abandonment costs is complicated by the fact that PERTAMINA is the manager of petroleum operations but is not the recipient of petroleum revenues. It has none the less the obligation to render advice to the Government on petroleum operations, including the matter of removal. Currently, it is reviewing the situation in conjunction with other government departments.

Of the 29 offshore platforms which have been installed in China, one has already been removed and another partially removed. A further five platforms are to be abandoned shortly by removal contractors, and the China National Offshore Oil Corporation (CNOOC) intends to remove yet another by itself. The contracts with foreign oil companies contain provisions on abandonment costs; these are to be shared by the parties according to their actual proportion of the field development costs. Since the State petroleum company may participate up to 51 per cent, it is potentially liable for more than half the costs of removal. No removal under this contract regime has yet occurred.

As far as that legislative rules applying to removal offshore are concerned, these are not necessarily of general application. For example, article 11 of the Provisional Regulations of Navigation Administration of Petroleum Exploration and Development Operations within the Offshore Area of the Northern Part of China requires that an abandoned structure be cleared to at least 4 metres below the mud line and that any partially removed structure be marked clearly, under the supervision of the harbour administration. These regulations only apply to the offshore area within 35 degrees northern latitude of China.

In Japan, a reserve fund has been established to assist companies in making provisions for removal

costs. These will be treated as company expenses and are therefore tax deductible.

Rigs to reefs

The question of removal has also been examined in the context of the alternative uses to which disused structures could be put. Given the relatively shallow water in the region (see table), it is not surprising that their utilization as artificial reefs to enhance fishing should be considered.

On 28 August 1988, an experiment was conducted in Brunei Darussalam using two platform jackets to create an artificial reef of 1,500 cubic metres volume in water depth of 5 metres. A site well away from shipping lanes was selected by the Department of Fisheries. The Marine Department's standard procedures for notifying users of the sea of the existence of new objects such as wrecks were adopted. The costs of removal and disposal in this way were slightly cheaper than onshore scrapping, which is the usual way (along with deep-water dumping). Removal of the two jackets, in 123 and 136 feet water depth, was equivalent to one-and-a-half day's operating costs (Br$ 2.22 m/US$ 1.14 m). Once removed, ownership of the structures was transferred to the Fisheries Department, preventing claims being made against the joint venture company, Brunei Shell Petroleum (BSP).

Although there is no removal requirement, it was also not necessary to legislate since oil production is already being carried out by a company which has a government shareholding of 50 per cent and has representatives from the Government on its board. While other companies are prospecting for hydrocarbons, BSP is the only company with production structures at the present time.

The policy aim is to maximize community benefit by dumping structures in spots likely to attract fish for breeding and also permit recreational use of the waters. Experience in the Gulf of Mexico was influential in this choice. Japan too, is currently reviewing the feasibility of artificial reef construction with offshore petroleum structures on a case-by-case basis.

Finally, it may be noted that outside Australia the complex question of more liability in the event of partial removal has made little impact. Will the host Government accept the transfer of legal liability to the State, thus freeing the operator from the risk of claims for damages? This is partly due to the stage of the debate and partly to the fact that where State-owned oil companies hold title to offshore structures, the question does not arise.

Standards required

The basic problem with most of the legal regimes is the absence of any detailed, explicit standards to govern the removal process. The use of existing rules intended for another purpose, such as the prevention of marine pollution (as in Japan), is at the very least a remarkably casual way of addressing a problem that is likely to incur billion dollar costs to Governments in the 1990s.

Asia and the Pacific: Offshore production platforms, selected countries

Country	*Number*	*Water depth*	*Removal costs (estimated)*
Australia	20	> 50 – 125 million	$ A 1 billion
Brunei Darussalam	200	18 – 75 million	US $1.14 million (onshore scrapping) US $1.14 million (rigs to reefs) per platform
China	27	5 – 40 million (Bohai)	n.a.
Indonesia	319	90 million (maximum)	US $500 million
Japan	3	83 – 154 million	US $25 million per platform
Malaysia	167	10 – 90 million	US $1 – 2 billion
Thailand	43	70 million (maximum)	n.a.
Total	779		

Source: ESCAP.

Note: The above estimates represent order of magnitude costs which vary with time, methodology and market forces.

The need for a more assertive response to the problem is becoming apparent, as Asian Governments and State petroleum companies note the steps being taken by Governments in other offshore areas to pay the abandonment bills. More importantly, they are responding to the developments occurring within the framework of the 1982 Convention on the Law of the Sea. As yet unratified, it has none the less a great deal of authority in Asian countries. Unlike earlier international laws of the sea, the Convention was developed with the full participation of the developing countries as independent nation States. Indonesia, for example, played an important part in developing the provisions of the Convention relating to the archipelago problem. Most of the Asian States are already signatories to the Convention. There is, therefore, much interest in its impact upon the issue of removal.

Article 60 paragraph 3, of the Convention permits a form of partial removal subject to ensuring safety of navigation and meeting "any generally accepted international standards established in this regard by the competent international organization". The International Maritime Organization (IMO) has a role in this as the most competent organization to make standards. Its Maritime Safety Committee has developed Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone. After three years of discussion by national representatives, the results will be presented to the IMO General Assembly in 1989 for approval. Several North Sea States are likely to respond quickly by introducing detailed regulations governing removal which incorporate the IMO Guidelines and Standards. In framing a national regime to deal with the problem, Governments will then have the discretion to allow partial removal on a case-by-case basis and in accordance with their obligations in international law. The development of internationally accepted standards for removal under article 60 therefore seems to be reaching the end of its first phase.

The Asian debate

The first attempt to assess the specifically Asian dimension of the removal issue took place early in 1989. The United National Economic and Social Commission for Asia and the Pacific (ESCAP) held an educational seminar on this issue for government officials. After the United Nations role in the development of the 1982 Convention on the Law of the Sea, a number of United Nation agencies have been active in marine affairs, such as IMO and the Food and Agricultural Organization of the United Nations (FAO). On that occasion, representatives of the Governments of eight Asian countries met to share their thoughts and experiences. This is the first time that abandonment has been discussed in a regional forum in the Asian and Pacific region.

The official representatives of Governments and State oil companies came from Australia, Brunei Darussalam, China, Indonesia, Japan, Malaysia and Thailand. They were joined by representatives of IMO, the E and P Forum, seven international oil companies (ARCO, BP, Esso, Mobil, Phillips, Shell and UNOCAL), and several national oil companies such as PERTAMINA, PETRONAS and PTT Thailand (E and P).

During the meeting, the specific features of the Asian context were identified and comparisons drawn with the Gulf of Mexico and the North Sea. The contractual regimes and the large-scale involvement of the Governments, directly or indirectly through their State oil companies, combine to shift the burden of abandonment costs in some cases entirely onto government shoulders. Whereas in Norway the Government faces the prospect of having to pay for 80 per cent of the removal costs under existing law, the form of legal agreement commonly found in countries with PSC systems (for example, Indonesia and Malaysia) appears to shift the entire cost of removal onto one party, the host Government. Under the terms of many existing PSCs, all installations and structures which a contractor brings into the country immediately become the property of the Government. It therefore seems logical to assume that responsibility for removal of those structures is a matter for the Government and not the contractor. Production sharing does not imply problem sharing as far as abandonment is concerned. This is an ironic and entirely unforeseen consequence of the doctrine of permanent sovereignty over natural resources which justified the overthrow of the old concession agreements in these countries.

The Seminar was organized under the ESCAP marine affairs programme and supported by the Government of the Netherlands with technical assistance provided by the International Institute voor Energierecht, University of Leiden, the Netherlands.

Even in countries which retain a modified version of the old concession system, such as Brunei Darussalam and Thailand, ensuring that responsibility for removal lies with the contractor, the host Government ends up having to pay most of the costs, since these are tax deductible. Asian Governments are therefore keen to explore the various forms of partial removal, as well as alternative uses, for abandoned structures. Since environmental issues have a lower priority in that part of the world than in the North, their scope to act to reduce costs is in this respect at least a little wider. In this context the constraints which the emerging IMO Guidelines and Standards would impose upon Government's room for manoeuvre were a source of discussion at the United Nations Seminar.

Flexibility versus constraint

Since the IMO Guidelines and Standards for removal require total removal in cases where structures are located in less than 75 metres water depth and weight less than 4,000 tons, it looks as if the shallow water depth of the Asian offshore areas implies total removal in many cases, albeit at significantly lower costs than in the North Sea, for example. This is not necessarily the case. To promote maximum acceptance, the Guidelines and Standards were designed to be flexible enough to suit areas as diverse as the North Sea and the Java Sea. For example, total removal is not required if there is to be a "new use" of the structure, such as the creation of an artificial reef by toppling the structure, nor if it is technically unfeasible to remove the platforms: in this case the standard could be related to local or national conditions. Nor is it required where extreme costs are entailed: again, this should be viewed relative to country conditions. The costs of developing a marginal field might be increased so much by a total removal requirement that a field might not be developed and that might be seen as constituting an extreme cost, particularly to a Government highly dependent upon revenues, such as Indonesia. Finally, the requirement may be varied if there are unacceptable "risks of injury to personnel". However, this safety aspect has to be weighed against the Government's obligation to take into account the interests of other users of the sea, not only oil company personnel and government employees.

The IMO Guidelines and Standards represent a careful attempt to balance the elements of constraint and flexibility to provide the essential criteria for a universal regime. They are not binding on Governments until incorporated in national legislation. Currently, they leave coastal States with the kind of discretion which the application of national policies on a case-by-case basis requires. This will surely be welcomed by Governments in Asia as well as in other developing countries.

An issue which IMO was not able to cover in the Guidelines and Standards — its competence was doubtful — was disposal of disused installations. It is likely that this matter will be dealt with by the London Dumping Convention under another set of guidelines to be worked out separately.

Conclusion

The potentially large costs of abandonment in the region are now generally appreciated among Asian Governments, as are the current developments in the customary international law on this issue. Three conclusions may be drawn.

First, the wide impacts of abandonment operations mean that the extent of inter-Ministerial cooperation required is considerable. This is as true in the Gulf of Mexico as in the Asian offshore waters. The operations will involve authorities responsible for navigation, fisheries, defence, energy, communications, transport, environment, ports and scientific research. Given the common use of State petroleum companies and the different levels and kinds of State authority, the establishment of channelling mechanisms for responsibility must be a priority.

Second, in developing a policy on abandonment of offshore structures after the necessary consultations, Governments should request the operators to supply them with the information necessary to draw up a removal plan, including data on the various options (total or partial or deferred removal) as well as proposals on alternative uses of abandoned structures.

The third point turns on the contract structures which have evolved over the past two decades. A

basic problem for Governments in Asia is that for the most part they have a form of petroleum agreement which places the oil company in the position of a contractor and the Government in the position of owner of the production structures. On that legal basis it is extremely hard to argue that the contractor has any responsibility to bear the cost of removal. Despite the sensitive investment climate, it seems likely that in the next rounds of contract awards there will be provisions included on this issue, especially in the countries with proven reserves. It remains to be seen, however, whether such remedial actions will be sufficient to deal with an issue of growing economic importance or whether some re-examination of the basic structures is required.

Before action is taken on any of these matters, however, there will be a period of intense discussion between the various government departments and State oil companies. Now that they are better informed about both the potential costs and the international developments, it is in their own interest to address this issue soon and to do so openly, making the responsibility for future abandonment costs a matter free from doubt and ensuring that government policies do not have an adverse impact on adjacent States and other users of the sea. Governments in the Asia and Pacific region have a clearer idea than ever before of what the problems are. They are therefore better equipped to decide what actions they ought to take, and they have fewer excuses for not acting.

Dr. Peter Cameron is the Director of the International Instituut voor Energierecht at the University of Leiden, the Netherlands. The Institute is developing databases of international and national legal materials for comparative research on specific issues, including abandonment.

THE STATUS OF OFFSHORE HYDROCARBON EXPLOITATION AND THE REGULATIONS OF REMOVAL AND DISPOSAL OF OBSOLETE OFFSHORE PLATFORMS IN CHINA*

The offshore petroleum industry in China originated in the late 1950s. Having made considerable progress in the 1980s, the industry which through Sino-foreign cooperation and self-financed programmes, is engaged in the exploration for, development, production, utilization and marketing of offshore oil and gas resources, contracting services to the offshore oil and gas operations and other business activities, is now in a growing stage at the high tide of reform and opening towards the outside world.

The Sino-foreign cooperation in the offshore oil sector is extensive. A total of 69 exploration and development contracts and agreements of various kinds have so far been awarded to 49 companies from 13 countries and regions, and US $3.13 billion of foreign capital used. In Sino-foreign cooperation, the principle of equality and mutual benifits is cherished, foreign capital is utilized effectively, and a cooperative partnership of mutual trust is established. Meanwhile, China's self financed exploration and development programmes are also advanced by Sino-foreign cooperation undertakings.

Significant achievements made in oil and gas exploration. By the end of 1991, 67 prospects had been made and proved with oil and gas discoveries which gave a cumulative total of 870 million tons of oil and 133 billion cubic metres of natural gas in place. A number of rich middle- or small-sized oil/gas fields are found not only in Bohai, the Pearl River mouth and Beibu Gulf (where grouped development areas could be formed); there are some large oil fields elsewhere (each with oil in place exceeding 100 million tons and a gas field with reserves exceeding 100 billion cubic metres), indicating good offshore oil and gas potential in China.

Oil/gas fields development reaching full size, crude oil production having increased yearly. There are six oilfields on stream, seven oil/gas fields being developed, and three oil/gas fields in the pre-development stage. The annual crude oil production offshore in China was 2.39 million tons in 1991, and will reach more than 3 million tons in 1992.

Through importation and modernization, China has had available the equipment and facilities needed for offshore petroleum exploration and development projects, including 12 oil production platforms, 14 drilling vessels, 65 offshore engineering vessels and over 4,000 sets of other specialized equipment, most of which reached the international standards of the 1980s. There are now no obsolete offshore platforms related to production of hydrocarbons in China, and the regime of removal and disposal of obsolete offshore platforms, structures and installations, including the legal, economic and financial framework, has not been set up. There are some rules on this in Regulations of the People's Republic of China Concerning the Dumping of Wastes at Sea. For example:

Article 2: For the purposes of these Regulations, "dumping" means... the disposal of vessels, aircraft, platforms or other man-made structures at sea...

Article 7: No wastes of foreign countries shall be allowed to be shipped to the sea areas under the jurisdiction of the People's Republic of China for the purpose of dumping, including the disposal of vessels, aircraft, platforms or other man-made structures at sea. The violators shall be ordered by the Competent Authority to remedy the pollution damage within a definite time, pay clean-up expenses incurred in eliminating the pollution, compensate for the losses and be liable to a fine.

Article 15: ... When the vessels, aircraft, platforms or other vehicles which sail and operate at sea have to be abandoned due to *force majeure*, the owners shall report to the Competent Authority and the nearby harbour superintendency administration, and shall conduct the salvage and clean-up work as soon as possible.

* Presented at the 1992 Seminar by Zhang Haiqi, Office of Marine Geology, Ministry of Geology and Mineral Resources China.

By participating in the ESCAP/CCOP/ LEGIMAS Seminar, China sincerely hopes to have exchanges and cooperation with other countries and regions on the legal, financial and technical aspects involved in the removal and disposal of obsolete offshore platforms, structures and installations related to the production of hydrocarbons, and to use the beneficial experience for reference in order to establish a regime of removal and disposal of such obsolete offshore platforms, structures and installations suited to the conditions in China in the near future.

THE CONSTRUCTION AND REMOVAL OF OFFSHORE PLATFORMS IN CHINA*

My representation is in three parts: first, a general description of exploration and development of offshore petroleum resources in cooperation with foreign enterprises in China; second, an introduction to the construction and removal of offshore oil platforms in China; and third, Chinese laws and regulations and the provisions stipulated in the petroleum contracts signed with foreign oil companies with respect to the removal of offshore installations.

General description of exploration and development of offshore petroleum resources in cooperation with foreign enterprises in China

In accordance with the Regulations of the People's Republic of China on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises, China National Offshore Oil Corporation (CNOOC), a State oil company, with authorization to conduct Chinese-foreign cooperative exploration and development of offshore petroleum resources on the continental shelf of China, was established in February 1982. CNOOC has four regional companies: Bohai Oil Corporation in Tianjing, Nanhai East Oil Corporation in Guangzhou, Nanhai West Oil Corporation in Zhanjiang, and South Huanghai Oil Corporation in Shanghai, and three professional companies, the China Offshore Oil Logging Company in the Yanjiao area of Hebei Province, the China Offshore Oil Development and Engineering Company in Beijing, and the China Offshore Oil Exploration and Development Research Center at Xincheng County, Hebei Province.

As they have a total of over 30,000 employees CNOOC and its affilates have the ability not only to carry out the research and engineering work related to offshore petroleum exploration and development but also to fabricate oil platforms, carry out offshore construction, vessel towing and conduct other offshore operations, such as geophysical survey operations, drilling operations, logging etc. Therefore, CNOOC is a State company which has multiple functions.

Beginning in 1979, the Chinese Government opened its vast offshore area for the cooperative exploration and development of petroleum resources with foreign oil companies. Prior to that China had relied on its own efforts in conducting offshore exploratory activities, mainly within the area of Bohai Gulf. Since the start of our cooperation with foreign oil companies on offshore China, up to the time of writing this paper CNOOC had entered into 44 petroleum contracts and agreements with 45 oil companies from 12 countries by means of bilateral negotiations and invitations for bids in the first and second rounds. The total area awarded covers more than 169,000 square kilometres; 39 petroleum discoveries have been made by drilling a total of 171 exploratory wells; some of these discoveries are of commercial value, with several significant discoveries having been made in the last three years in particular. For the time being, Chengbei oilfield and Wei 10-3 oilfield are on stream, while BZ 28-1, BZ 34-2-4 and Hueizhou 21-1 oilfields are now under development and are expected to be on stream this year and next year. The overall development programmes of the self-developed Weizhou 11-4 oilfield and Jinzhou 20-2 oilfield have already been approved by the government authorities and will enter the construction phase very soon. The production from these two oilfields is expected to start in 1992. Four other oilfields, Suizhong 36-1 oilfield, Hueizhou 26-1 oilfield, Ya 13-1 gas field and Xijiang 24-3 oilfield, are currently under preparation for development. Once the overall development programmes of those oil and gas fields have been approved by the Government, the construction activities will be started immediately and these four oil and gas fields will put into production around 1993.

Generally speaking, at present the exploratory and development activities in offshore China are quite active and more and more international offshore engineering and construction companies are provid-

* Presented at the 1989 Seminar by Li Qinxiu and Xing Zhifeng, China National Offshore Oil Corporation.

ing services for the development of offshore oilfields in China.

Introduction to the construction and removal of offshore oil platforms in China

Up to now, the oilfields developed in China have all been located in shallow water and most of the engineering facilities are based on fixed platforms. Since the first production platform was built in Bohai Gulf in 1966, 29 platforms with various functions have been built up to the end of 1988, including drilling platforms, production platforms, a fixed single point mooring system and offshore terminal; among these, 17 platforms were all financed, constructed and installed by China itself and 12 were financed together with foreign oil companies. Only a few platforms were built by an international engineering contracting company.

All the platforms built in offshore China now are of steel-piled structure except one, a template structure. The depth of the piles is between 50 and 80 metres below the mud line.

Among 29 platforms, one has been completely removed, and another partially removed. Removal contracts have already been signed with contractors to remove five other platforms and these will soon be implemented. CNOOC intends to remove still another one on its own. The other 21 platforms are all within their design life and are still in use.

To remove an offshore platform is rather costly work, especially under the current situation of low oil prices, and such huge expenditure is no doubt a heavy burden for the oil companies. But in order to secure the safety of navigation, removing the abandoned platforms is also an inalienable responsibility of the oil companies. However, with the expansion of the exploration area, the offshore operations are gradually moving from shallow water areas to deep water areas. It is then more and more difficult for the oil companies to clear up the sunken objects in the sea and remove the platforms and more expenses will be incurred. Currently, in the Pearl River Mouth Basin of the South China Sea offshore exploration operations have been conducted within a water depth of 500 metres. In such cases it is obviously not appropriate for the rules or regulations for a shallow water area to apply. Therefore it would seem that formulating different standards for removing platforms and clearing up the sunken objects in the sea according to the different water depths is a pressing matter at this time. From our point of view, the formulation of the standards should be based on the condition that navigation of ships and submersibles, as well as fishing operations, will not be interfered with, taking into account not only the necessity for establishing such standards but also the feasibility and economic viability of implementing such standards. If the standards established are not practical, that is to say it proves very difficult for the oil companies to accept such standards from both the technical and the economic points of view, they cannot be followed in practice.

In China, in order to remove platforms we mainly use the method of making an explosion inside the pile which is below the mud line; once the jacket and the part of the pile below the mud line are broken they will be removed.

In order to reduce the expenditure incurred for removing platforms and take account of the actual situation in China, the following two measures will be taken:

After the expiration of production of the platform, such platforms will be offered, within their design life, to other departments of oceanography or meterology for other kind of usages such as observation platforms, aiming to share a part of the removal expenditure to be incurred in the future.

After the expiration of production of the platform, the platform will be removed as soon as possible so as to recover a portion of the costs incurred during the removal from the sale of the scrap steel as early as possible, and of course to as great an extent as possible.

Chinese laws and regulations and the provisions stipulated in the petroleum contracts signed with foreign oil companies with respect to the removal of offshore installations

The earliest law stipulating the removal of offshore installations in China is the Maritime Traffic Safety Law of the People's Republic of China, which was enacted on 1 January 1984. In accordance with the provisions set forth in article 26 of that law, the removal or dismantling of installations, the salvaging or clearing up of shipwrecks or sunken objects and

the winding-up of underwater projects should leave nothing that tends to be a threat to the safety of navigation or operation. Pending the completion and the proper winding-up of the aforesaid operations, their owners or operators should lay marks as required and should make a true report to the competent authorities as to the name, shape, size, location and depth of water over the obstructions in question. From the wording it can be seen that no specific standard and requirement is mentioned in the law, which just takes as a principle no interference in the safety of navigation and offshore operations. In March 1987, the Chinese Government promulgated the Provisional Regulations of Navigation Administration of Petroleum Exploration and Development Operations within the Offshore Area of the Nothern Part of China. In these regulations there are specific requirements for removing offshore installations. According to article 11 of the Regulations, in the event that any movable drilling platform or vessel needs to be removed, first, the abandoned wellhead or any other sunken objects have to be cleared up to at least 4 metres below the mud line; sencond, the wellhead maintained or any other individual overwater and under water facility will, according to the requirement of the harbour superintendency administration, lay position marks, or within the scope of not exceeding 50 metres, lay the isolated marks which show the danger. The Bohai Oil Company of CNOOC did follow this requirement in removing Bohai No. 9 platform. However, these regulations are only tried out within the offshore area of northern latitude 35 degrees of China and have not yet been applied to the total offshore area of China.

In addition, there are some provisions in connection with the removal of offshore installations in the petroleum contracts signed by China with the foreign oil companies. In article 4.6.2.1, it is stipulated that if both parties to the contract agree to abandon production from any oil or gas field, the abandonment costs will be paid by the parties in proportion to their participating interests in the development of such oil or gas field. In article 4.6.2.2, it is stated that if one party decides not to abandon production from any oil or gas field while the other party decides to abandon production, then the party that decides to abandon the production will not pay any abandonment cost. Some of the participants present at the meeting today may be aware that according to the provisions of its model contract, CNOOC has the right to participate up to 51 per cent of the development costs and the remaining costs required will be financed by the foreign contractor. So the costs for the removal of the offshore platform or other installations will be shared by the cooperative parties according to their actual proportion of the development costs invested in an oil or gas field. Since abandonment of a production platform in the cooperative zone has not yet occurred, the provisions in the petroleum contracts, therefore, have not been put into execution in fact. But CNOOC believes that as long as the standards of the removal of the offshore installations established are reasonable and practical and the terms related to the removal of the offshore installations in the contracts are acceptable to the parties to the contract, the difficult subject of the removal of offshore installations can be solved in a proper way.

RIGS TO REEF*

Introduction

1969 was a historical year for the oil and gas industry in Brunei Darussalam. That year marked the start of the country's oil and gas production from its offshore areas. So far, about 200 platform structures have been installed, functioning as drilling platforms, riser platforms, production platforms, living quarters platforms etc.

A number of platforms have also been disused. However, in the interest of good house keeping, all disused structures offshore were removed from the sea by Brunei Shell Petroleum Company Sdn Bhd (at present the only producing petroleum company in Brunei Darussalam). Before 28 August 1988, all disused platforms were disposed of either by:

(i) Deep-water dumping i.e. dumping the jackets into deep water (+2000'-0") in the area well beyond the continental self. The platform decks were then scrapped onshore.

or

(ii) Onshore scrapping. i.e. all structures (jackets and decks) were brought onshore for scrapping.

1. Why rigs to reef?

In 1986, a study made by the BSP Offshore Construction Department concluded that disposal of the Company's disused offshore structures as an "artificial reef" was more feasible and was preferable to deep-water dumping and onshore scrapping, for economic and safety reasons.

The following is an overview for comparison purposes:

On the other hand, investigations carried out during phase 1 of the ASEAN-US Coastal Resources Project in Brunei Darussalam (through the Department of Fisheries, Brunei Darussalam) indicated that underwater structures associated with oil platforms could harbour a fairly diverse fish and invertebrate community.

What is more important is the extended usefulness of the disused structures to the community, though for a completely different purpose.

2. First rig to reef in Brunei Darussalam

2.1 Turning the project into reality

Based upon the two different studies and investigations by the two different organizations, the Petroleum Unit of the Prime Minister's Office considered that it was beneficial to turn the project into reality.

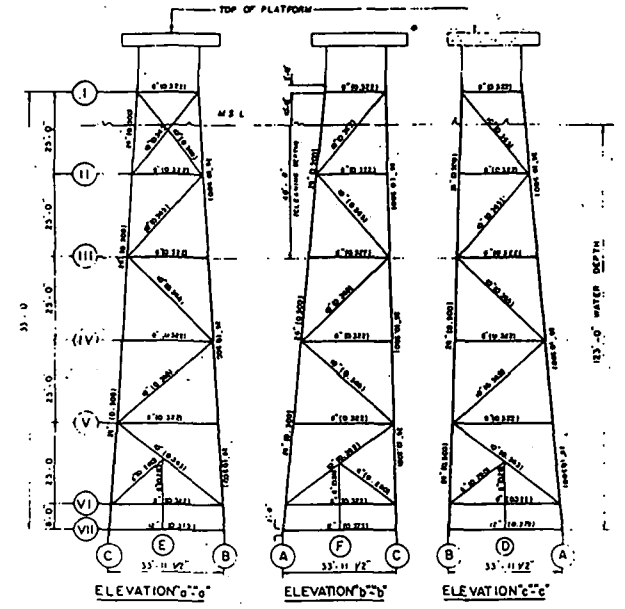
Meetings among the Department of Fisheries, the Petroleum Unit and BSP were held in order to plan and implement this project.

2.2 Size and configuration of SWA-45 and SWA-58

During the third quarter of 1988, BSP planned to salvage two disused tripods of structures, SWA-45 and SWA-58. Figures 1 and 2 illustrate in detail the size and configuration of the two structures.

Comparison criteria	*Deep-water dumping*	*Rigs to reef*	*Onshore scrapping*
Method of jacket transportation	"Under sling"	On top	On top
Length of towing route in nautical miles	60	15	7.5
Method of offloading	Released by cutting sling	Lift off offshore	Lift off onshore
Future benefit to community	No	Yes	No
Renegotiate scrap contract	Yes	No	Yes
Estimated cost in thousands of Brunei dollars	2 481	2 224	2 234

* Paper presented at the 1989 Seminar by Haji Mohd. Nasar bin Haji Momin, Petroleum Unit, Prime Ministries Office, Brunei Darussalam.



Reference drawing

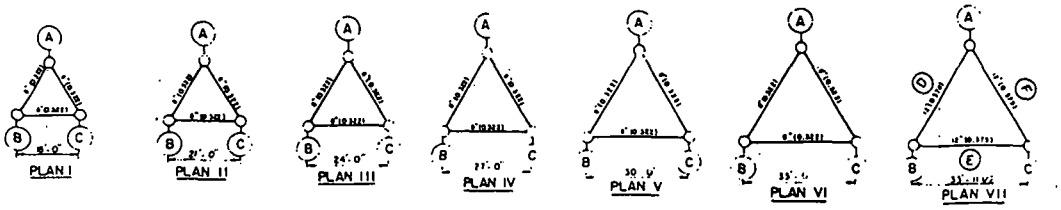
Jacket	E 13906/1
Fender	E 13658/3L
Risers	E 13917/1B

Tubular reference

26" (0.500) = 26" DIA. PIPE X 0.500 W.T. PIPE

Cleaning area

Jacket	180 SQ YDS
Fender	20 SQ YDS
Risers	15 SQ YDS
Conductor	37 SQ YDS
Total	252 SQ YDS



S.W.A-45

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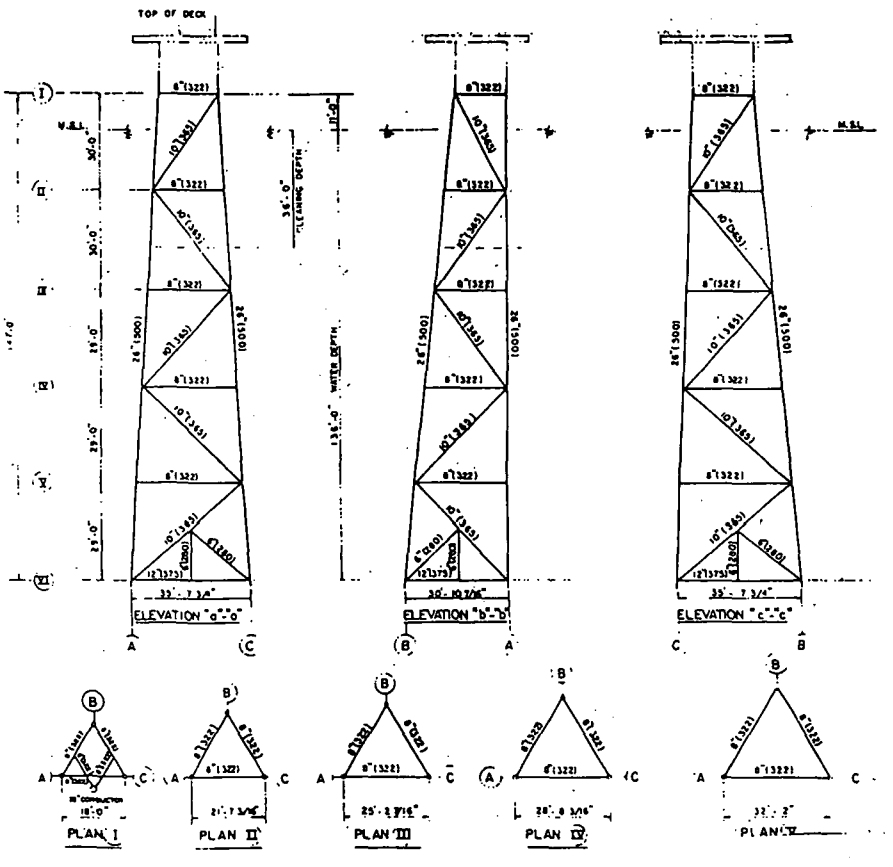
Figure 1.



Tubular Reference

8" (322) = 8" DIA. = Q 322" W.T.

Reference Drawings

Jacket	E 14266/1E
Risers	
Fender	E 136568/2B

Cleaning area (including at above MSL)

Conductor	35 SQ YDS
Jacket + Anooes	145 SQ YDS
Risers + Clamps	25 SQ YDS
Fender	23 SQ YDS
Total	228 SQ YDS

SWA-58

Figure 2.

The placement of these two oil structures on the seabed could provide for an instant artificial reef with a volume of over 1,500 cubic metres. It was then agreed that these structures should be placed in an area to be nominated by the Department of Fisheries.

2.3 Platform data

SWA-58

Coordinate:	N 1,730,722, E 1,630,498 Lat. 4 deg 45' 59.22"N Long. 114 deg 11' 47,432"E
Water depth:	136ft MSL
Jacket legs (3):	26" OD (outer diameter) x 0.500" WT (wall thickness)
Piles (3):	24" OD x 0.500" WT
Insert piles (3):	20" OD x 0.500" WT
Conductor:	32" OD x 0.750" WT
Riser (2):	6"

Submerged weight:

Displaced steel bouyancy:	17.0 standard tons
Tubular bouyancy	8.7 standard tons
at @50 per cent:	25.7 standard tons

Expected submerged weight: 117.2 standard tons including piles, mudmats, marine grout, flooded members etc.

Deck weight: 19 standard tons including deck structure, deck legs and timber handrails

Boatlanding weight: 18 standard tons including boatlanding structures, grout marine growth

SWA-45

Coordinate:	N 1,730,178, E 1,643,994
Water depth:	123 ft to MSL
Jacket legs (3):	26" OD x 0.500" WT
Piles (3):	24" OD x 0.500" WT
Conductor:	32" OD x 0.750" WT
Riser:	6"

Jacket weight: 112 standard tons including piles, mudmats, marine growth, flooded members, miscellaneous

Deck weight: 19 standard tons including deck structures, deck legs, timbers, handrails

Boatlanding weight: 18 standard tons including structure, grout, marine growth

2.4 Location of rigs to reef

In the past few years, the Department of Fisheries has built an artifical reef by dumping, up to now, 9,394 used tyres in the Two Fathom Rock area. Based on this experience, the Department of Fisheries preferred that two structures be dumped into this area i.e. in the centre of a triangle formed by three reefs called the Two Fathom Rock. The peaks of these three reefs rise to a water depth of 5 metres. However, the area is well outside the shipping lanes.

2.5 Salvaging work of SWA-45 and SWA-58

The two tripod structures SWA-45 and SWA-58 were originally located in AMPA field, about 51 nautical miles west of the Two Thousand Rock area. The removal and salvaging of these three structures were carried out by Brunei Shell Petroleum Sdn Bhd. However, it is not the intention in this paper to cover the engineering details of the removal and salvaging work in depth.

The objectives of the salvaging works were:

(a) To remove loose topside facilities, jibcrane, navigation lights, loose handrails, loose timbers and miscellaneous items;

(b) To remove redundant risers;

(c) To remove conductions;

(d) To remove deck;

(e) To remove jacket/piles.

All of the salvaged items were backloaded onto the cargo barge with the arrangements as shown in figure 3.

2.6 Disposal of SWA-45 and SWA-58 in the Two Fathom Rock area

As mentioned earlier, the purpose of placing the structures in this location is to provide for the nucleus of a reef and to provide aggregating, breeding and nursery grounds for fish and other marine life, hence enhancing the productivity of the coastal waters. As these structures are also likely to attract sports divers in the future, all items were placed on the seabed in stable positions with no likelihood of their being dislodged for further movements.

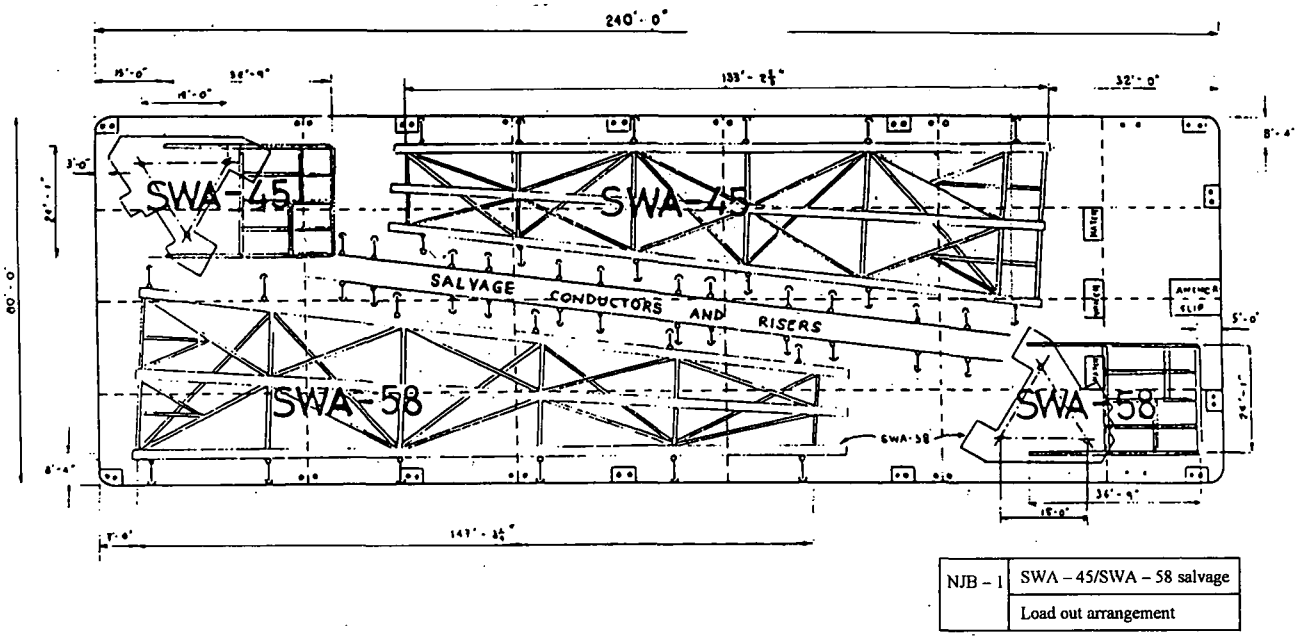


Figure 3.

After salvaging the two structures, the items were towed and the working barge and the diving vessel sailed to the disposal area. The journey took one and a half days.

The diving vessel provided remotely operated vehicle (ROV) support for this operation and carried out the initial first dumping seabed surveys. After an ROV seabed survey had been done, the placing of salvaged items was effected in the following order:

(i) SWA-58 jacket

(ii). SWA-45 jacket

(iii) Jacket decks

(iv) Conductors

(v) Risers

(vi) Boat landing

The two jackets were placed parallel to each other about 30 feet apart. The decks, conductors, risers and boatlanding were placed between the jackets. Figure 4 shows the plan view of the rigs turned reef.

Figure 5 shows the elevation view of a jacket in position. The water depth above the highest peak of the tripod jacket during low tide is approximately 7 m.

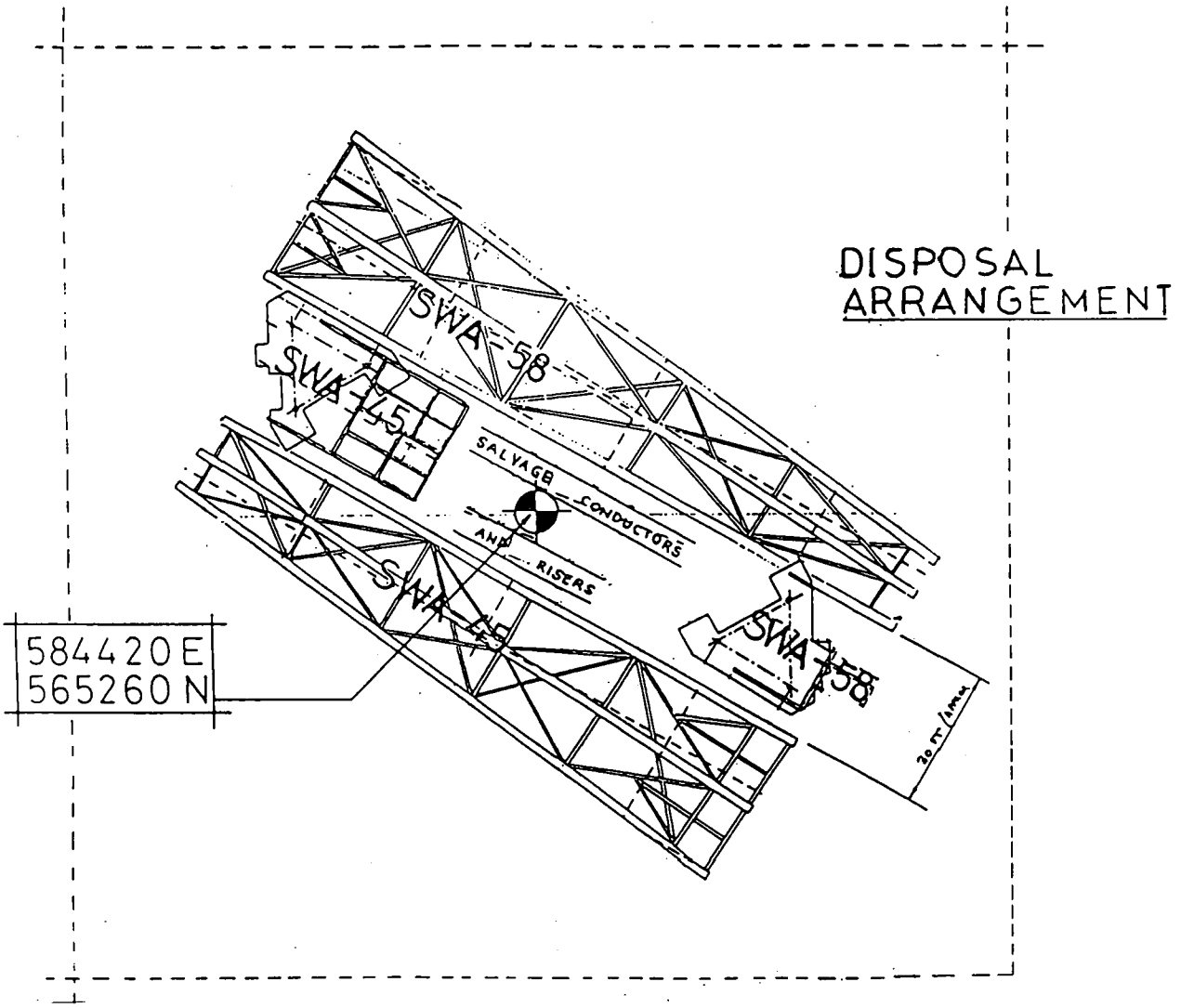


Figure 4. Rigs to reef

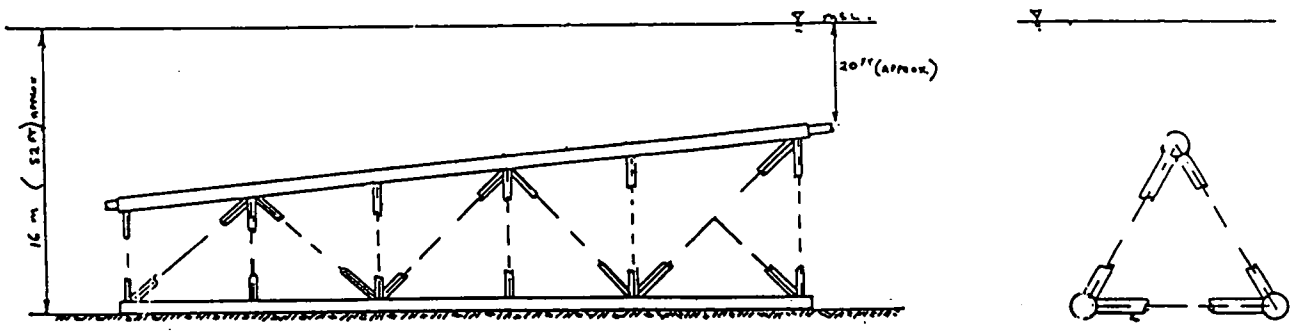


Figure 5. Rigs to reef jacket disposal

THE ECONOMIC AND FINANCIAL ASPECTS OF REMOVAL AND DISPOSAL OF OBSOLETE OFFSHORE PLATFORMS*

Summary

Indonesia has approximately 370 offshore platforms at present, and many of these will become obsolete in the near future. By the turn of the century, platform removal and disposal will become a major problem for Indonesia and for other countries producing oil and gas from offshore fields. Indonesia has an existing regulation requiring offshore platforms to be removed completely, but does not have procedures or detailed requirements for abandonment, removal and disposal of the obsolete platforms.

It is expected that in the future, the State Oil Company, PERTAMINA, and the production sharing contractors will take up a joint study of this potential problem and propose alternatives of less costly methods for the removal, disposal and possible reuse of offshore installations and structures. PERTAMINA and the contractors may also start designing new offshore platforms, considering the cost of removal and disposal. At present, the Government is reviewing all the alternatives and is expected to develop a national policy for future implementation.

Introduction

Indonesia has been producing oil and gas from the offshore fields since 1971. At present 30 per cent of Indonesia's crude oil production comes from offshore areas. Oil and gas production from the offshore field is expected to increase and in the future a greater portion of hydrocarbon production will come from offshore fields, based on the estimate that two thirds of hydrocarbons resources are deposited in the offshore sedimentary basins.

Indonesia has approximately 370 existing offshore platforms at present and will be installing 10 to 15 platforms each year in the foreseeable future. Almost all the existing offshore platforms are now producing, with a few exceptions, such as three in Maxus fields, and two in PERTAMINA Poleng field.

More platforms will soon cease to be productive and become obsolete as the reservoirs are depleted. Indonesia has an existing regulation requiring offshore platforms and other marine installations to be removed completely and disposed of properly after the economic life of the structures is finished.

The present paper will discuss the technical, economic and financial aspects of removal and disposal of obsolete offshore installations and the various options available.

I. EXISTING PLATFORMS IN INDONESIA

1. Non-producing offshore platforms

Maxus fields have three non-producing structures: (1) DUMA, (2) Selatan B, and (3) Selatan C, while PERTAMINA Poleng field has two non-producing structures. Selatan C topside structure has been removed and relocated onto a new jacket at a different location and this deck is producing at this time. Maxus is in the process of planning to remove and relocate the other two decks. There is another platform in Maxus field PAMA-E, which is not very productive, and therefore the main deck has been removed and relocated on a new jacket and a smaller deck has been installed onto this RAMA E jacket for water injection and producing from a single well.

However, the Selatan C jacket is still in place and navigation lights have been installed on this structure for the safety of shipping passing in this field. Maxus has undertaken a study for the possible removal and reuse of the jacket of the structure. The study done so far concludes that the jacket is still suitable for further use. This study included the following analysis and inspection:

(a) Special condition survey and inspection above water and under water to determine the present in-place condition of each structural member;

(b) In-place analysis;

* Presented at the 1992 Seminar by the Directorate General of Oil and Gas, Indonesia.

(c) New fatigue analysis to determine the remaining fatigue life of the jacket;

(d) Earthquake analysis.

Poleng field platforms have become non-producing and have been shut down; no decision has been made to remove or relocate the platforms.

Since the platforms are in various water depths, it will present a different problem for each field to remove and dispose of them. Table 1 and figure 1 indicate the number of platforms in various water depths.

Table 1. Water depth variations for oil and gas platforms in Indonesian waters (as of 1 May 1992)

Water depth (feet)	*Number of platforms*
0 – 20	41
20 – 50	34
50 – 100	106
100 – 150	160
150 – 200	20
200 – 300	9
300 – 400	–
Total	370

2. Producing offshore platforms

At present, there are 10 offshore producing companies in Indonesia, as shown in figure 2. These companies have about 370 offshore platforms of various types, as indicated in table 2 and figure 3, which have been installed since 1971. A graph and table showing the number of installations against the year in which these were installed is shown in table 3 and figure 4.

3. Platform service life and abandonment estimate

The offshore platforms are site-specific dependent structures and are designed for a specific design life based on the life of the reservoir. The life of a platform is controlled by the environmental conditions and so it will vary from one site to the other.

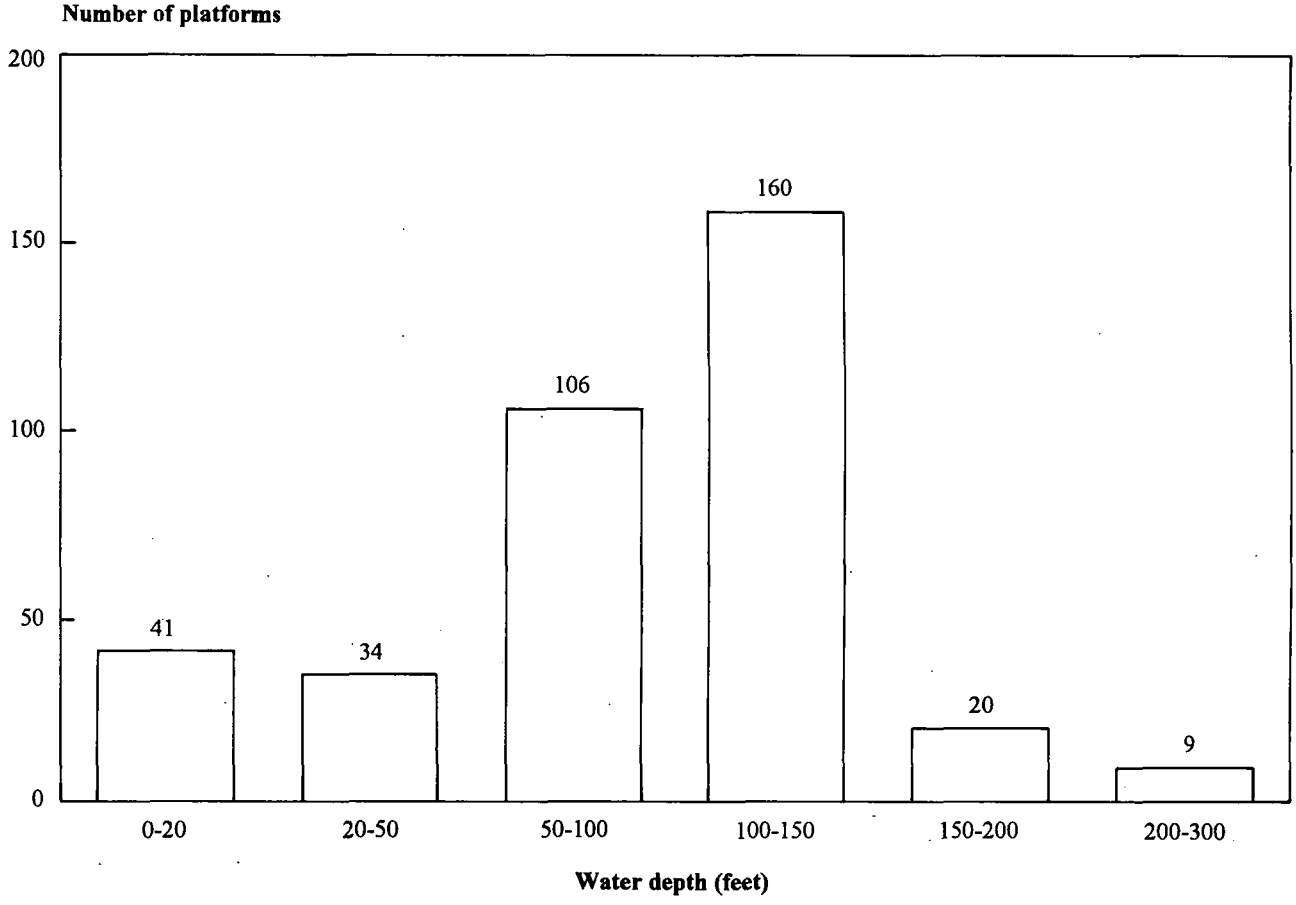


Figure 1. Water depth variations offshore platforms – Indonesia

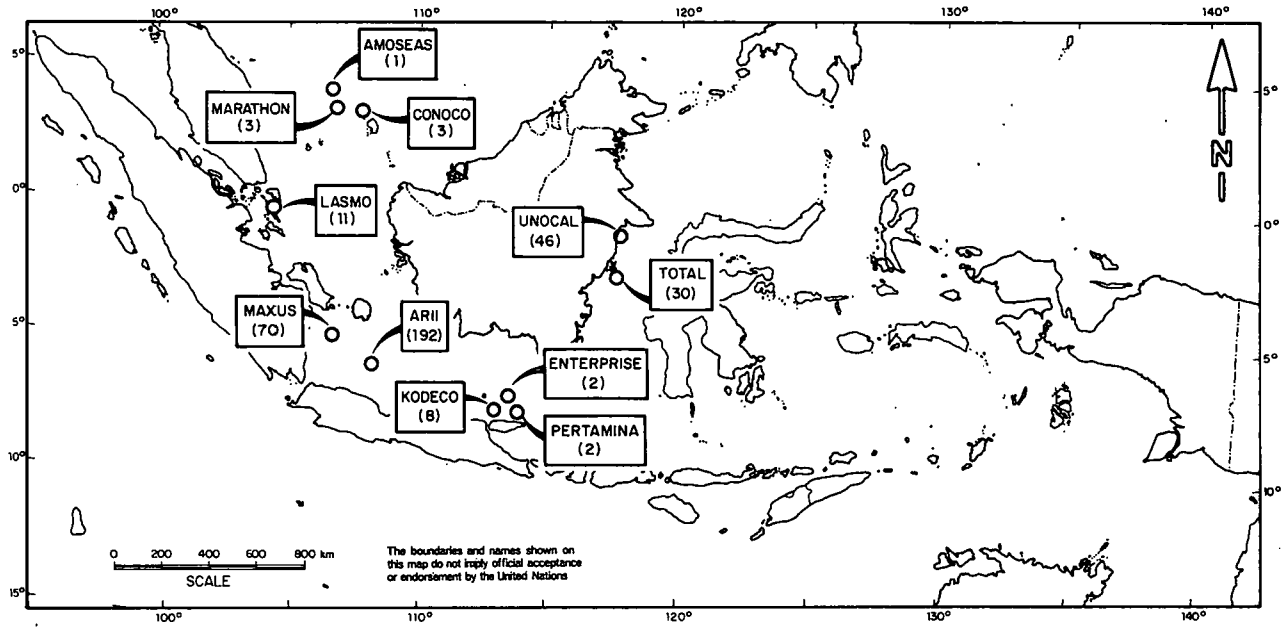


Figure 2. Location of platforms – Indonesia

Table 2. List of offshore platforms in Indonesian waters (as of 1 May 1992)

Company	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*Total*
AMOSEAS	1	–	–	–	–	–	–	1
ARLL	122	22	9	2	22	13	2	192
CONOCO	1	1	–	–	1	–	–	3
ENTERPRISE	1	1	–	–	–	–	–	2
LASMO OIL	6	1	1	–	–	–	3	11
MAXUS	53	9	–	–	7	3	–	72
KODECO	4	2	–	1	1	–	–	8
MARATHON	1	1	–	–	1	–	–	3
TOTAL INDONESIA	13	12	1	2	1	1	–	30
UNOCAL	31	6	2	–	5	–	1	46
PERTAMINA	2	–	–	–	–	–	–	2
TOTAL	236	55	13	5	38	17	6	370

Notes: A = Well B = Process C = Quarter D = Junction E = Flare F = Bridge support G = Hose tripod

Generally, in Indonesia, offshore platforms are designed for 20-30 years of design life, unless the reservoir life dictates a longer design life. Design life is a theoretical life and is calculated based on code criteria, such as fatigue life. In many cases, the actual life of a platform exceeds the design life.

In Indonesia, there are five obsolete platforms due to reservoir depletion, although the structures are still in good condition. On the other hand, there will be more than 50 platforms in the 1990s, in which their design life will be finished. Therefore, we need to prepare a guideline for detailed inspection and monitoring of platforms whose design life is exceeded. The estimated number of platforms to become obsolete annually in Indonesia is shown in table 3 and figure 5.

4. Abandonment practice in Indonesia

Indonesia has a regulation which requires an offshore platform to be removed entirely after the

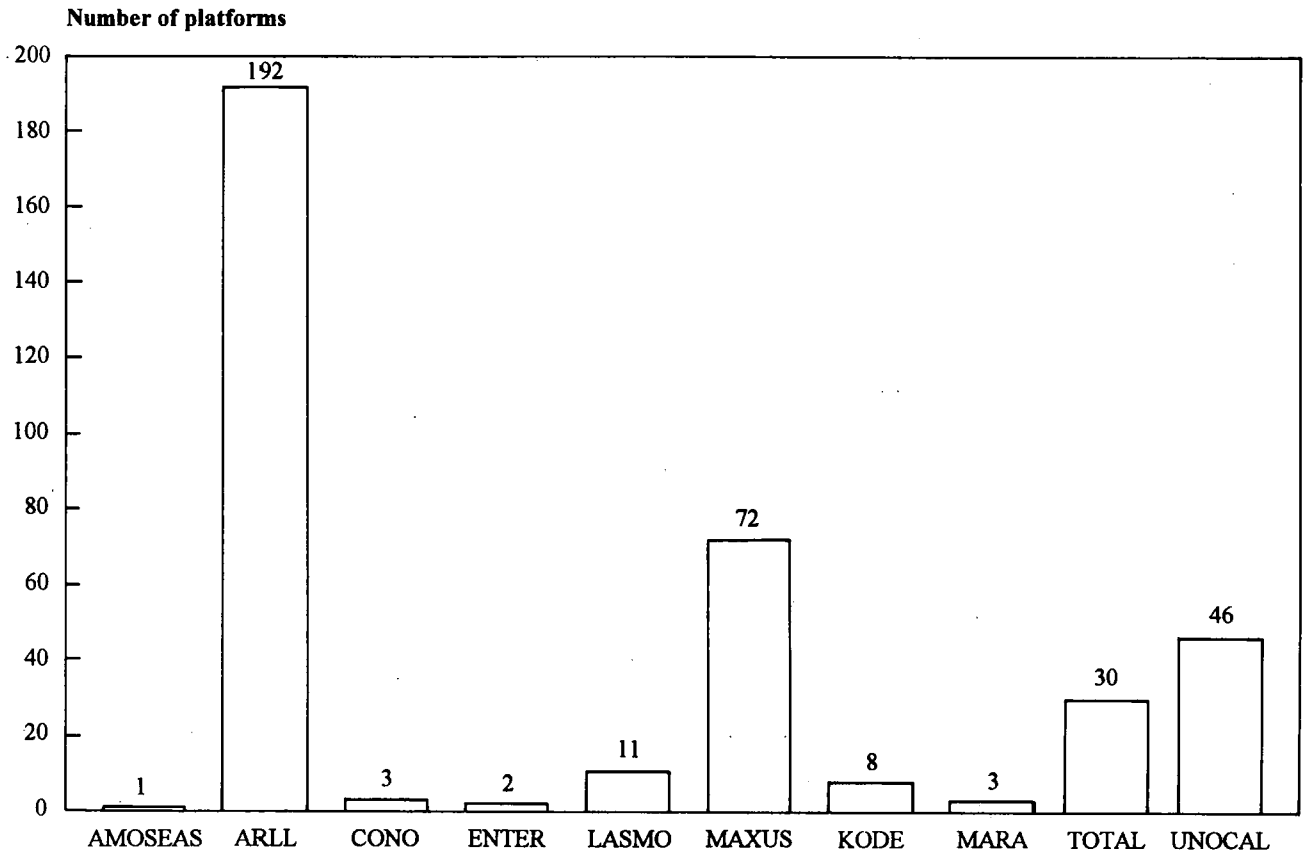


Figure 3. Number of offshore platforms by company, in Indonesia

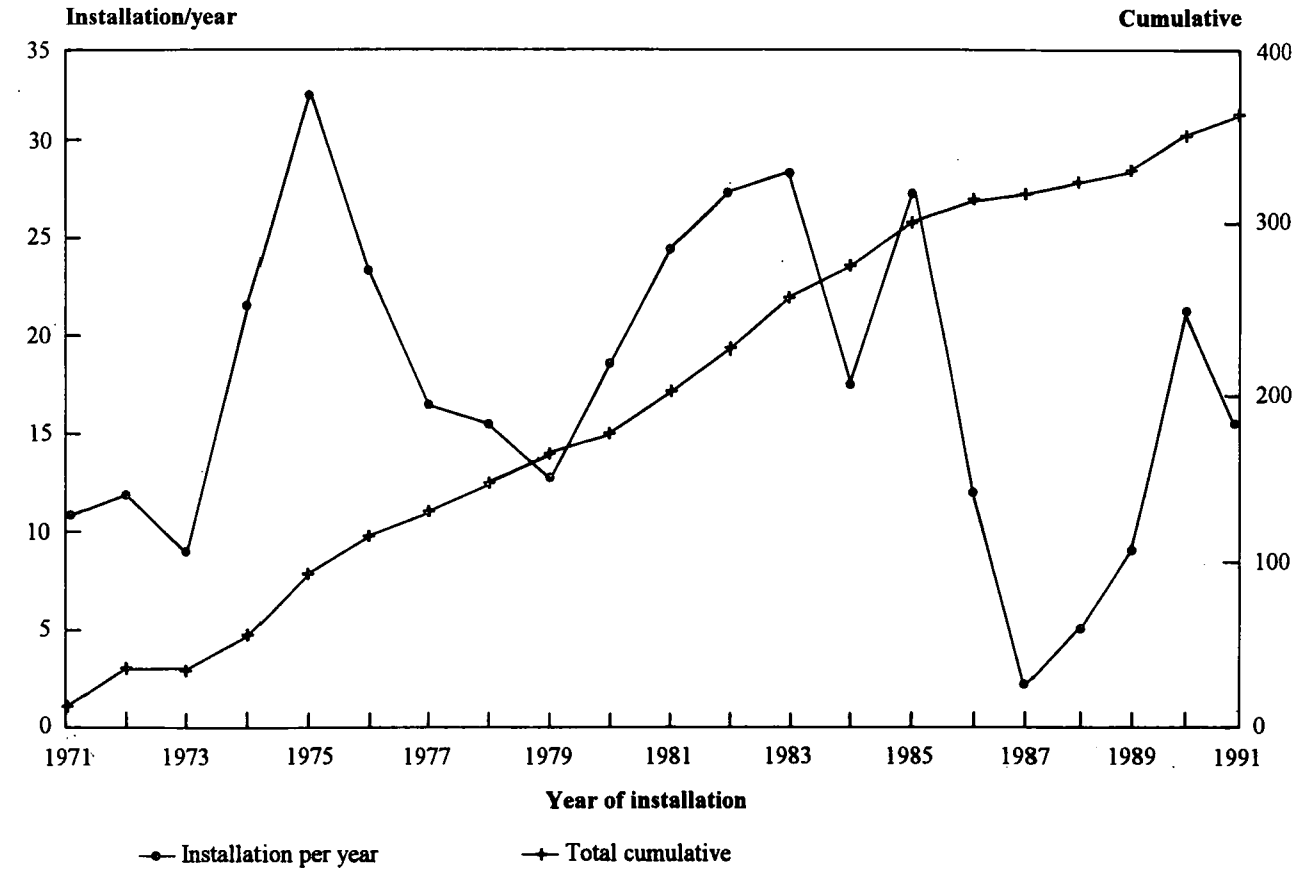


Figure 4. Offshore platform statistics

Table 3. Estimated number of obsolete structures

Year installed	*Kind of platform*							*Total*	*Cumulative*	*Obsolete in year*
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*
1971	7	2	–	–	2	–	–	11	11	1996
1972	7	3	1	–	1	–	–	12	23	1997
1973	8	1	–	–	–	–	–	9	32	1998
1974	5	6	2	1	5	3	–	22	54	1999
1975	11	8	2	–	7	5	–	33	87	2000
1976	11	9	2	–	1	1	–	24	111	2001
1977	11	3	–	–	2	1	–	17	128	2002
1978	9	2	–	–	4	–	1	16	144	2003
1979	12	–	–	–	1	–	–	13	157	2004
1980	14	2	–	–	1	–	2	19	176	2005
1981	15	5	–	–	2	3	–	25	201	2006
1982	18	5	1	–	2	2	–	28	229	2007
1983	23	1	2	–	2	–	1	29	258	2008
1984	14	1	1	–	1	1	–	18	276	2009
1985	23	1	–	1	3	–	–	28	304	2010
1986	8	–	–	1	2	1	–	12	316	2011
1987	1	–	1	–	–	–	–	2	318	2012
1988	5	–	–	–	–	–	–	5	323	2013
1989	7	1	–	–	1	–	–	9	332	2014
1990	12	4	1	2	1	–	2	22	354	2015
1991	15	1	–	–	–	–	–	16	370	2016
Total	236	55	7	5	38	17	6	370	–	–

Notes: A = Well
B = Process
C = Quarters
D = Junction
E = Flare
F = Bridge support
G = Hose tripod
H = Per year
J = Cumulative
K = End year of platform life, assuming 25-year lifetime

completion of its useful life. So far, five platforms are non-producing and these have not been removed completely. In some cases, such as in Maxus fields, the top-side structure (deck) has been removed and relocated. These removal and reuse practices are on a case-by-case basis, and there is no standard practice in Indonesia at present.

II. ECONOMICS AND FINANCE OF PLATFORM REMOVAL AND DISPOSAL

1. Estimated cost

With several hundred structures in Indonesia, it is impractical for a study of this type to analyse the cost of removing each offshore structure. Rather, the structures are divided into four categories on the basis of size, depth and type. A removal cost estimate was made for each category and a total cost estimate was developed accordingly. These estimates are based on current techniques using 1992 United States dollars.

Category I includes smaller structures, single-well caissons, well protectors and other items that can be removed using equipment with a lifting capacity of not more than 100 tons (for jackets weighing less than 100 tons). Generally, these structures are in a water depth of 20 feet or less. However, some of the very old structures in deeper water (up to 50 feet) also fall into this category.

Category II covers typical eight-pile structures in water depths up to 100 feet, with jackets weighing 500-700 tons. Until better techniques become standard, these structures will also be removed by lifting.

Category III includes structures with jackets weighing from 1,200 to 1,500 tons. This encompasses typical present-day structures in water depths of 100-200 feet.

Category IV covers structures located generally in 200-400 feet of water. The cost estimates are based on cutting the jacket into sections, lifting the sections onto cargo barges and returning them to

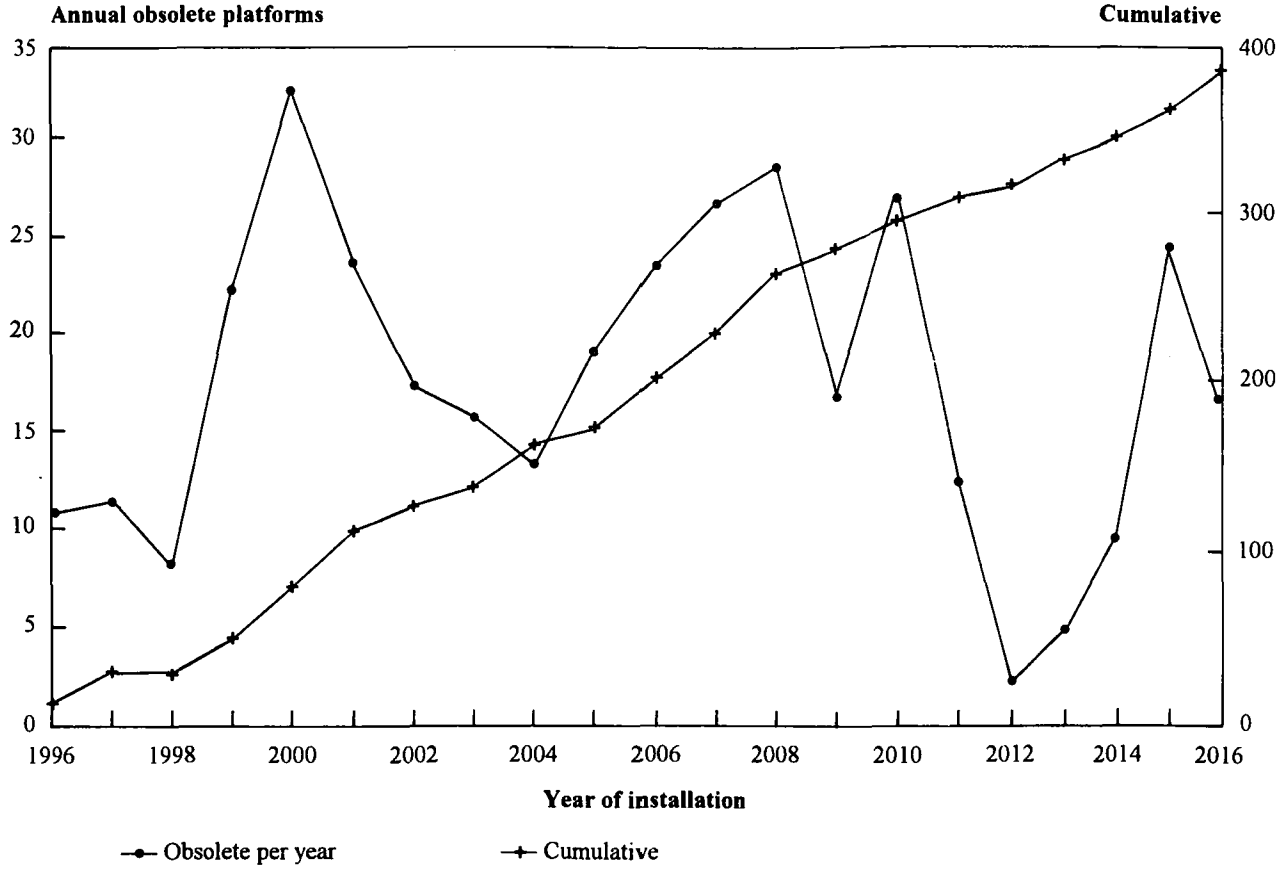


Figure 5. Estimate of obsolete offshore platforms in Indonesia

shore. The problem will not begin until category IV structures are to be removed somewhere in the time-frame 1995-2005. With few exceptions, category I and II structures will be completely removed and returned to shore. Structures of these categories are not difficult to remove and therefore can be removed cheaply when no longer usable. Even if operators were allowed to leave structures in place, liability considerations and maintenance cost would dictate the removal of the bulk of them. Since the water depth of these structures is also relatively shallow, they are not likely to be treated as structures to be cut off at some point below the water line with the bottom section left in place. For purposes of preparing an overall estimate, typical removal procedures were developed for a structure of this category. The normal removal cost of a category I structure is estimated to be in the range of US $100,000 to US $400,000. Larger equipment and more time on location is required for category II: it is estimated that the average removal cost of these structures will range from US $600,000 to US $1.3 million.

It was assumed that structures in category III would also be removed completely and returned to shore. Considering the additional size and complexity of these structures, it is estimated that the removal of category III structures by present techniques would cost from US $1 million to US $2.5 million.

These estimated costs are shown in table 4.

Table 4. Cost estimate for removal and disposal of obsolete offshore platforms in Indonesia (structures returned to shore)

Category	*Approximate weight (tons)*	*Water depth (feet)*	*Estimated cost (thousands of US dollars)*
I	< 100	< 20	100 – 400
II	500 – 700	20 – 100	600 – 1 300
III	1 200 – 1 500	100 – 200	1 000 – 2 500
IV	> 1 500	200 – 400	> 2 500

2. Planning

The average usable time-span for a platform is anywhere between 20 and 30 years, based on fatigue. The oil companies and the contractor should come up with a design that will justify the benefit of removal of a platform. This should be a major concern of the oil companies owing to the high cost of platform dismantling, estimated at approximately 50 per cent of the installed cost.

III. TECHNICAL AND ENVIRONMENTAL

1. Technical aspect

To date, the removal of offshore structures has not been a major industry. The removal of structures has been occasional, which has not promoted the development of more economical procedures. When the removal of offshore structures grows into a significant market, the technical proficiency in platform removal will improve. The industry has shown continuing developments in two areas that will improve removal capabilities: one is the development of larger, more weather-resistant crane barges, and the other is the improved technology in working under water with remotely operated vehicles and with improved diving systems that will allow deeper divers for a longer period of time.

Certain other technical developments could assist platform removal capabilities. For example, pile cutters, which can sever the pile below the mud line without using divers or without expanding the pile diameter, can be improved. The ability to cut jacket members, legs and braces within the structure using a remotely operated vehicle and a cutter not requiring divers would also be very advantageous. Possibly also of benefit would be the development of temporary buoyancy systems with a positive means of attaching to the jacket legs to assist in lifting the larger sections by flotation. For the typical Indonesian offshore structures, the development of removal procedures is not a normal part of the original design effort. For most of the structures designed to date, the removal procedure has been considered primarily a reverse of the installation procedure. If the structure had been designed for installation by lifting, then the same or larger equipment could remove it. If the structure had been designed to float before installation on the bottom, the jacket could probably be refloated by capping the legs and blowing out the water. No detailed analysis of platform removal procedures is normally performed other than to ensure in the design of the structure that adequate buoyancy is available. However, for deeper water structures that are likely to be cut into several sections, a more detailed analysis of a removal procedure is sometimes performed to ensure that removal is possible and to obtain a rough estimate of the removal cost.

2. Removal procedures

The procedures for removing fixed steel platforms are the reverse of the installation procedure. The primary procedure has been to cut the platform into sections and remove by lifting. The size of the component to be lifted is determined by the capacity of the lifting equipment. In some instances it has been possible to separate the structure into its original components of deck and jacket. In others, deck and jacket have had to be cut into smaller components because of the limited size of the lifting equipment employed.

In the United States, there are several options for removing and disposing of offshore structures, as shown in figure 6 and decribed below:

(a) Existing international rules and guidance

Removal of platform is stipulated in the OCS lease. OCS order No. 3 requires the lease operator to clear the obstructions to at least 15 ft (5 metres) below the mud line prior to relinquishing the lease.

(b) Partial removal

The United States Department of Defense requires removal of subsurface obstruction as follows: under 400 metres deep, remove to 5 metres above the sea floor, and over 400 metres deep, remove to 15 metres above the sea floor.

Note: The oil industry Exploration and Production Forum has proposed the following requirements: under 40 metres, complete removal, and over 40 metres, remove the obstruction to 40 metres, and mark the position and size of remaining structure on nautical maps.

(c) Emplace elsewhere

This implies locating the obsolete structure in the marine environment for another use, such as a

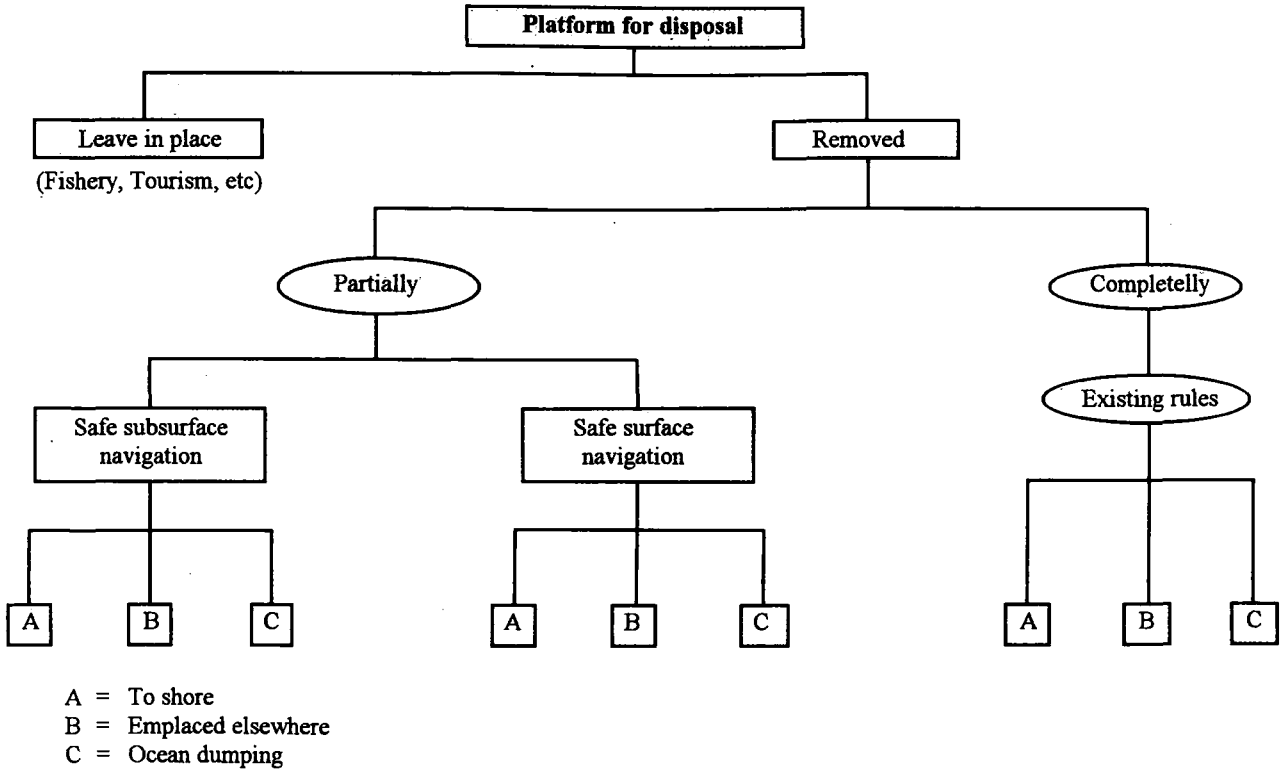


Figure 6. Option of disposal

fishing reef. Options for reef development include leaving the platform in place, toppling it in place or relocating it elsewhere.

(d) Ocean dumping

Platform can be removed, towed to deep water and dumped on the ocean floor.

The removal procedures have been discussed in section IV, 2 above.

3. Reuse of platforms

The reuse of the platform is an ideal concept, but is not often practical. An important aspect in considering the reuse of a platform is that the structure is still safe for operation.

The only case of platform reuse in Indonesia is in Maxus fields. In this case, the top-side of the platform is reused at the other location using a new jacket, as described previously.

4. Environmental aspect

(a) Environmental considerations

The installation and operation of offshore platforms have attracted environmental attention for almost 40 years. From a historical perspective, concerns focused on the issue of offshore leasing or on the environmental effects of drilling and production operations have been addressed through the regulatory process and environmental law. Environmental concerns associated with the disposition of offshore platforms are relatively new, since only a small number of structures have been removed. To define the consequences and concerns, leading spokesmen from environmental interest groups were surveyed, and published comments were obtained by the Minerals Management Service.

Disposing of offshore structures results in both positive and adverse environmental impacts. The positive impacts are related to potential fisheries aggregation and enhancement values of structural elements left in the marine environment. Potential adverse concerns include continuing navigational risks (which could lead to pollution damage) as well as the appropriate cleaning of structures, their physical removal, resulting bottom clean-up, the logistics associated with transport, and ultimate disposition. While each of these potential impacts is a subject of environmental concern, properly executed disposition was not cited as a major problem.

(b) Biological resources

When offshore structures are installed, they are colonized by a diversity of marine life. These may include barnacles, oysters, mussels, bryozoans, sponges, and (in subtropical or tropical waters) corals. These organisms attach themselves to and grow on the structure and provide a source of food and habitat for many invertebrates and fishes. Collectively, these life forms comprise the structure's bio community.

IV. RECOMMENDATIONS

1. An appropriate unit should be established under the Ministry of Mines and Energy, which should be in charge of platform removal and disposal.
2. Dump sites for ocean dumping should be established by the Government and the selected site should not interfere with shipping lanes; they should also be close to each major field.
3. The Government should have its representative inspect platforms before removal, during removal and during disposal to ensure that approved procedures are followed.
4. The cost for the disposal of platforms should be shared by the Government and the oil companies, according to the agreed arrangement of the production sharing principles.
5. The deck structure from an older non-producing platform should be reused if at all possible.
6. The possibility of removal, disposal or reuse of a structure should be considered in future platform design.

OPERATION AND DEVELOPMENT OF PRODUCT SHARING CONTRACTS IN INDONESIA*

Abstract

When the Government of Indonesia introduced the production sharing contract in the early 1960s, there were only six oil companies operating, mainly in onshore areas. Three of these were the young State-owned enterprises, while the other three were multinational members of the Seven Sisters who had held onshore oil fields since the beginning of the nineteenth century.

Driven by concern over the future of the national petroleum industry, the Government set up the National Oil and Gas Company, PERTAMINA, in the mid-1960s by way of integrating the three State-owned enterprises. Its main missions were to secure the need for domestic fuel consumption, and to earn foreign exchange through export, briefly, to serve the country in making the best use of the petroleum resources as national assets to fuel the economic development of the nation.

The Government introduced Law No. 8 of 1971 to allow the national oil company to operate on the national scene. The law also makes it possible for the company to develop cooperation with foreign companies and investors under an established legal base. The production sharing contract stems from this law.

Through the ups and downs of the industry in the course of history, the company has been able to carry out its missions, cooperate with foreign investors and adapt to changes in the international scene, including the recent global wave of environmental awareness through the operations of various legal frameworks. The national oil companies will have to meet perpetual change in the world over time, that will take a number of forms. It will certainly affect future petroleum operations.

We believe our production sharing system works well to cope with such changes. First, with the production sharing contract, the national oil company and the Government were able to construe the issues as an operational problem and thereby to address them at the operational level. Second, when the need to formalize the solutions into legal forms arises, the Government is ready with the legal frame that is appropriate to operational needs. So the solutions endorsed by the national oil company and/or the Government in a number of precedents had taken operational matters into account in a serious way.

The present paper describes the continuing recent efforts to adapt the production sharing contract to the needs of operations and provides a look into the future following the global trends in environmental awareness.

Introduction

Petroleum operations in Indonesia started as early as 1893, a few years after Colonel Drake ventured in with his drilling outfits. Indonesia was still under Dutch colonization at that time. When Indonesia freed itself to become an independent State in 1945, petroleum and other natural resources were declared national assets essential for developing the nation in the future.

These ideals were construed under the basic constitution of the newly independent Indonesia. The laws and the associated regulations governing the use of these national assets that were later derived embodied a philosophy in developing important resources critical for the lives of the people, such as petroleum.

In the early years of independence Indonesia adopted regulations established during Dutch rule before developing its own. It used the concession-type arrangement for the upstream ventures. It allowed operating companies to operate independently, paying royalty and taxes. As a measure of safety in operations it adopted Mining Policy Regulations. The operating company was initially the Royal Dutch Company. Two other American companies, Stanvac and Caltex, joined later to form the

* Presented at the 1992 Seminar by Gatot K. Wiroyudo, Trisakti University (at the request of PERTAMINA).

first three private operators in the earlier years of the petroleum industry in Indonesia.

The foreign concessionaires were independent operators. They operated for their economic interests. The Government of Indonesia, which was concerned with the future development of the national petroleum industry, found it necessary to replace the concession-type deal. It introduced the contract of work to replace the deal.

Under the new deal, the sharing of production replaced payment of royalty. The contracts required a commitment to exploration and development, but allowed the operating companies to operate independently for the Government.

Later in its development the contract of work expanded to form the basis of the production sharing contract. Only at that stage did petroleum operations start to extend into the offshore areas.

Status of production sharing contract operations

Petroleum activities have increased dramatically in Indonesia since the early 1960s along with the industry's acceptance of the production sharing contract. Starting with Asamera, which signed the first agreement in 1961, 44 production sharing contracts were operating by the early 1970s.

Figures 1 and 2 depict the number of petroleum working acreages in the last 10 years. They show companies operating in 29 offshore blocks in 1981, plus 4 blocks covering both offshore and onshore areas, increasing to 57 by 1991.

The statistics also show that the offshore blocks made up about 40-50 per cent of the total active blocks, the reason being that the geologic basins of Indonesia cover both onshore and offshore areas. Figure 3 depicts the distribution of geologic basins throughout the Indonesian archipelago. There are 60 identified sedimentary basins. Out of 36 basins explored in the last 25 years, 14 are producing now.

Under activities involving seismic surveys and drilling, most of the basins were explored, including the "fore-arc" basins in the exclusive economic zone. None of them, however, yielded production from the zone. The 16 producing offshore fields spread over to the "back-arc" basins of the inner continental shelf of the archipelago.

Figure 2 shows the distribution of major oil and gas fields, including those developed in the offshore areas. There are now 362 offshore structures operating, constructed at a water depth range of 25-100 metres. Maxus constructed the oldest one in 1971 to produce the Cinta field in the Sunda Basin, while enterprise is the latest operator to build an offshore installation, last year.

The statistics in figure 4 show the number of offshore constructions from 1981 to 1991.

We note from the illustrations that petroleum operations have been very active in the last 25 years. They are continuing now. For example, figure 5 shows how seismic surveys have been picking up in the last two years after a considerable drop in 1986 and 1987. From past experience, we may expect that exploratory drilling is likely to increase in the next two years following the upward trend of the seismic surveys (figure 6), provided that the oil prices are at least equal to or higher than the 1990 and 1991 price levels.

Should that be the case, we look forward to finding more oil and gas fields in offshore areas in the future.

Legal framework governing the petroleum operations

The Government of Indonesia implements a legal framework in the petroleum industry to serve three purposes. The first purpose is to portray the national philosophy that petroleum resources constitute a national asset: the nation should use them wisely in the best interests of the people. The second purpose is to coexist with the international community. The last is to provide the petroleum industry with a legal base on which to conduct operations.

The petroleum-related laws and regulations of Indonesia have evolved in the course of history. They follow three stages of development:

(a) Pre-independence period

(b) The period 1945-1980

(c) Post-1980

The following section discusses the development of a legal framework in each of the above stages to depict underlying policies and decisions affecting the petroleum industry in Indonesia.

(a) Development in the pre-independence period

The Dutch interest in Indonesia dates from 1602 with the formation of the Dutch East India Company, which controlled trade, mostly in spices and rubber, for the following 200 years. During this period, the Dutch set up many administrative organizations of control through which they excercised a strong influence over Indonesia, and eventually ruled the country. The Netherlands East India Government introduced a culture system in the 1830s by which villages could either pay a land rent to the government or cultivate one fifth of the lands in crops by order of the government. Indonesia was a feudal, agrarian society and the government intended to keep it that way.

The imposition of foreign control allowed an active search for oil in Indonesia. Active exploration started as early as the 1870s on the Indonesian islands. A.J Zilker drilled in North Sumatra and proved the areas' potential in 1885. His discovery set off a wide search for Indonesian oil. J.A Dilder built a refinery it 1892, and by 1898 the Royal Dutch Company had begun building storage and shipping fascilities in Pangkalan Susu and constructed the first oil shipping port in the country. The Far Eastern market received oil shipped from this port.

In the quest for oil, the Shell Transport and Trading Company established a refinery in East Kalimantan in 1894. In 1902, the Royal Dutch and Shell companies merged to form Shell Transport and the Royal Dutch/Shell group of companies, later known as "Shell". During that time, 18 oil companies were exploring and producing oil.

Dutch law restricted exploration activities undertaken by foreign companies at that time. Foreign companies intending to obtain concessions and exploration rights had to join with Dutch companies. This regulation created conflicts between the Dutch companies and their "foreign" counterparts. In 1918, the Mining Law of 1899 was amended to lift the ban on concession grants and that made it possible for companies to obtain concession rights with less legal conflict.

Before the Second World War, Shell employed a large number of foreigners, mostly Dutch, with some British, American and Romanian participation. Few Indonesians were employed in administrative, supervisory or technical positions, nor did they receive training. Although Indonesia had resented foreign dominance for years it was only after it gained its independence in 1945 that Indonesians recognized their opportunity to make use of the natural resources existing in the country for their own benefit. Indonesia proclaimed that its natural resources belonged to the people. They are national assets to be used in the best interests of the people as a whole.

The subsequent development of Indonesia's petroleum industry has been aimed at realizing this ideal. To a large extent it was a reaction against the dark foreign dominance in the history of Indonesia.

(b) Development in the period 1945-1980

In 1950, the entire Indonesian economy was predominantly foreign-owned and foreign-managed. The big three oil companies, Shell, Stanvac and Caltex, dominated Indonesia's oil industry. For the most part, with the exception of oil, Indonesia was still an agriculture-based country. Foreign exchange earnings were very small. Driven by the need to gain more from the exploitation of its natural resources, Indonesia wanted to increase its control over the oil industry.

The earlier part of the second period of development was a period of struggle for control between Indonesia as the host country and the three foreign companies. Lacking the capital to finance ventures, Indonesia also realized that it lacked the management skill and technology to undertake total control on its own. Indonesia was aiming at collaboration arrangements to encourage foreign capital investment on a contractual, not a concessional, basis. Indonesia would retain management and control, and would arrange production sharing agreements instead of profit sharing agreements.

In the 1960s, the Government introduced a new mining law that required government approval before any new contracts were signed. Law

No. 44, as its was called, required that all mining projects of mineral oil and gas be undertaken by the State or by the State with the collaboration of private enterprise. In that way Indonesia could make use of what it had — petroleum resources — in exchange for what it lacked: technology and funds, to develop the country and make it grow.

The Indonesian interests were concerned about the future growth and development of the industry besides some assurance of revenue stability. The Government found it necessary to pool resources, workforce and capital.

Since the early 1950s there have been three State-owned enterprises. None of them had enough capital or experience to undertake capital-intensive oil and gas ventures. After much consultation and deliberations, the Government finally issued a Law No. 8 of 1971 establishing an integrated single national oil company, PERTAMINA.

Having complete control over the industry and an integrated national oil company the Government is now ready to embark on more intensified undertakings. Through PERTAMINA, the Government continues to invite foreign investments by means of production sharing agreements. Foreign companies that subscribed to the production sharing agreements were not only the majors but also the smaller independent companies. They viewed production sharing agreements as the better way to avoid the friction that had usually developed in the past between the host country and the foreign enterprise over profit shares and price. Production sharing contracts also allow both parties to specify initially the monetary terms of the contract, a firm commitment on work programmes and the guaranteed share of production if oil is discovered and developed commercially.

That was the main stream of development between 1945 and the 1980s. The focus of the later part of this second period of development was to adapt to the dynamic change of the international community — a change of theme from the previous efforts, which consisted of the consolidation of internal resources to gain better control over the use of the national assets. None the less, the need to adapt to the requirements of international development had started as early as 1961, when Indonesia issued Law No. 19 to accept the Geneva Convention of 1958 in 1962, Indonesia joined OPEC to seek cooperation among the oil exporting countries in dealing with oil prices. Indonesia also pursued regional cooperation actively by setting up the ASEAN Council on Petroleum among ASEAN member countries in the early 1970s.

After the Stockholm Conference on the Environment in 1972, Indonesia established the State Ministry of Environment in 1978. In 1983, this Ministry assumed a greater role and supervisory responsibility in dealing with population and environmental management.

With such sets of laws and ensuing regulations, PERTAMINA assumed the role of government agent to translate them into operational matters so that activities and petroleum operations ran smoothly. This approach is also intended especially to meet the international community standard of quality in petroleum operations.

(c) Development post-1980

Using the production sharing contract as a legal framework PERTAMINA has been able to meet its intended functions. On the one hand, it acts as government agent and assumes the responsibility of conveying the Government's policy by implementing laws and regulations. On the other hand, it acts as a business party to the industry and has to meet stringent business requirements. This means coping with a large number of problems. However, recently PERTAMINA has demostrated that it was able to response to the industry's problems adequately, partly because it was able to contain problems at the operational level and to solve them promptly at that level, and partly because of the flexibility of the production sharing contract that allows the industry and PERTAMINA to solve problems reasonably. This operational mechanism seems to work well with all kinds of issues and on all scales. it ranges from global issues such as environmental issues to business issues and regional cooperation.

This may not necessarily be the outcome of the production sharing contract as such, but perhaps one of the most obvious reasons is that the contract is a product of the philosophy of cooperation. And because of this underlying philosophy it is probably better able to accommodate differences inherent between the host country and its counterparts.

The development of the legal framework after the 1980s was therefore more and more to promote international cooperation in business as well as cope with the environmental issues. The production sharing contract had to adapt once again to the new tax law issued in 1984, which affected operations strongly. A substantial adjustment to the production sharing contract was necessary to enable it to remain economically attractive. After this new tax law, the Government has not issued any other new Law governing the petroleum industry particularly, in fact since law No. 8 of 1971.

On the other hand, the business climate in Indonesia has taken a new course since the early 1980s. The Government adopted a market-oriented business policy to allow even greater flexibility in the overall business climate. Although the government policy was aimed at non-petroleum business, it exerted a considerable influence on the petroleum sector. Adjustment to the production sharing contract was also necessary at that stage to meet the spirit of deregulation introduced by the Government. The adjustment was an overall improvement in existing procedures.

Contrary to the improvements in business through the deregulation policy, the government policy on the environment has been gaining greater momentum and exerted more and more influence on operations. This is due to developments on the international scene, where environmental awareness is also gaining strength. As a hint of acceptance of the global wave of environment awareness, Indonesia issued Environmental Policy Act No. 4 in 1982, describing the principles of environmental management. In 1986, the Government issued Regulation No. 29, which obliged operators to carry out an environmental impact assessment before undertaking a project that has a substantial impact on the environment. The Government also established an Environmental Control and Monitoring Agency, through Presidential Decree No. 23 of 1990.

The impact of those rigorous regulations on environmental management to production sharing contract operations is obvious. Their strict implementation in the field increases operating costs. This holds true now with the requirements for better treatment of water discharged from drilling, in treating and production facilities, mercury and sulphuric gas vents, carbondioxide venting, etc. The more green we want the world to be the more costly it will be.

The production sharing contract will have to treat the cost involved in meeting the environmental protection measures at the operational level. It will certainly require adjustment to the cost recovery procedures in the production sharing contract, but the point is that it will be able to absorb the costs at the operational level.

Problems with the environmental issues

Dilemma in the developing countries

The developing countries are facing a dilemma when it comes to a decision whether to continue using their natural resources or to stop using them for the well-being of the living environment of the world. Natural resources for the developing countries are often the only means of living, the only means to improve the quality of their lives. It would be inconceivable for them not to use these resources.

At a closer look it becomes evident that the consumers of these natural resources are the developed countries. The question is who should bear the cost of protecting the environment. Neither the developing countries nor the consuming countries will, if they are to bear it alone. Somehow the solution will be likely to a share of the burden by both the producer and the consumer. In the case of the production sharing contract, it will have to be the burden of both the host country and the operators.

How to cope with the issues

In the course of time the production sharing system may have to face changes continuously. It may be the usual business change, or some remote yet powerful change as a result of development in other domains outside the oil and gas business.

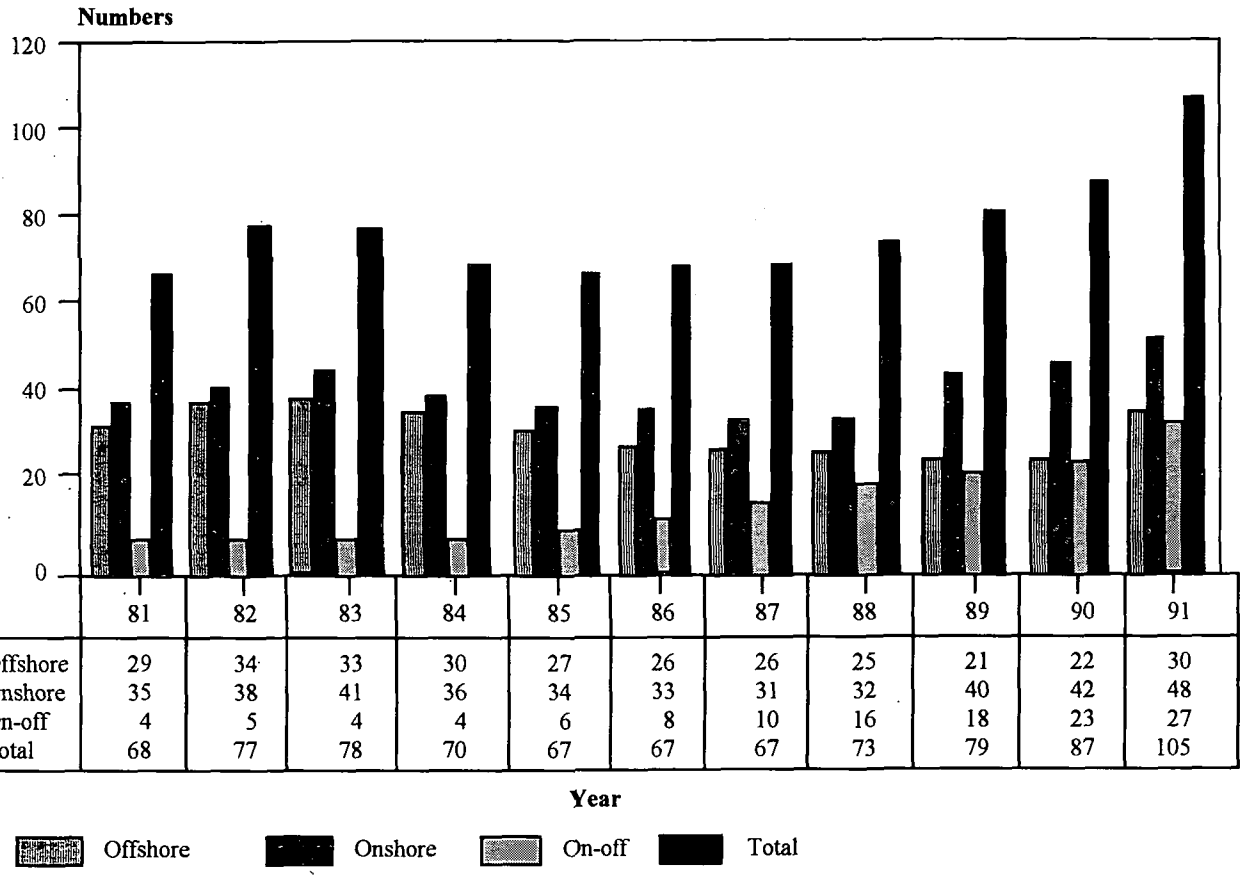
Any changes which had taken place in the past were absorbed into the operational level. Such an approach worked well in the past and it has no reason to be otherwise in the foreseeable future.

The philosophy underlying the production sharing contract is the spirit of cooperation. It allows both parties to achieve a "win-win" situation — a better approach than the profit sharing arrangement in which one party may dominate over the other.

Under the spirit of cooperation, the production sharing agreement offers means of cooperation between the host country and its partners by way of trade-offs. The host country, having the natural resources to offer in return for technology and funds for investment owned by the foreign partner, also assumes the responsibility of maintaining a favourable investment climate. It is therefore obliged to look for an acceptable solution in case of troubles.

The operations of the production sharing contract over the last three decades have proved that it has withstood the test of time. It offers enough flexibility to face world change in the future.

PSC working area, 1981-1991



	81	82	83	84	85	86	87	88	89	90	91
Offshore	29	34	33	30	27	26	26	25	21	22	30
Onshore	35	38	41	36	34	33	31	32	40	42	48
On-off	4	5	4	4	6	8	10	16	18	23	27
Total	68	77	78	70	67	67	67	73	79	87	105

Note: Status October 1991.

Figure 1. Graphic overview of Indonesian hydrocarbon production, 1981-1991

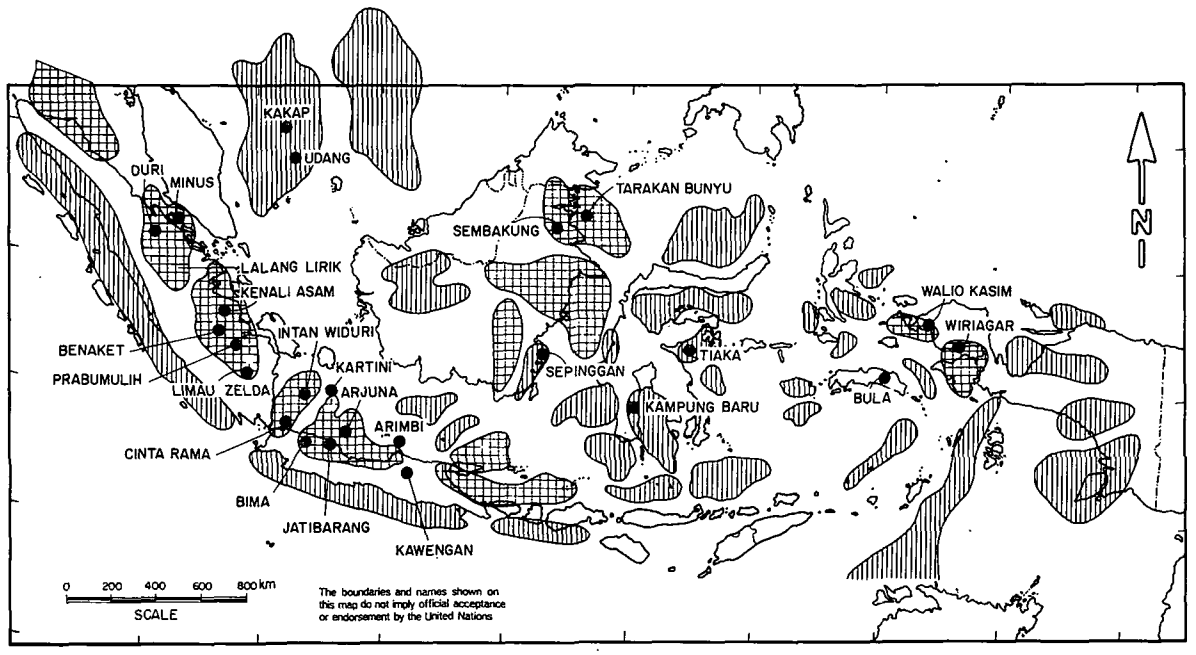


Figure 2. Major oil/gas fields

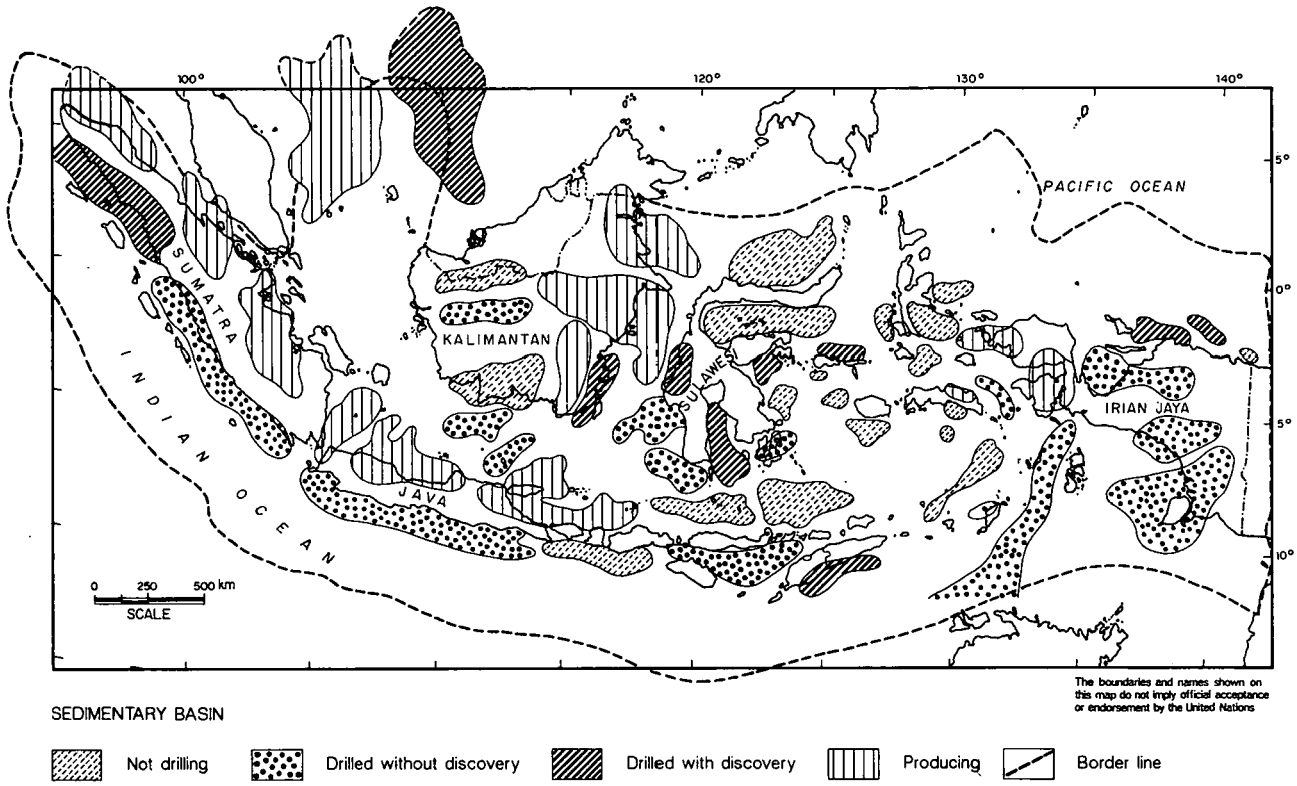
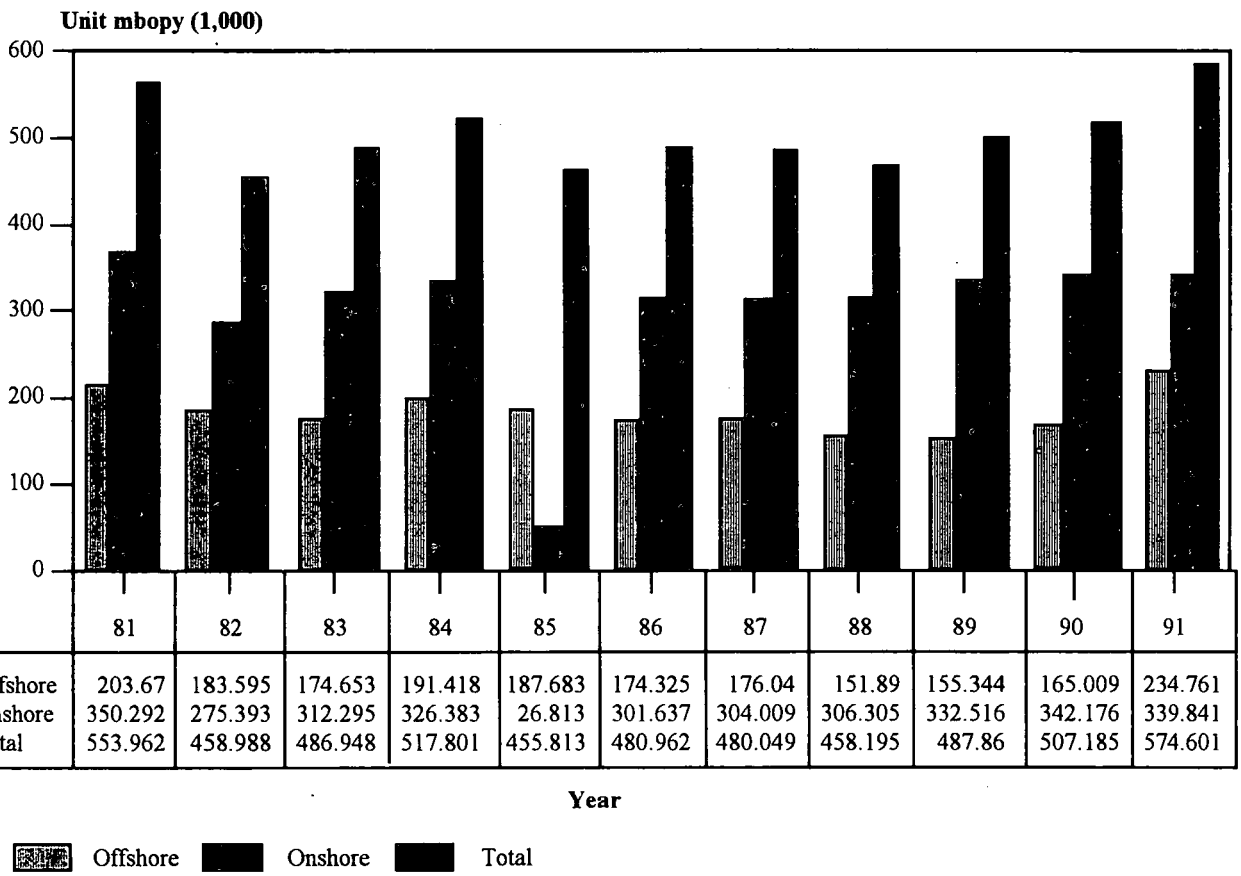


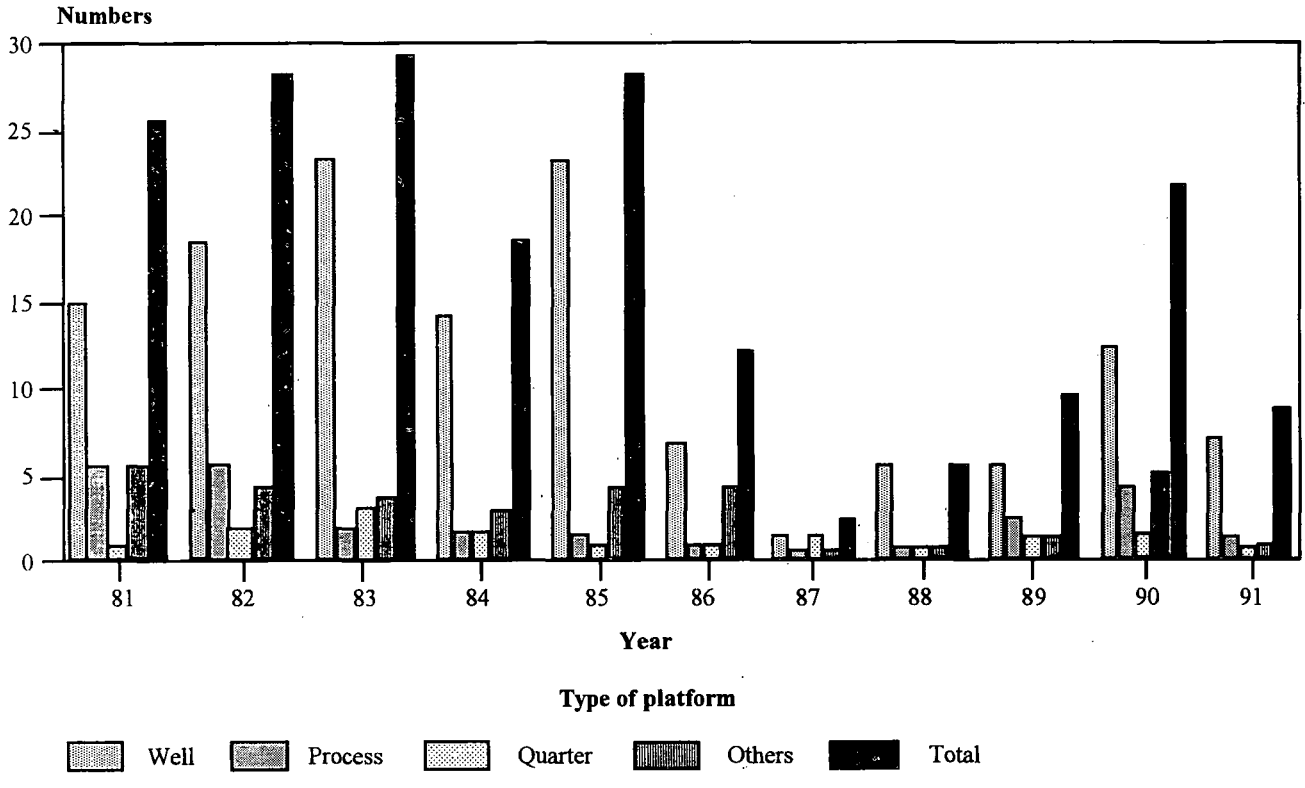
Figure 3. Sedimentary basin



	81	82	83	84	85	86	87	88	89	90	91
Offshore	203.67	183.595	174.653	191.418	187.683	174.325	176.04	151.89	155.344	165.009	234.761
Onshore	350.292	275.393	312.295	326.383	26.813	301.637	304.009	306.305	332.516	342.176	339.841
Total	553.962	458.988	486.948	517.801	455.813	480.962	480.049	458.195	487.86	507.185	574.601

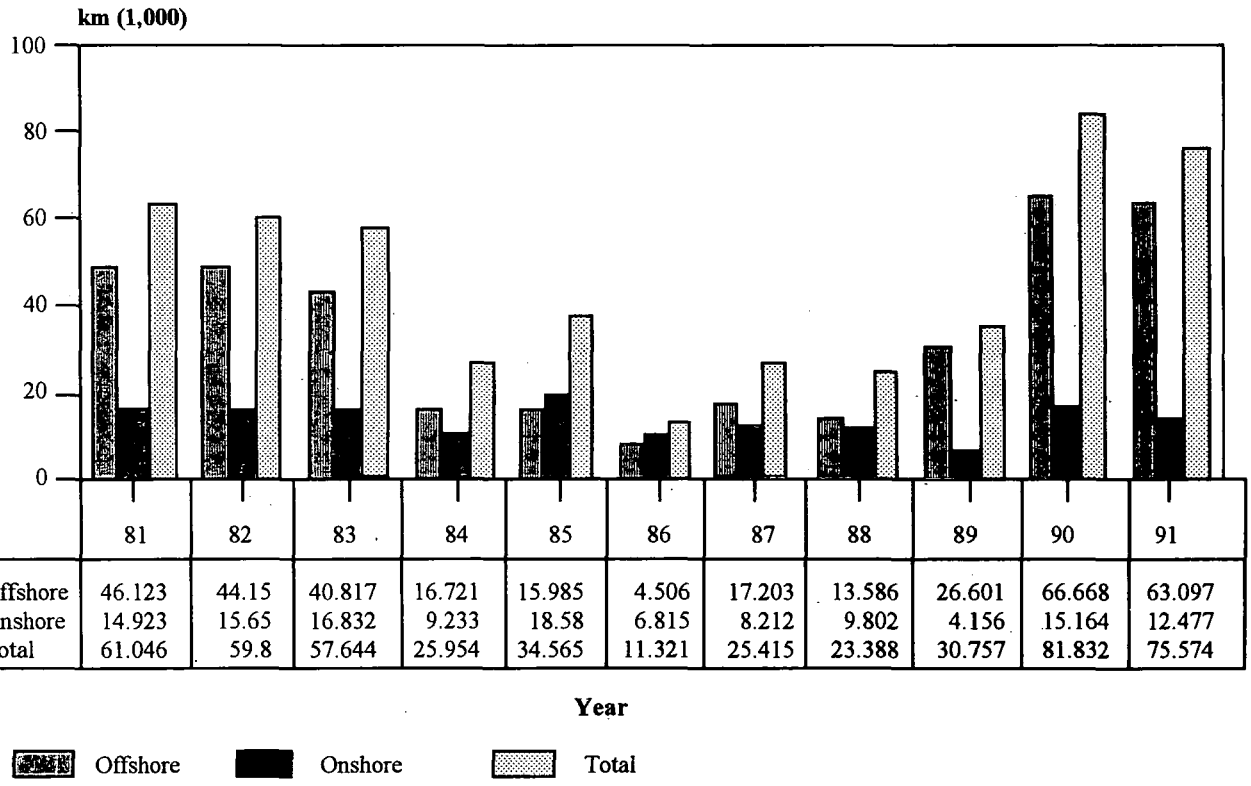
Note: Status October 1991.

Figure 3a. PSC oil production, 1981-1991



1. Status October 1991
2. Others = Junc. Flare. Brid. Sup. H. Trp.

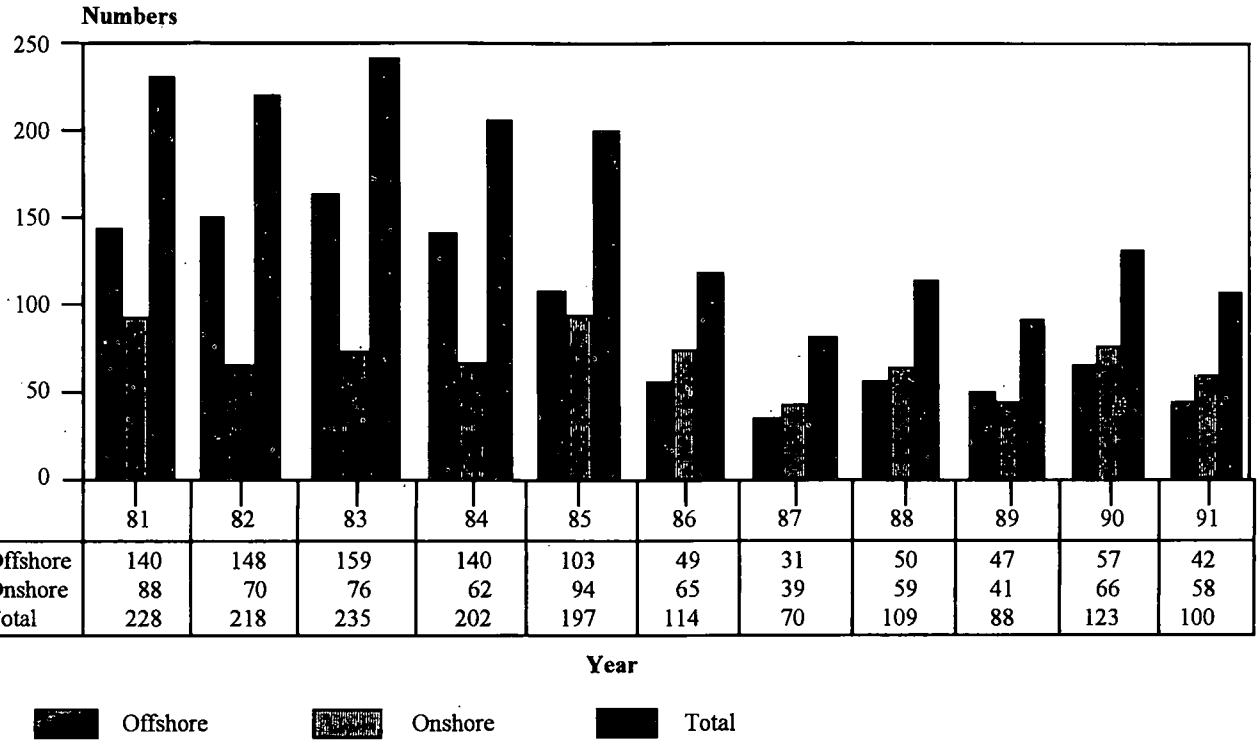
Figure 4. Offshore structure – construction, 1981-1991



	81	82	83	84	85	86	87	88	89	90	91
Offshore	46.123	44.15	40.817	16.721	15.985	4.506	17.203	13.586	26.601	66.668	63.097
Onshore	14.923	15.65	16.832	9.233	18.58	6.815	8.212	9.802	4.156	15.164	12.477
Total	61.046	59.8	57.644	25.954	34.565	11.321	25.415	23.388	30.757	81.832	75.574

Note: Status October 1991.

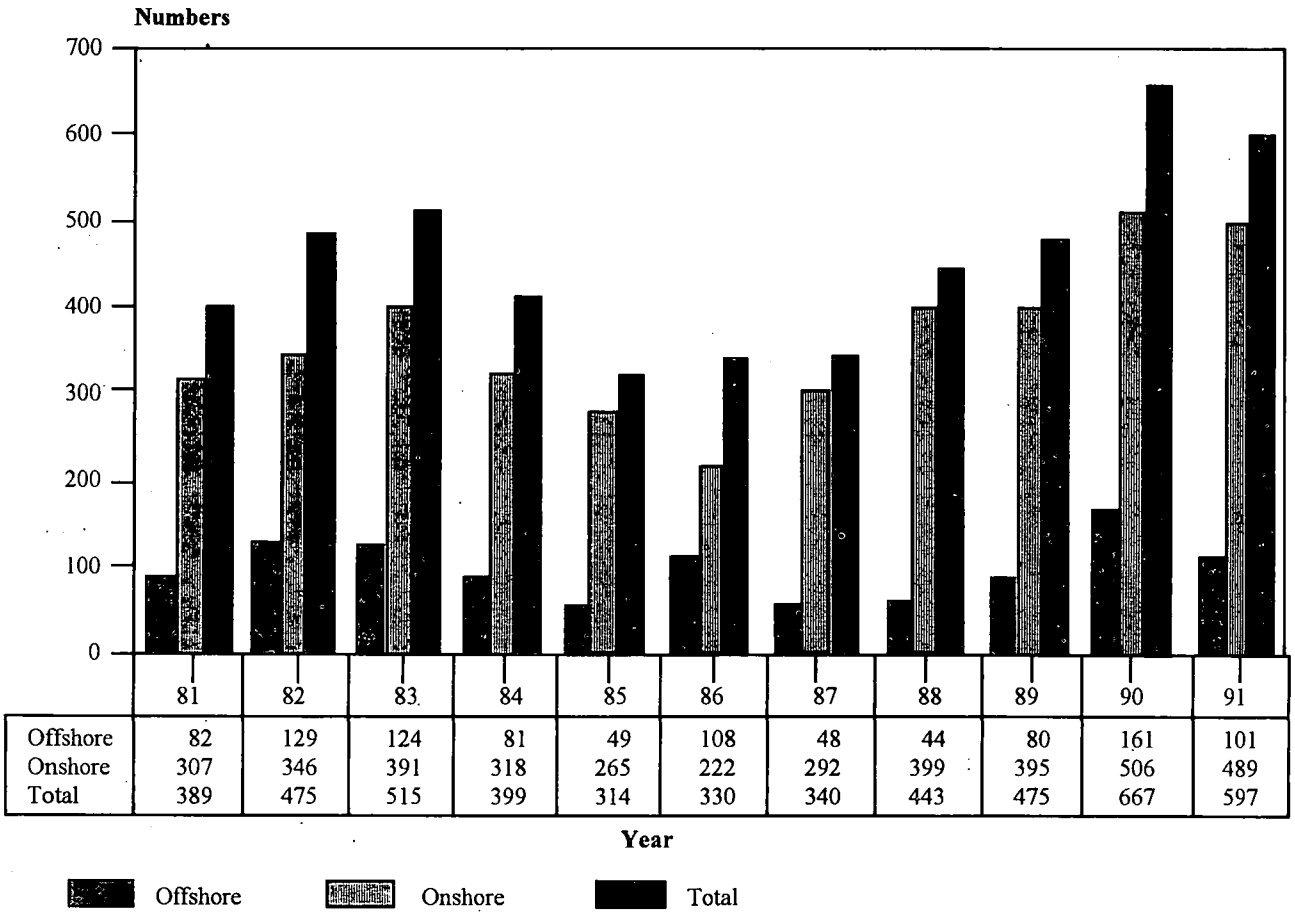
Figure 5. PSC seismic survey, 1981-1991



	81	82	83	84	85	86	87	88	89	90	91
Offshore	140	148	159	140	103	49	31	50	47	57	42
Onshore	88	70	76	62	94	65	39	59	41	66	58
Total	228	218	235	202	197	114	70	109	88	123	100

Note: Status October 1991.

Figure 6. PSC exploration wells 1981-1991



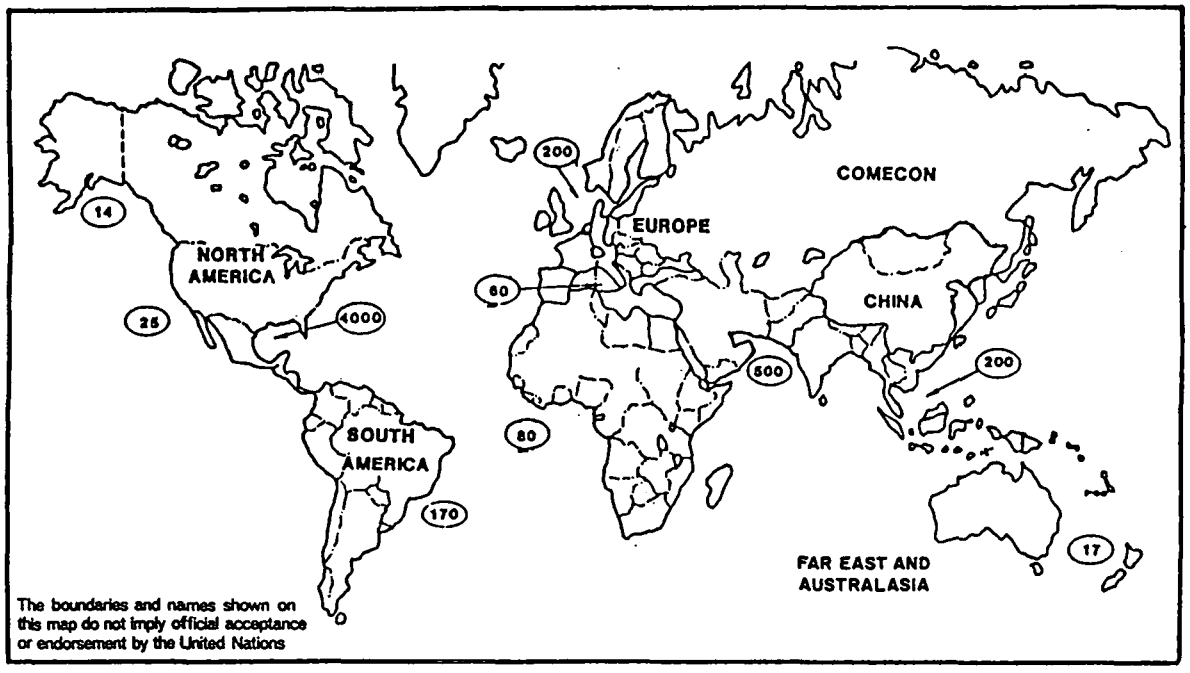
	81	82	83	84	85	86	87	88	89	90	91
Offshore	82	129	124	81	49	108	48	44	80	161	101
Onshore	307	346	391	318	265	222	292	399	395	506	489
Total	389	475	515	399	314	330	340	443	475	667	597

Note: Status October 1991.

Figure 6a. PSC development wells, 1981-1991

A WORKING PAPER ON PLATFORM ABANDONMENT — THE MALAYSIAN EXPERIENCE*

Platform distribution worldwide



- In Malaysian waters, there are well over 160 offshore structures installed in water depths ranging from 10 to 90 metres, and a total weight ranging from 90 to 9,000 tons.
- Some of these platforms were installed as early as the 1960s and all of them are still producing.
- Under Malaysian law, there is no provision under the Exclusive Economic Zone Act 1984 requiring the removal of disused or abandoned platforms/jackets. The Act only contains a provision dealing with the removal of disused submarine cables and pipelines.

However, section 6 of the Continental Shelf Act 1966 allows the Yang Di Pertuan Agong to make regulations for the removal of installations located in the continental shelf area which have been abandoned or become disused. So far no regulations have been enacted pursuant to the said section.

There is no provision in the current production sharing contract (PSC) except in the 1985 PSC with SSB/PCSB JV, requiring the removal and disposal of disused structures. Under article 10 of the 1985 PSC with SSB/PCSB JV, the contractor is responsible for removing and disposing of disused structures, and contributing Malaysian ringgits 1.5 million annually towards the costs of removal of the facilities.

To date, one manifold jacket in 50 ft of water, 2 SBMs and 1 SALM have been totally removed.

A. Existing legislation

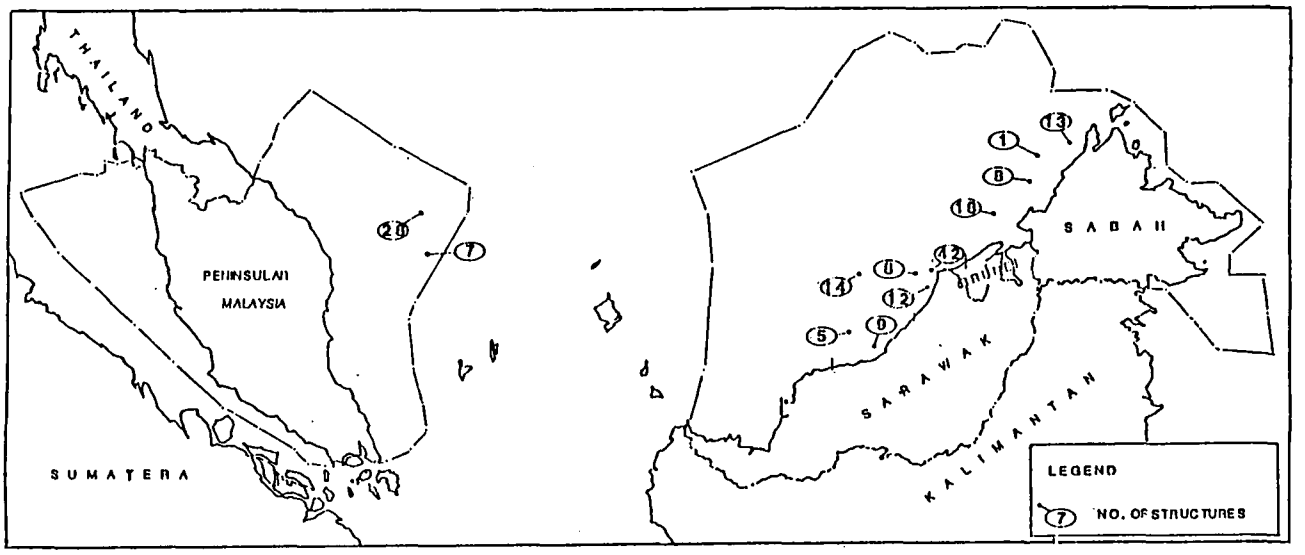
1. Removal

The Geneva Conventions (1958)

- Convention on the Continental Shelf
- Convention on Fishing and Conservation of the Living Resources of the High Seas
- Convention on the High Seas
- Convention on the Territorial Sea and Contiguous Zone

* Presented at the 1989 Seminar by Yeow Kian Chai, PETRONAS.

Platform location in Malaysia



Article 5(5) of the 1958 Convention on the Continental Shelf

"Due notice must be given of the construction of any such installations, and permanent means for giving warning of their presence must be maintained. Any installations which are abandoned or disused must be entirely removed".

1982 United Nation Conference on the Law of the Sea, article 60(3)

"Due notice must be given of the construction of such artificial islands, installations or structures, and permanent means for giving warning of their presence must be maintained. Any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation, taking into account any generally accepted international standards established in this regard by the competent international organization. Such removal shall also have due regard to fishing, the protection of the marine environment and the rights and duties of other States. Appropriate publicity shall be given to the depth, position and dimensions of any installations or structures not entirely removed".

Currently 48 countries (1986 figure) have ratified the Convention. Malaysia is a signatory and preparations are Under way for ratification of the Convention. The law will come into force 12 months after 60 countries have ratified it.

IMO (International Maritime Organization)

IMO is the competent organization referred to in the 1982 Convention to formulate international standards for the removal and retention of abandoned installation.

- The Subcommittee on Safety of Navigation provided guidelines for the complete removal of structures in less than 75 metres water depth or weighing less than 4,000 metric tons.
- Water depth increased to 100 metres for platform installed after 1 January 1988 and all structures to be installed should be designed/constructed for total removal upon abandonment.
- Coastal States involved have the discretion to waive the removal requirement if it involves extreme cost, is technically not feasible or involves an unacceptable risk to personnel or the marine environment.
- For partial removal, a minimum of 55 metres clear water depth is required for safe navigation.

E and P Forum (Oil Industry International Exploration and Production Forum)

- Platforms be removed to provide a clear water depth of 40 metres below the surface with provisions for certain exception.

- Disposal on sites and any areas designated as artificial reef sites.

ASCOPE draft proposal (based on Indonesia's proposal)

ASCOPE (ASEAN Committee on Petroleum Exploration) is reviewing/commenting on IMO drafts on the removal of disused offshore installations and structures in the EEZ and Continental Shelf Act. The comments are to be submitted to IMO through the E and P Forum. The comments were discussed in February 1988 with no official confirmation of the ASCOPE stand.

French proposal

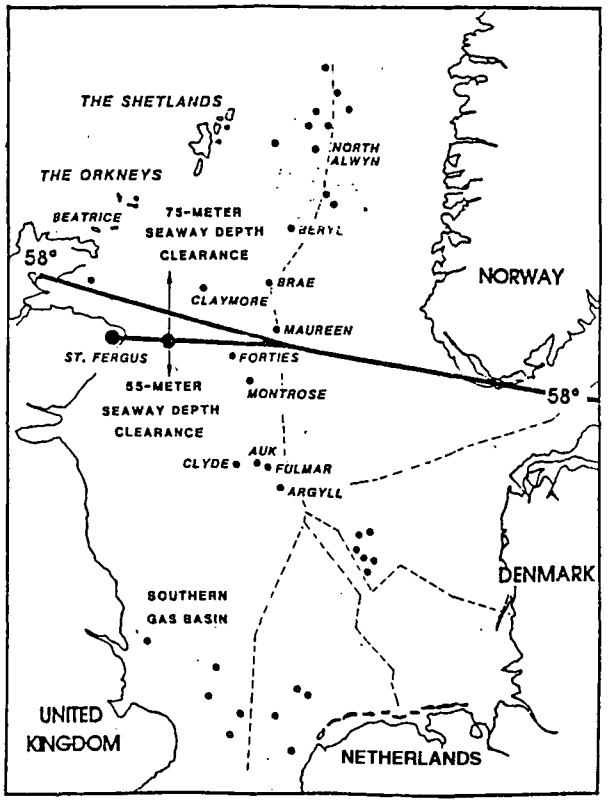
Any installations or structures which are abandoned or disused shall be removed in order to ensure the safety of navigation and to take into account fishing, the protection of the marine environment and the rights and duties of other States. Accordingly, such installations and structures shall:

- "Be entirely removed if the seabed on which they rest is at a depth of 60 metres or less;
- Be dismantled in such a way that structures not entirely removed do not exceed a height of 10 metres above the seabed, if the latter is at a depth of between 60 and 510 metres;
- Be dismantled from the surface to a depth of 500 m if the seabed on which they rest is at a depth of more than 510 metres.
- The marking of installations and structures shall be maintained until completion of the work of dismantling, of which adequate advance notice shall be given. The position, depth and dimensions of any installation or structure which has not been entirely removed shall be indicated by the coastal State on charts on the appropriate scale, to which due publicity shall be given and a copy of which shall be deposited with the international organization competent to ensure the implementation of the provisions of this paragraph".

United Kingdom proposal

Due notice must be given of the construction of such artificial islands, installations or structures,

Clearance for UK platform abandonment proposal



The boundaries and names shown on this map do not imply official acceptance or endorsement by the United Nations

and permanent means for giving warning of their presence must be maintained. Any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation, taking into account any generally accepted international standards established in this regard by the competent international organization. Such removal shall also have due regard to fishing, the protection of the marine environment and the rights and duties of other States. Appropriate publicity shall be given to the depth, position and dimensions of any installations or structures not entirely removed.

United Kingdom Petroleum Act (April 1987)

Came into force in July 1988. The main provision of the first part of the Act is to empower the Secretary of State to require operators jointly to prepare and submit an abandonment programme. All operators are required to submit details of their joint abandonment agreement by 1 July 1988.

- Total removal in shallow water to 40 metres below the surface.

- Completely clear the sea to a depth of 55 metres south of 58th parallel/St. °Fergus line.
- Above 58th parallel/St. Fergus line, 75 metres clear water is required.

United States of America

- Recommend complete removal based on the 1982 Convention on the Law of the Sea and article 5(5) of the 1958 Geneva Convention.

Germany

- National rules and regulations require installation to be completely removed. No dumping of installation on location is allowed.

Norway

- No firm position; decision based on navigational safety considerations.

Australia

- Platform removal is a statutory requirement in Australian offshore legislation — the Petroleum (Submerged Lands) Act 1967.
- Estimated removal costs in Bass Straits are about US $ 70 million each.
- Pipeline removal is not required.

2. Disposal

1982 Convention on the Law of the Sea, article 1.1(5)a

Defines dumping as:

(i) Any deliberate disposal of wastes or other matter from vessels, aircraft or other man-made structures at sea:

(ii) Any deliberate disposal of vessels, aircraft, platforms or other man-made structures at sea;

Article 210, paragraph 5, states that "Dumping within the territorial sea and the exclusive economic zone or onto the continental shelf shall not be carried out without the express prior approval of the coastal State, which has the right to permit, regulate and control such dumping after due consideration of the matter with other States which by reason of their geographical situation may be adversely affected thereby".

Oslo Convention (1972), article 19(1)

Defines dumping as:

(i) Any deliberate disposal of substance and materials into the sea by or from ships and aircraft other than:

(a) Any discharges incidental to or derived from the normal operation of ships and aircraft and their equipment;

(b) The placing of substances and materials for a purpose other than the mere disposal thereof...".

(ii) It requires dumping in 2,020 metres of water and at least 150 nautical miles from land, to be carried out under licence.

B. Industry practices

Gulf of Mexico

- Most concentrated area which contains over 4,000 producing structures, 90 per cent of which are in water less than 200 ft. Two thirds are less than 20 years old.
- Refurbish for reuse/redeploy at new locations, currently water depth involved is less than 250-300 feet, most less than 100 feet.
- 159 platforms removed as of 1985; 88 were considered in 1987.

North Sea

- **Dutch sector**

— Removal (15 m above seabed) of a Pennzoil Block K13 DE and K13 CF (4-pile jacket) gas satellite platform in 26 metre water.

Jacket weighs 700 metric tons, top-sides 870 metric tons. Jacket installed in 1979.

— Jacket to be refurbished/modified for use in L8 gas field.

- **United Kingdom sector**

— Complete removal of a B.P West Sole WE satellite platform.

— Partial removal to a depth of 75 metres for Piper Alpha (proposed).

Malaysia

- Complete removal of a pipeline manifold jacket in 50 feet water depth (West Lutong Pipeline Manifold Jacket). Jacket weight, including decks, was 200 tons.
- Complete removal of an offshore SALM (Tapis Offshore Loading Terminal) offshore Peninsular Malaysia.
- Complete removal of 2 SBMs (SBM 1 and 2 offshore Sarawak).

C. Platform removal projects

Structure	Operator	Water depth	Method
West Sole WE (1978)	British Petroleum	85 ft	• 180 tons top-side removed by cutting jacket at 45 ft above sea level. • 260 ton jacket removed by underwater cutting.
Block K13D satellite (Summer 1988)	Pennzoil Netherlands	85 ft	• Remove in 3 separate lifts using SSCV Balder. • Deck was refurbished for use in Block L8. • Jacket legs cut by explosive.
Piper Alpha (planned)	Occidental, UK	470 ft	• Jacket legs cut by explosive.
West Lutong Pipeline Manifold Jacket (1987)	Sarawak Shell/ PETRONAS	50 ft	• Remove in a single lift using DB15, transport via Intermac 250. • Jacket legs cut under water by divers.
Gulf of Mexico Brazos Block A-106 (1985)	Shell	197 ft	• Sirius III of 2,000 ton lifting cap and 432 ft launch barge. • Reverse launch method.

D. Options for alternative uses of disused platforms

Abandonment	Alternative uses
• Abandonment *in situ* • Partial removal • Toppling *in situ* • Complete removal • Wreckage • Artificial reefs	• Refurbish for use at other locations • Marine/maritime research facility • Search and rescue facilities • Communication/navigation aids • Prisons • Wing/wave power stations • Fish farms • Diver training centre • Test facility for new evacuation/survival • Military use • Waste disposal

E. Factors to consider for total versus partial removal

(1) Deepest vessel draft in the area, compare with charted shipwrecks in the area

(2) Draught of semi-submersible.

(3) Submarine activities

(4) Fishing industry problems with partial removal — trawling boards/nets

F. Current removal technology

- Essentially reverse of installation
- Extensive use of cargo and barges, underwater cutting and use of shape charges
- Use of flotation tanks

G. Future development

- Use of liners and explosives and cut from internal side 3 of legs
- New platform design incorporating features to facilitate removal
- Use of corrosive chemical cutting
- Use of "Hand truck", long grappling arm and buoyancy tank for lifting
- Use of single barge and vertical jack for lifting

H. Policy regarding removal costs

Australia

- Deductible expense with full carryback

United States of America

- Deductible in the years expenditure is incurred and full carryback

New Zealand

- Same as for United States of America

Netherlands

- Future abandonment costs are estimated and deflated.
- Deflated value is spread over the life of the field on a unit-of-production basis.
- Annual charge is calculated against the production profit tax liability.
- In the first year of tenable income, the charge is deducted from a company's profit tax liability, and the same amount is deducted from the estimated abandonment cost.
- In subsequent years, the estimated abandonment cost is reassessed in the light of inflation using this method, and full relief is taken of abandonment costs.

Special provisions rule that when abandonment costs prove to be higher than estimated, any resulting loss may be carried back for three years against corporation tax. On the other hand, when abandonment costs are lower than expected, an additional payment to the Government will have to be made as compensation for the higher level of tax relief already claimed.

Norway

- In 1985, Norway announced plans for dealing with abandonment costs in the form of a direct grant based on the tax paid. Thus the Government's share of costs may work at zero.

Ireland

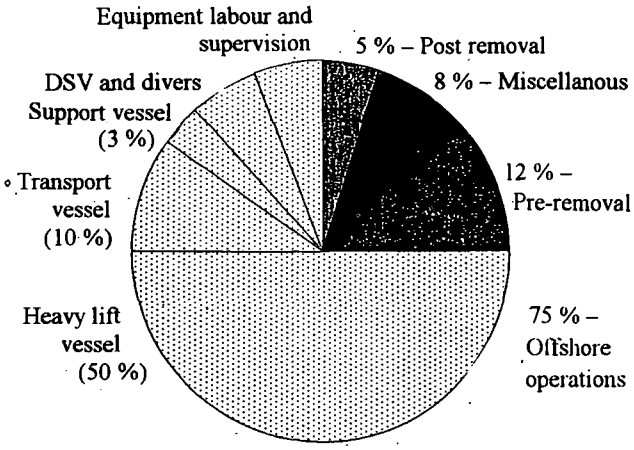
- Abandonment costs covered by terminal loss provisions under its corporate tax legislation of 1976, where a loss incurred during the final accounting period — before trading has formally finished — may be carried back over the previous three accounting periods.

I. Removal costs

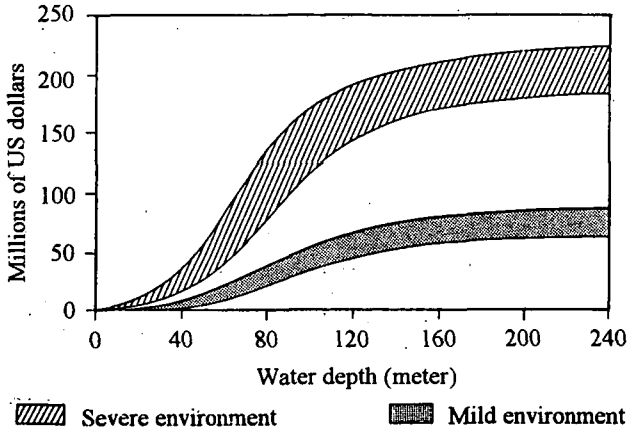
- Malaysia Actual Removal Cost (1987) — Sarawak Shell/PETRONAS

—	West Lutong Pipeline Manifold Jacket (50 ft depth)	$M 1.1
—	SBM-1 (47 ft depth)	$M 0.7
—	SBM-2 (47 ft depth)	$M 0.7
	Total	$M 2.5 million

- BP West Sole WE — Cost breakdown of platform removal



- Analysis of platform removal costs estimated by E and P Forum, Mineral Management Services, Taywood Santa Fe Ltd., Malaysian Cost-screening Study, etc is given below:



J. Malaysian cost-screening studies

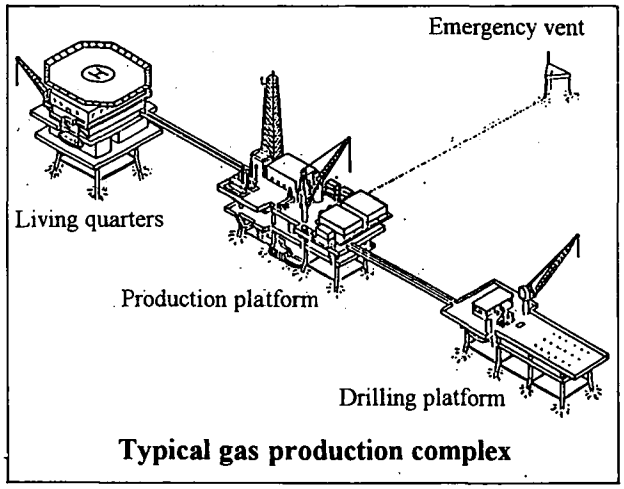
- Typical platforms are identified and abandonment procedures evaluated under total, partial and "leave *in situ*" scenarios.
- Cost data are generated. Water depth sensitivities were developed for "ball park" figures of other structures.
- Detailed abandonment steps/execution plans were developed.
- Work scope/terms of reference of cost-screening studies are:
  - — Complete removal of platform and facilities, excluding wells
  - — Partial removal of platform and facilities, excluding wells
  - — Toppling *in situ* to free water depth of between 40 m and 50 m
- The studies are undertaken by both production sharing contractors' in-house staff and engineering consultants.
- The schedule for the studies is shown below:

Milestones	Jun '88	Jul '88	Aug '88	Sep '89	Oct '88	Nov '88	Dec '88	Jan '89	Feb '89	Mar '89	Apr '89	May '89	Jun '89
	Data gathering			Develop options		Cost screening studies						Report submission	

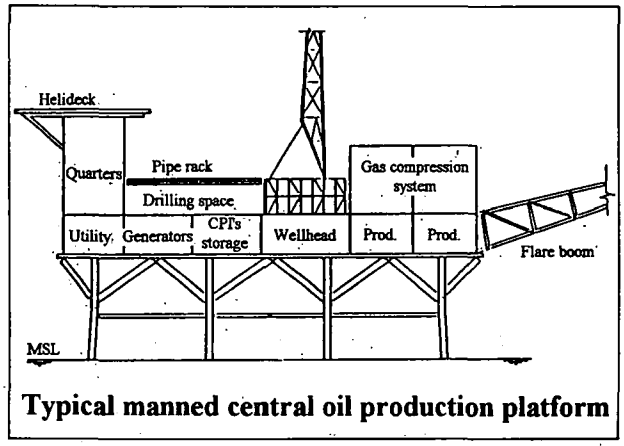
Data gathering	Develop options	Cost screening studies	Report submission
* Industry practices – Gulf of Mexico – North Sea * Existing legislation – IMO – United States Geological Survey – Department of Energy – 1982 Convention on the Law of the Sea * Technical literature – E and P Forum – Offshore Technical Conference Papers – Trade Journal * Completed case studies – North Sea	* Total removal * Partial removal * Maintain *in situ* * Other applications – Fish Sanctuary – Military use – Lighthouse	* For each option develop site-specific cost studies – 4 selected structures O/S Terengganu – 5 selected structures O/S Sabah/Sarawak * Water depth sensitivities studies * Detailed platform component removal cost * Detailed execution plans	* Analysis of options and implications * Suggestions on best option in Malaysia Environment

Key player	Shell/ESSO PETRONAS	Shell/ESSO PETRONAS	Shell/ESSO/Consultant	PETRONAS

- The diagrams depicting typical Malaysian offshore structures that were selected for the studies are given below:

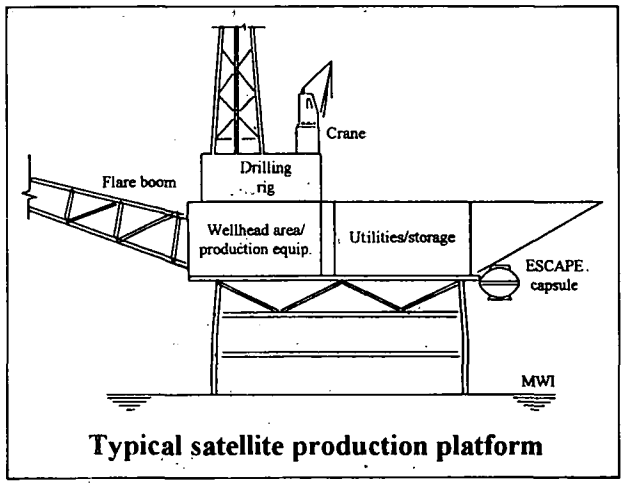


Typical gas production complex



Typical manned central oil production platform

- The results of the cost-screening study on three selected platforms and one SALM are summarized as follows:



Typical satellite production platform

The most costly option evaluated is total removal of the platform with subsequent onshore disposal. Platform abandonment costs (exclusive of well abandonment) can be reduced as much as 50 per cent if the "topple *in situ*" option is used in place of total removal. The topple *in situ* or partial removal options provide 40-55 m of clear water depth and thus would present no hazard to navigation.

The option of using exclussively non-explosive cutting techniques was evaluated as a sensitivity. Such a constraint would have a significant impact on costs of platform abandonment, amounting to as much as US $670,000.

- Basic steps for complete removal:

(1) Engineering studies, planning and design to evaluate aspects, including:

— Well abandonment

Structure	*Jacket weight (metric tons)*	*Topside weight (metric tons)*	*Water depth (feet)*	*Well abandonment (millions of US dollars/well)*	*Removal options (millions of US dollars)*		
					Total/ onshore disposal	*Partial onshore disposal*	*Topple in situ*
Manned central oil production	2 588	1 250	210	0.33	5.1	3.6	3.1
Unmanned satellite oil production	2 615	2 087	258	0.26	6.2	4.9	2.8
Manned central oil production	2 940	2 963	210	0.25	10.3	5.9	4.7
Central gas drilling platform	4 838	6 534	246	0.32	12.8	8.1	6.8
Single anchor leg mooring	–	–	85	n.a.	1.2	n.a.	n.a.

— Pipeline and facilities purging/flushing

— Structural analysis (stability, integrity, lifting lugs, sea fastening, etc)

— Crane barge selection

— Dumping location

(2) Site survey, including underwater inspection to determine actual condition of structure and the surrounding seabed

(3) Platform shut-down/decommissioned

(4) Plug and abandon wells

(5) Flush and seal subsea pipeline

(6) Cut topside structures and lift off using crane barge

(7) Remove substructure by cutting the pile at 5 m below the mud line and lifting off using the crane barge

(8) All structures, decks and equipment are loaded on a cargo barge for towing to disposal site, either deepwater or onshore location

(9) Seabed survey is conducted for post-removal inspection

K. Conclusion

- Currently there is no specific legislation in force for platform removal. However, preparations are being made to ratify the 1982 Convention on the Law of the Sea
- Offshore structures (jackets and SBMs) were completely removed based on safety considerations.
- In selective PSC arrangements, the obligation for abandonment has been addressed.
- Cost of abandonment is high — US $1-2 billion.

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13. *The Oilman,* October 1988, p. 13.
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15. "Removal and abandonment of offshore oil and gas production platforms", Offshore Technical Conference paper No. 4558.

Annexes

I. Steps for total removal of West Lutong pipeline manifold jacket

II. Malaysian offshore structure statistics

III. Malaysia: bathymetric map

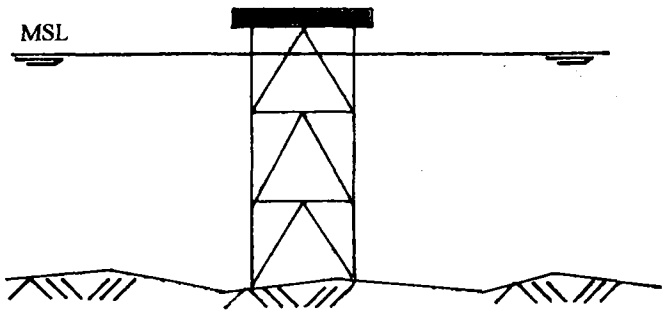
IV. Platform location in Malaysia

V. Malaysia: contract areas

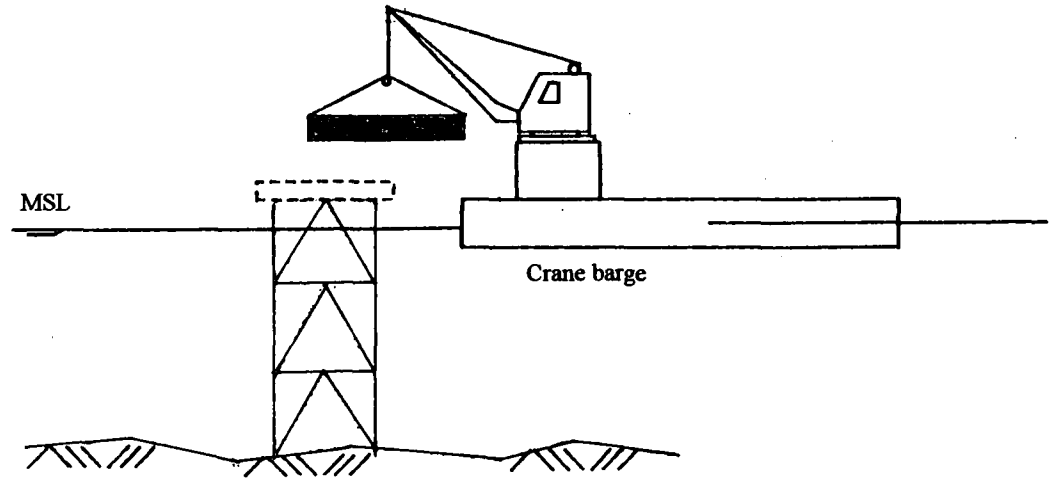
Annex I

Steps for total removal of West Lutong pipeline manifold jacket

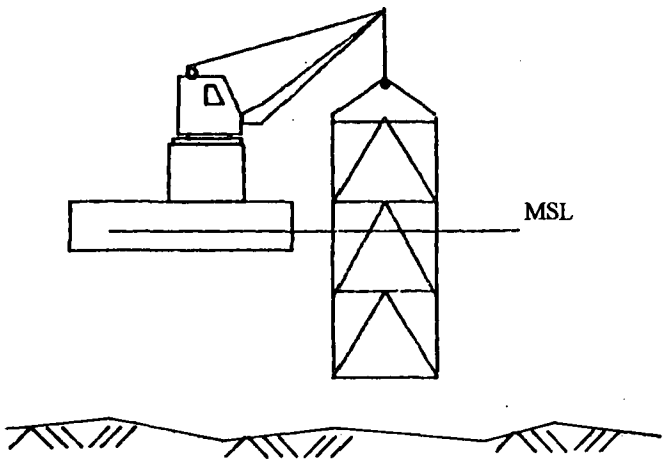
1. Platform decomissioned, risers cut off and removed



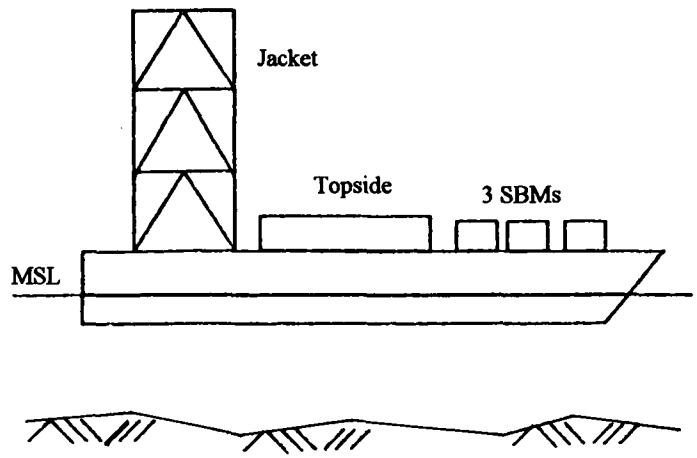
2. Topside structures cut off and removed



3. Piles cut off and jacket removed

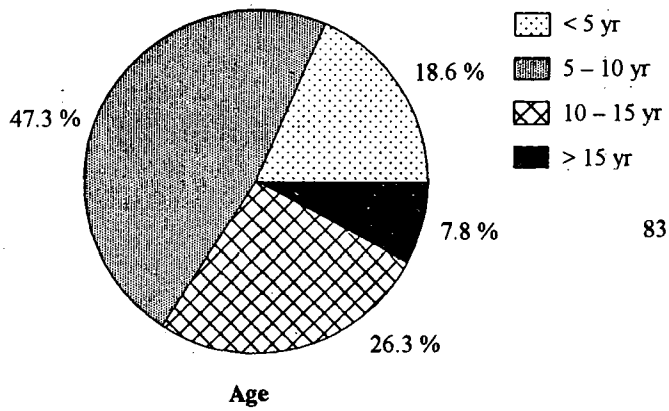


4. Structures seafastened on cargo barge and towed to onshore location for scrapping

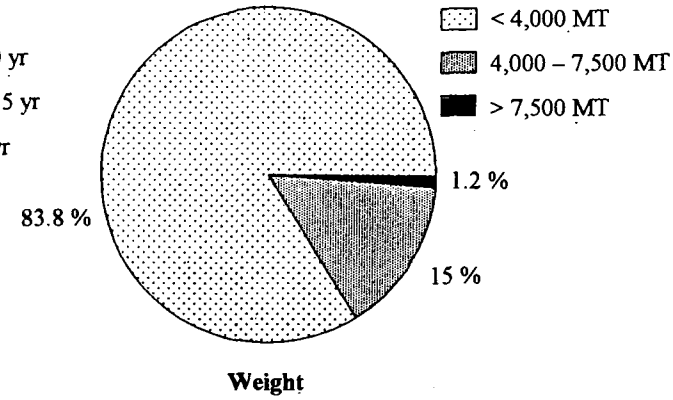


Annex II

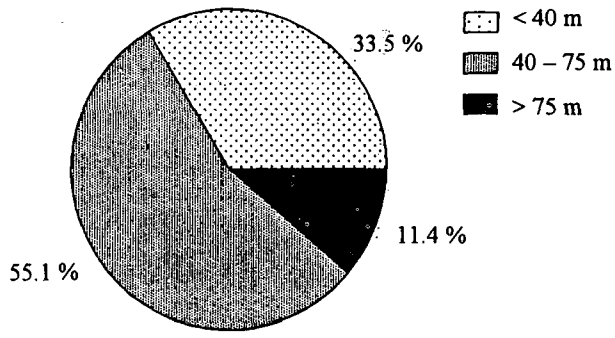
Malaysia offshore structure statistics



Age

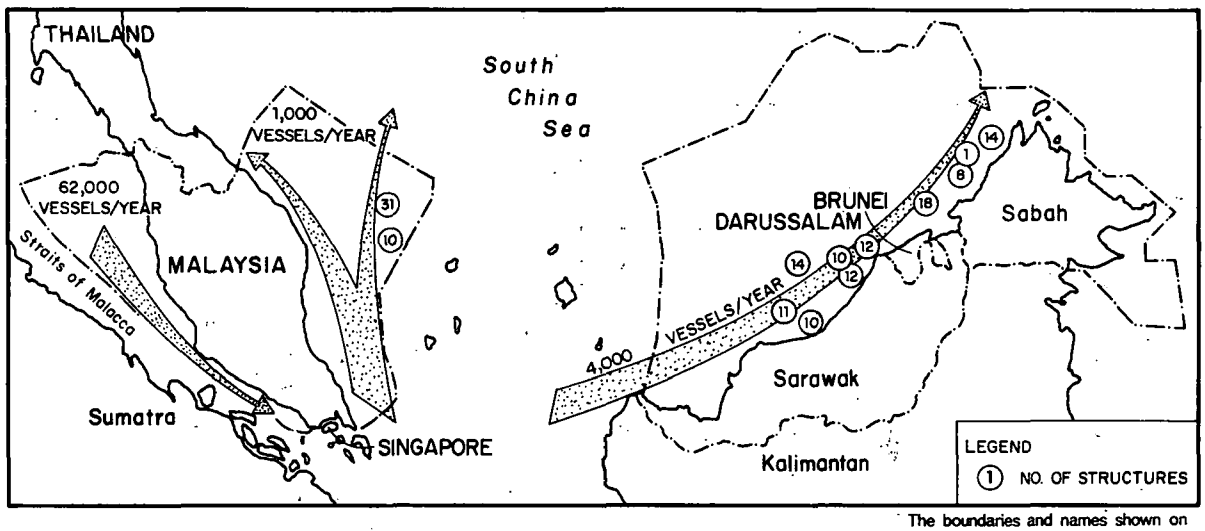


Weight



Water depth

Total number of platforms: 167
Platform age : 1 yr to 20 yrs.
Structural weight: 70 MT to 9,000 MT
Water depth: 8 m to 85 m



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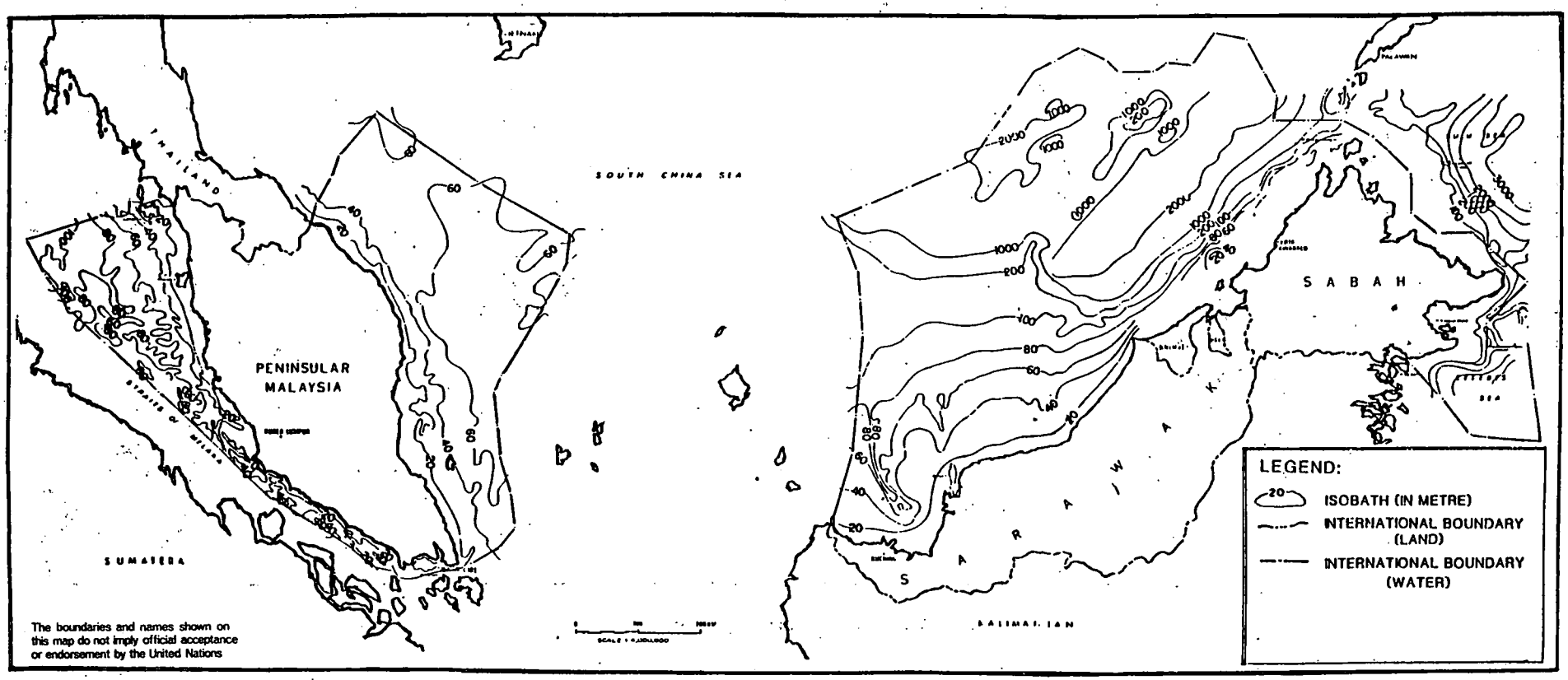
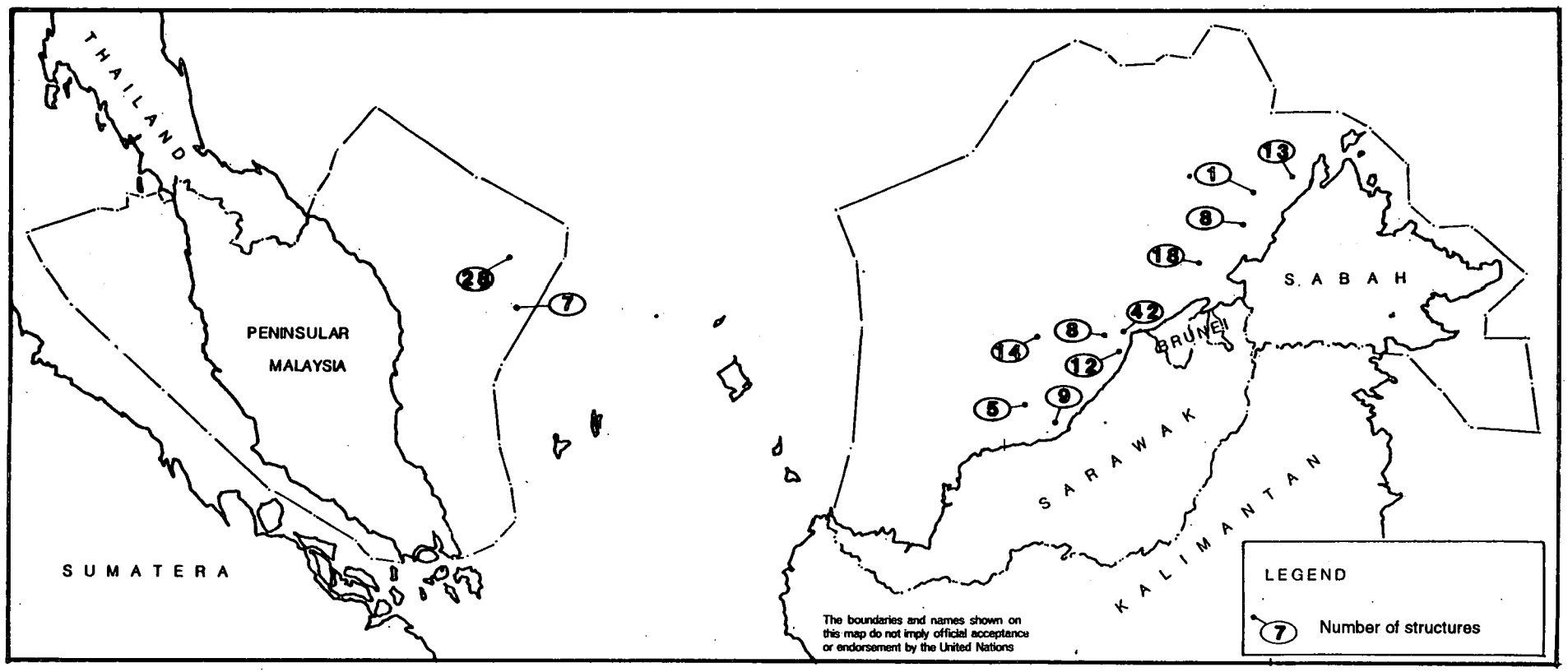
Annex III

Malaysia: Bathymetry map



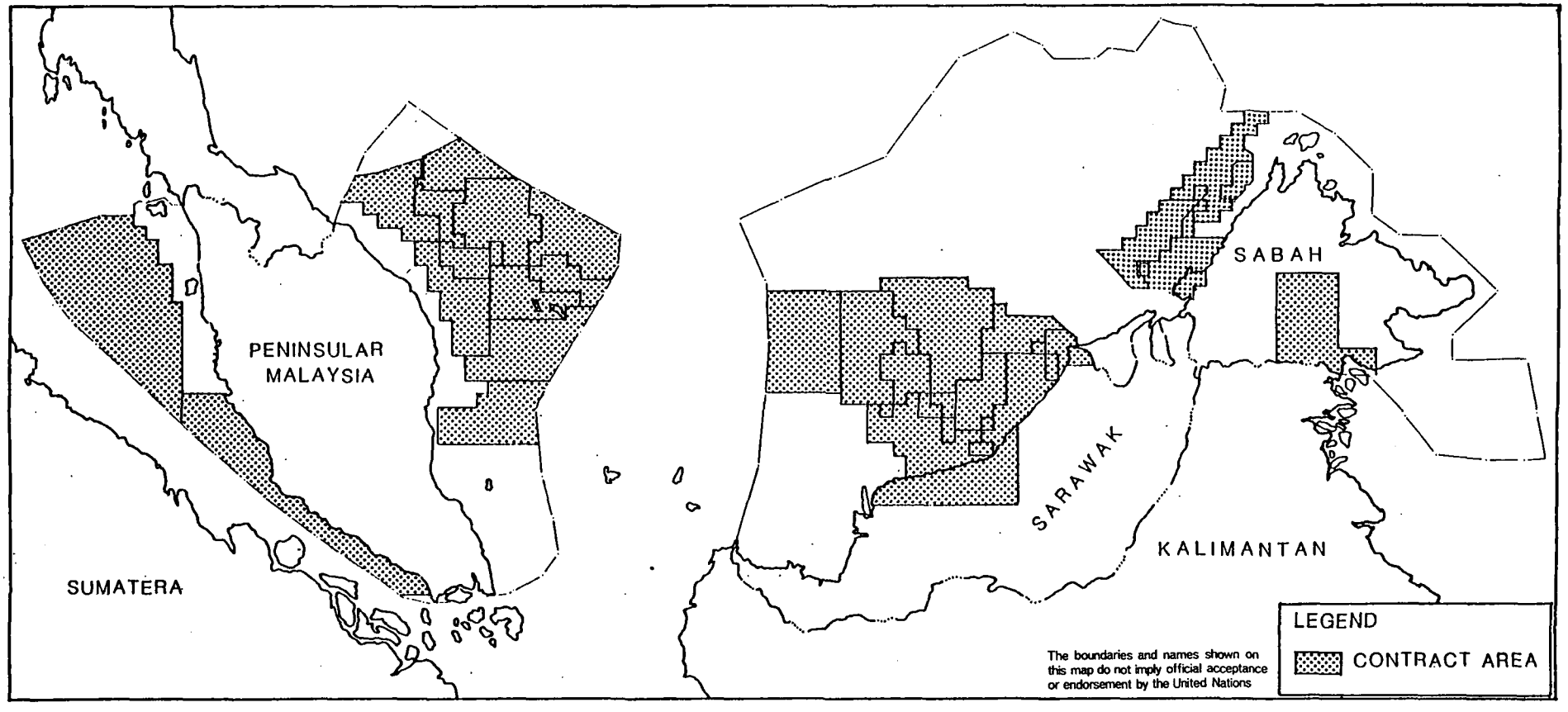
Annex IV

Platform location in Malaysia



Annex V

Malaysia: Contract areas



PLATFORM ABANDONMENT — MALAYSIAN APPROACH*

SUMMARY As of 1.1.1992, there are 182 steel structures installed in offshore Malaysia. By mid-1990s onwards, as the first generation of oil and gas fields are beginning to mature, the abandonment, disposal and removal of offshore installations will become a critical issue to deal with. This is due to the lack of applicable legislations on abandonment, removal and disposal of offshore installations.

PETRONAS, the National Oil Company, together with PSC Contractors conducted a platform abandonment study to evaluate methods and estimate costs for abandonment of disused offshore installations. The study estimates that abandonment costs can range from M$1.6 to 2.0 billion.

Platform abandonment costs are high, therefore, efforts should be made to look for removal alternatives as well as to incorporate certain criteria at design stage for ease of removal and to lower removal costs. At national level, the Government is reviewing all aspects of abandonment including tax incentives, environment impact, etc. with a view to developing a national policy on the subject matter.

1. Introduction

Since 1975, oil and gas exploration and production activities in Malaysia are carried out based on the terms and conditions of Production Sharing Contracts (PSC) between PETRONAS, as owner of all petroleum resources in Malaysia, and multinational companies as PSC Contractors to PETRONAS. Currently, there are 31 PSCs, of which 7 are producing. There are over 180 structures installed offshore in water depth ranging from 10-90 metres with total weight ranging from 90-15,000 tons each. Several more platforms are expected to be installed in the near future.

Some of the existing platforms are over 25 years old and nearing the end of their useful lives. These platforms, especially those in East Malaysia, are located near the busy shipping lanes as shown in figure 1. Based on field production life, there would be an increasing number of offshore installations requiring attention by mid-90's onwards.

2. Platform abandonment study

2.1 Background

In view of the large number of platforms which may need to be removed, PETRONAS is concerned and has consequently, undertaken a study on the platform abandonment issue in the Malaysian environment. Owing to lack of experience on the subject, a Platform Abandonment Task Force (PATF) was formed comprising PETRONAS, PSC contractors and design consultants.

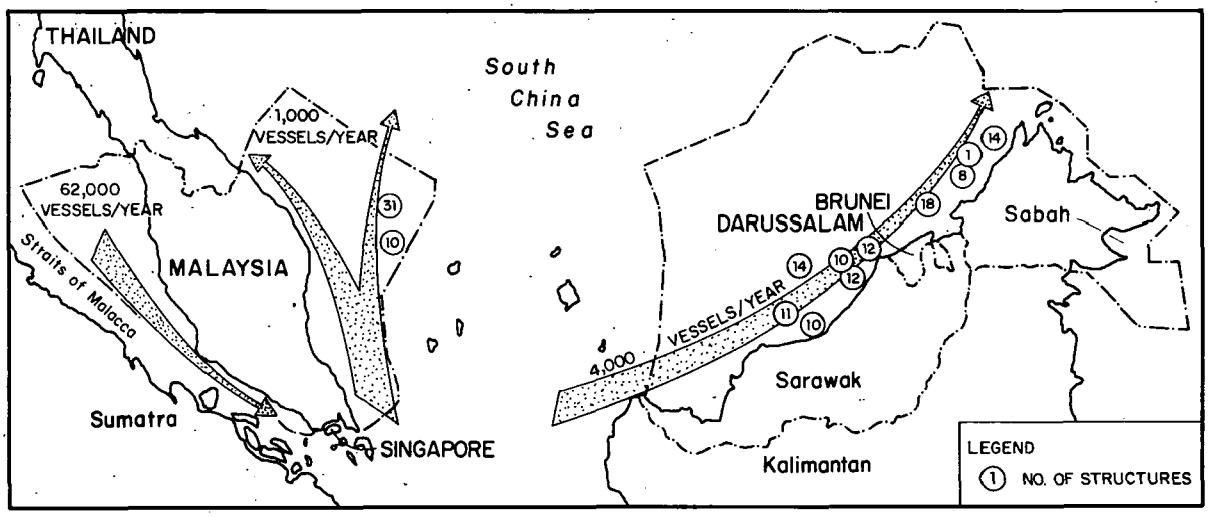


Figure 1. Shipping lane in Malaysia

* Presented at the 1992 Seminar by Kamaruddin Salleh, Manager, Production Operations Group, Operations Engineering Department, PETRONAS.

The role of the Task Force was to:

- Evaluate the technical, statutory and industry requirement, work scope and work schedule for the abandonment of offshore structures and installations.
- Estimate the cost of abandonment of offshore structures and installations in Malaysian waters based on current available technology.

The study covered the following typical offshore structures and installations with water depths and weight ranges as shown in table 1. This is to ensure that a broad database is established for cost estimation of other similar structures but of different weights and water depths.

2.2 Abandonment options

Six options were selected for review. The options, as shown in figure 2, are based on practices adopted elsewhere in the world and as far as possible meet the guidelines and standards proposed by IMO.

Options 1A and 1B involve total removal of the platforms, whereas options 2A, 2B and 2C involve partial removal to 55 m water depth only.

2.3 Procedures

The study recommended the following process and procedures for the removal of Malaysian structures. These procedures are commonly adopted by various companies that undertake platform abandonment works. The phases are as follows.

Table 1. Typical offshore structures and installations

Type	*Description*	*Water depth (metres)*	*Weight topside (metric tons)*	*Weight structure (metric tons)*
I	6-legged gas compression platform	10	840	748
II	6-legged tender platform	48	233	1 058
III	8-legged tender platform	86	1 234	5929
IV	Vent tripod	86	25	797
V	4-legged unmanned production platform	64	1 270	3 813
VI	8-legged manned production platform (small)	75	2 592	4 840
VII	8-legged manned production platform (large)	64	5 518	7 303

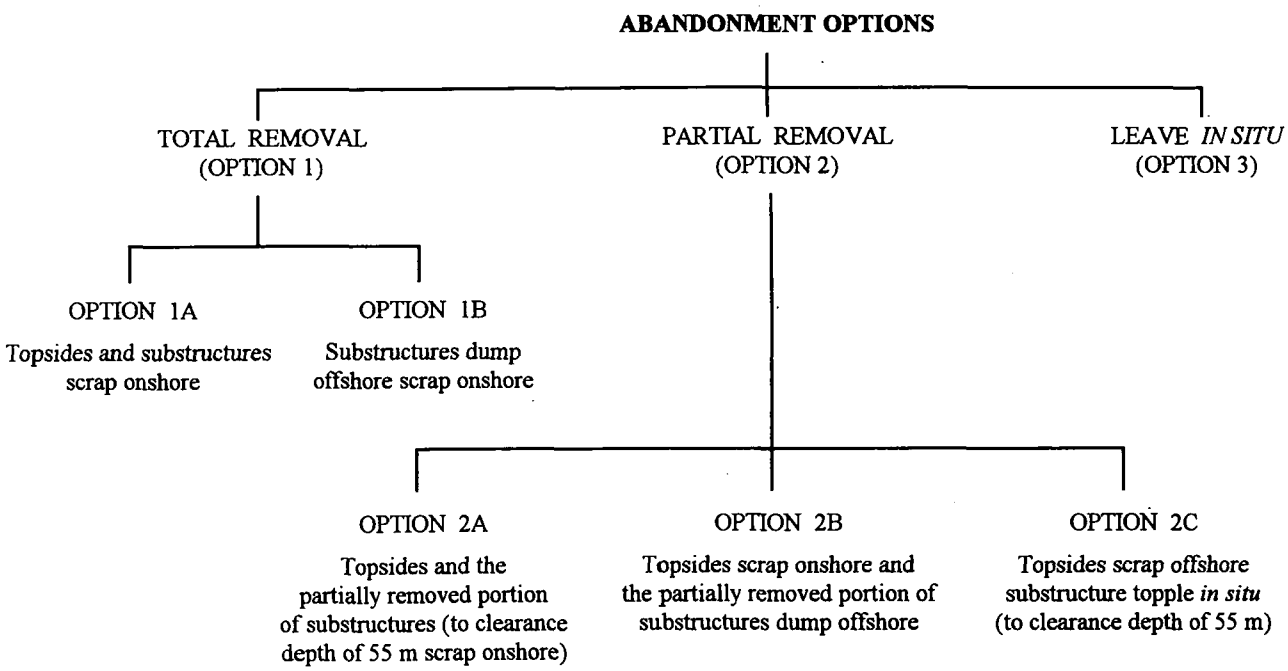


Figure 2. Abandonment options

2.3.1 Engineering, planning and survey

This phase involves the acquisition of relevant data through site surveys and engineering effort necessary to provide a detailed plan and method of platform abandonment. Information on *in situ* condition of equipment, equipment layout and structural modifications following installations is required. Site surveys will focus on the "as-is" condition and repair history of the structure. Very detailed engineering analysis is required to ascertain that the structural integrity will not be impaired during the removal operation and to enhance safe lifting operations.

2.3.2 Materials prefabrication

Materials prefabrication will be carried out to the maximum extent possible to reduce offshore time. Items which may be prefabricated include rigging attachments, padeyes plates, pipe spool pieces, etc.

2.3.3 Platform shutdown

Platform shutdown will be carried out in a logical sequence in accordance with the procedure developed in the engineering phase.

2.3.4 Well abandonment and removal

The structure to be removed will be isolated from hydrocarbon producing zones by plugging and abandonment of wells. This will be done by the operator itself.

2.3.5 Decommissioning

Decommissioning operations will be carried out to achieve hydrocarbon-free environment for safe hot work.

2.3.6 Preparation of topsides for removal

All interconnecting structural items, piping, cabling and tubing will be severed. Padeyes and additional deck stiffeners will be installed.

2.3.7 Removal of topsides

The topside will be removed in packages in the reverse order of installation.

2.3.8 Preparation of jacket for removal

This phase involves the severing of pile-jacket connection, pulling out the piles and cleaning the jacket base.

2.3.9 Removal of jackets

The jackets will be removed by multiple lifts or toppled *in situ*.

2.3.10 Disposal of structures

Several methods were considered. They were onshore scrap, dumping offshore and toppling *in situ*. For offshore dumping, locations were assumed to be 300-500 km from shore and the water depth greater than 1,000 m.

2.3.11 Seabed clearance

On completion of all deconstruction activities, the seabed in the vicinity of the platform will be cleared of all debris. For partial removal and toppling *in situ* methods, the remaining structures will be surveyed and their positions recorded. The information will be given to relevant authorities.

2.4 Resources

The minimum resources that generally satisfy removal needs include derrick vessel, cargo barge, launch barge, anchor handling, platform shutdown and decommissioning spread, ROV/diving spread, special equipment for cutting, flotation tanks, mining pumps, etc.

2.5 Schedules

Overall platform abandonment works require from 14 to 24 weeks to complete, as shown in figure 3.

2.6 Abandonment cost

From the study, the abandonment costs have been estimated as shown in table 2.

The cost breakdown in percentage by major cost elements representing the key activities is tabulated in table 3.

Using the information from tables 1, 2 and 3, the relationships between cost elements and platform weights were developed and plotted in figure 4, using option 1A as an example.

Utilizing the graphs in figure 4 and similar graphs for the other options, the total cost to abandon all Malaysian offshore structures was estimated and is shown in table 4.

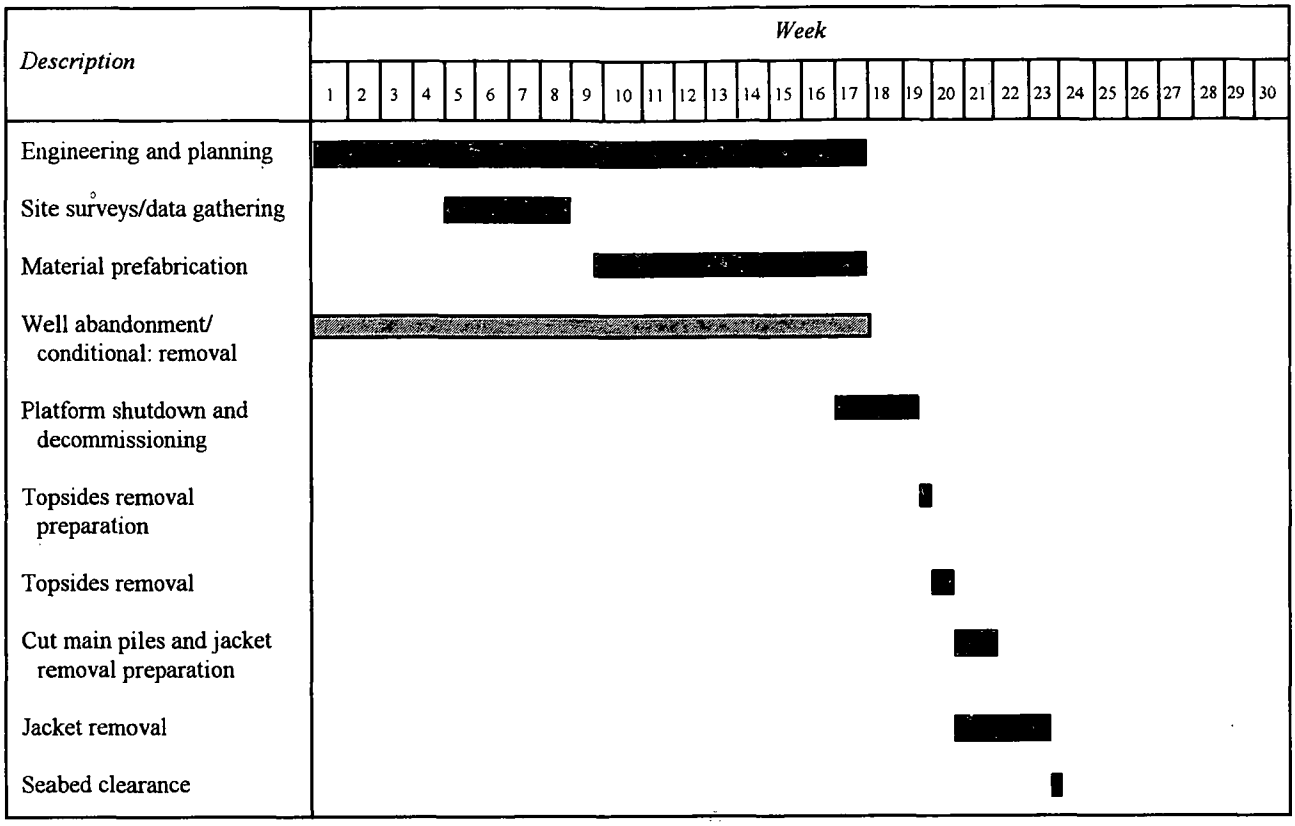


Figure 3. Typical platform abandonment process and schedule

Table 2. Abandonment costs (millions of Malaysian dollars – 1988 value)

Type of installation \ *Options*	*1A*	*1B*	*2A*	*2B*	*2C*	*3*
I	7.41	9.60	n.a.	n.a.	n.a.	5.2
II	7.92	9.57	n.a.	n.a.	n.a.	5.3
III	12.98	12.20	11.02	12.01	9.52	5.8
IV	6.05	6.08	5.07	6.16	4.28	1.0
V	10.85	10.23	9.15	9.88	8.21	5.4
VI	16.05	15.50	14.20	14.82	12.22	5.9
VII	20.53	19.20	18.70	17.80	16.68	6.5
VIII	2.74	n.a.	n.a.	n.a.	n.a.	7.3
IX	2.98	3.27	n.a.	n.a.	n.a.	7.4
X	2.98	3.27	n.a.	n.a.	n.a.	7.4

Note: n.a. = not available.

Table 3. Platform abandonment cost breakdown, in percentage

Major cost ellements/ key activities	*Options*		
	Complete removal	*Partial removal*	*Toppling in situ*
1. Engineering and planning	4	3	3
2. Site survey	8	9	10
3. Materials prefabrication	5	4	2
4. Platform shutdown and decommissioning	6	7	8
5. Topsides removal and decommissioning	21	26	30
6. Pile, jacket removal and disposal	30	25	17
7 Seabed clearance	1	2	2

3.0 Discussion

From table 4, it can been seen that the cost for platform abandonment is enormously high, regardless of whichever option is taken. The difference in costs between options is relatively small. Various combinations of options can be made to select the cheapest abandonment approach, while at the same time being committed to ensuring safe navigational activities in the area concerned.

Based on the recommendation of the study and other considerations, PETRONAS has adopted an interim policy on platform abandonment with regard

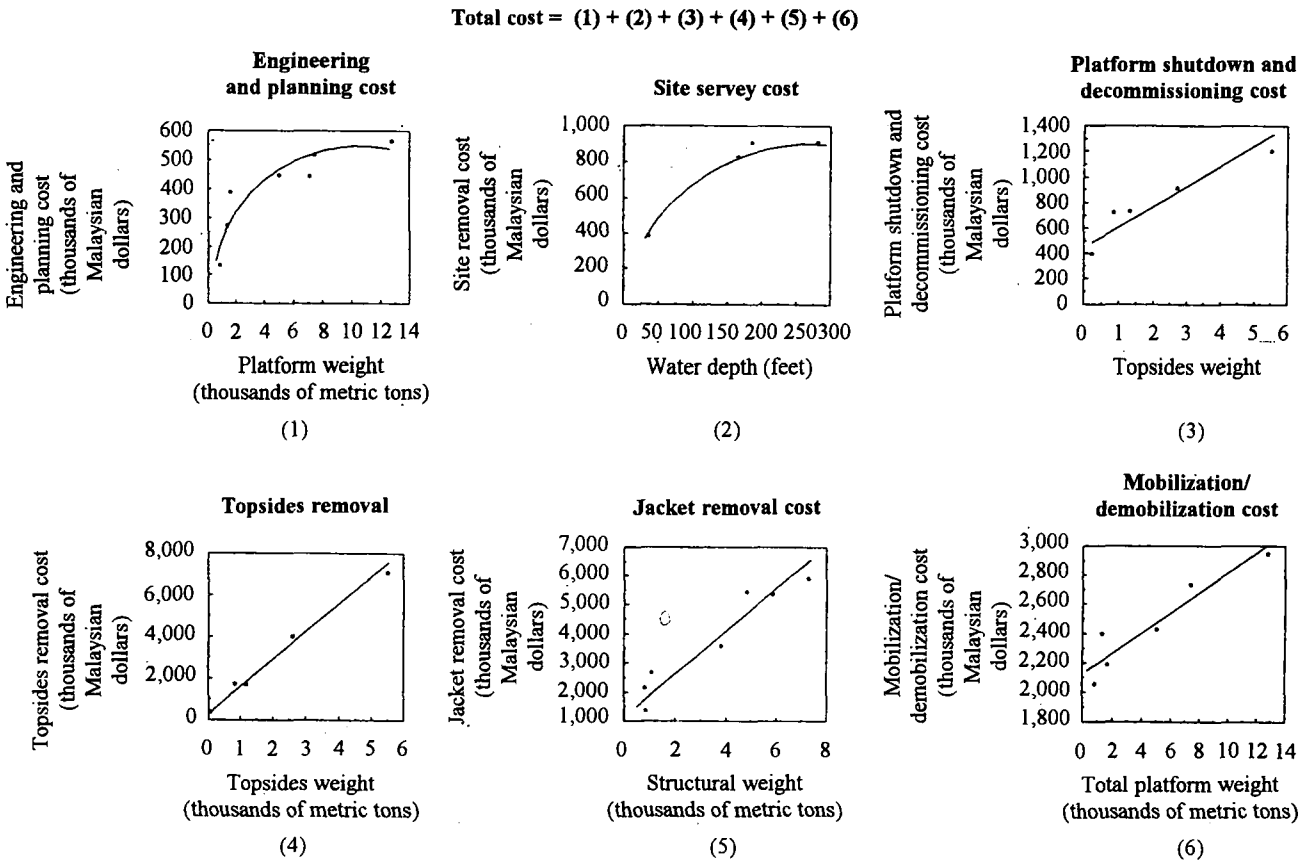


Figure 4. Elements of cost versus platform weight/water depth

Table 4. Estimated total abandonment cost (1992 value)

Option	**Well abandonment cost*	*Platform removal cost*	*Total removal cost*
	(millions of Malaysian dollars)		
1A	0.71	1.75	2.46
1B	0.71	1.93	2.64
2A	0.71	1.91	2.62
2B	0.71	1.64	2.35
2C	0.71	1.17	1.88

* Well abandonment cost estimation was done in a separate study (number of wells is 1,067).

to technical requirements. The interim policy states that:

> "All offshore installations located within a radius of 12 nautical miles of Malaysian territorial waters be totally removed while the rest shall be partially removed only to an appropriate water depth which is to be agreed upon".

Apart from technical and legislative requirements, sources of funds and their treatment in terms of taxation, etc. also need to be addressed before a firm abandonment policy can be developed. These requirements are also being studied by the recently formed National Task Force headed by the Prime Minister's Department of Malaysia.

4.0 Conclusion

The high costs of abandonment have prompted PETRONAS and the Government seriously to review the existing procedures and practices pertaining to platform designs and materials selection, role and responsibilities of the PSC contractors and latest abandonment technology available.

The practices of other nations having similar experience are also considered. While costs are the major concern, PETRONAS and the Malaysian Government are always sensitive of their duty to keep the environment free from potential hazards.

Reference

PETRONAS (1988), Platform Abandonment Study.

THE PHILIPPINES: 1991 OIL AND GAS SECTOR HIGHLIGHTS*

Introduction

Philippine petroleum exploration began on a bright note following the West Linapacan discovery by Alcorn at the end of 1990.

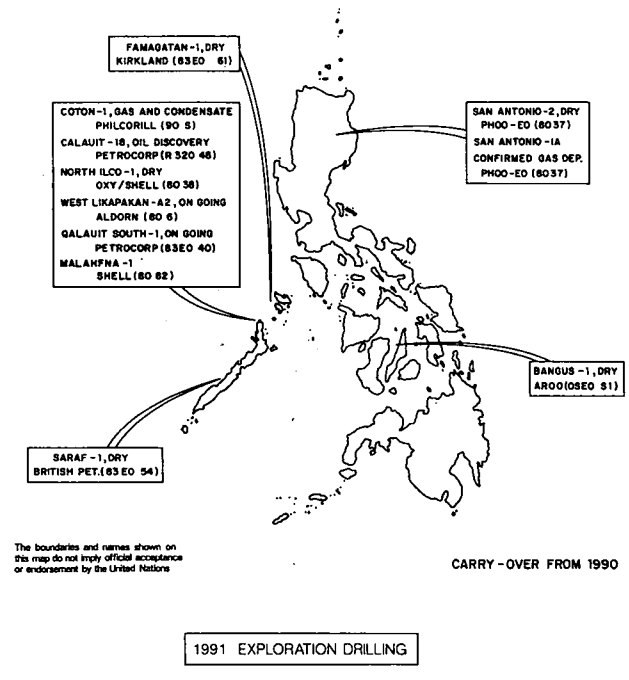
Ten wells were drilled within the year and one well, the Octon-1, a carry-over from 1990 drilling, was completed. The Octon-1 well drilled by Philodrill produced gas and condensate when tested, while the Calauit-1B discovery well drilled by Petrocorp produced oil from a previously untested limestone horizon.

The decision to carry-out the appraisal/development of the West Linapacan discovery was undertaken and commenced with the drilling of the West Linapacan A-2 in December.

Crude oil production for 1991 reached a total of 1.08 million barrels coming from the NW Palawan oilfields. The month of December, however, showed a cessation in production as most of the fields have been temporarily shut in to give way to the West Linapacan Field development.

A total of 2,916 line-kilometres of seismic data have been acquired by Petrocorp/Fletcher Challenge, Shell and Crestone Energy over their acreage. The Philippine Government, through the Office of Energy Affairs, on 20 September 1991 signed a bilateral agreement with the Australian Government through its Bureau of Mineral Resources to carry out a speculative survey wherein 2,500 line-kilometres of seismic data would be acquired in various offshore areas in the country.

Of the completed wells, Calauit-1B of Petrocorp, now Fletcher Challenge, turned out to be a significant discovery. The well, when tested, produced 3,000 barrels of oil per day from a previously untested limestone horizon. The initial reserves estimate made on the Calauit-1B prospect



was placed at 1-6 million barrels. However, studies made on mappable extensions of the structure showed a potential 100 million barrels (or greater) of oil for the whole Calauit complex.

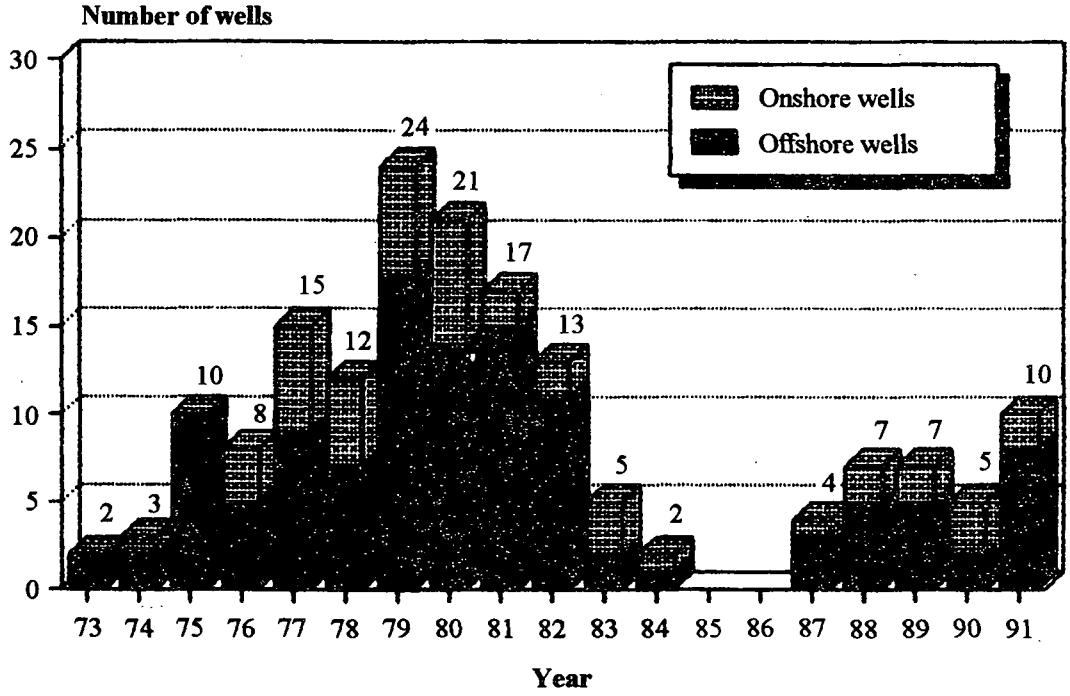
The exploration company of the State-owned Philippine National Oil Corporation drilled two onshore wells, San Antonio-2 and San Antonio-1A. The former was a dry well while the latter, a re-entry of the old San Antonio-1 well, reconfirmed the presence of natural gas in that area.

The Panagatan-1 well drilled by Kirkland in offshore South Mindoro turned out to be dry but with oil and gas shows. Kirkland remained optimistic and is currently programming some seismic activities and follow-up drilling over the contract area.

The rest of the contractors, however, did not fare well. Arco's Bangus-1 in North Tanon Strait, British Petroleum's Sarap-1 in West Palawan and Shell's North Iloc-1 yielded no hydrocarbon finds. Arco and BP relinquished their interests over the area while Shell/Occidental is modifying its reserve estimates of the NW Palawan gas fields.

* Presented at the 1992 Seminar by the Oil and Gas Division, Department of Energy, the Philippines.

Wells drilled under the service contract system



The three wells that were still ongoing at the close of 1991 are the following:

West Linapacan — A2

This is the first of the two delineation/development wells to be drilled by Alcorn Production Philippines in line with the West Linapacan field development programme. It was spudded on 28 November using the semisubmersible rig Hakuryu 5 and is projected to the tested and completed by the second week of January 1992.

This well was designed to reach a total depth of 6,000 feet true vertical depth, or 8,375 feet measured depth. The well was drilled directionally after the setting of the 20-inch casing and entered the Galoc Limestone reservoir in a sub-horizontal fashion. This was done in order for the well to take full advantage of the fractured limestone reservoir and attain optimal producibility.

Malampaya — 1

This is the second commitment well of Shell Philippines Exploration B.V. to earn the 50 per cent share of GSEC/SC which used to be solely operated by Occidental Petroleum. This well was designed to reach a total depth of 11,860 feet in order to test the hydrocarbon potential of the Nido Limestone. The drillship D.S. Pelerin was again used for the drilling. The well was spudded on 2 December 1991 and is expected to be completely drilled in two months time, plus a month for well testing.

Calauit South — 1

The Calauit South-1 well was spudded by Petrocorp/Fletcher Challenge on 3 December using the drillship Deepsea Duchess. The well is programmed to test the potential of the Calauit Limestone and will reach a total depth of 5,414 feet. It is projected to be tested and completed by January 1992. The well is the first of the two well drillings programmed by Petrocorp/Fletcher Challenge.

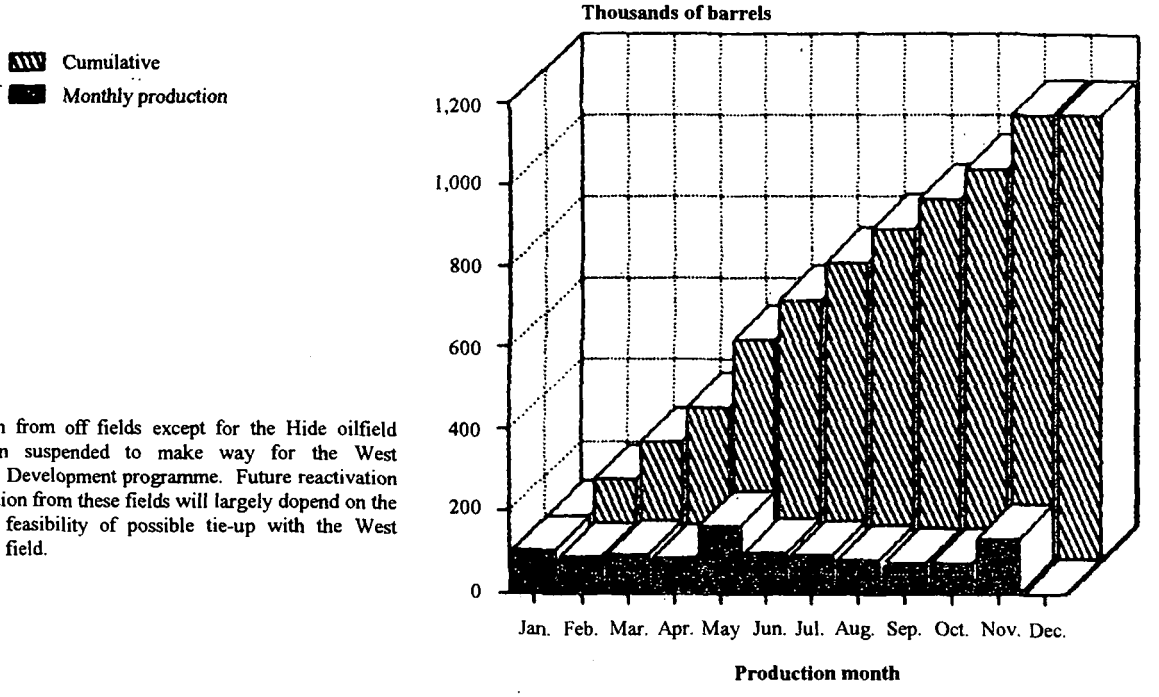
Production

Philippine crude oil production from the NW Palawan oilfields reached a total of 1.08 million barrels.

This is lower than last year's production of 1.7 million barrels, brought about by the natural depletion of the NW Palawan oilfields. Current average daily production from the country's five producing fields as the year ended was at 3,000 b/d.

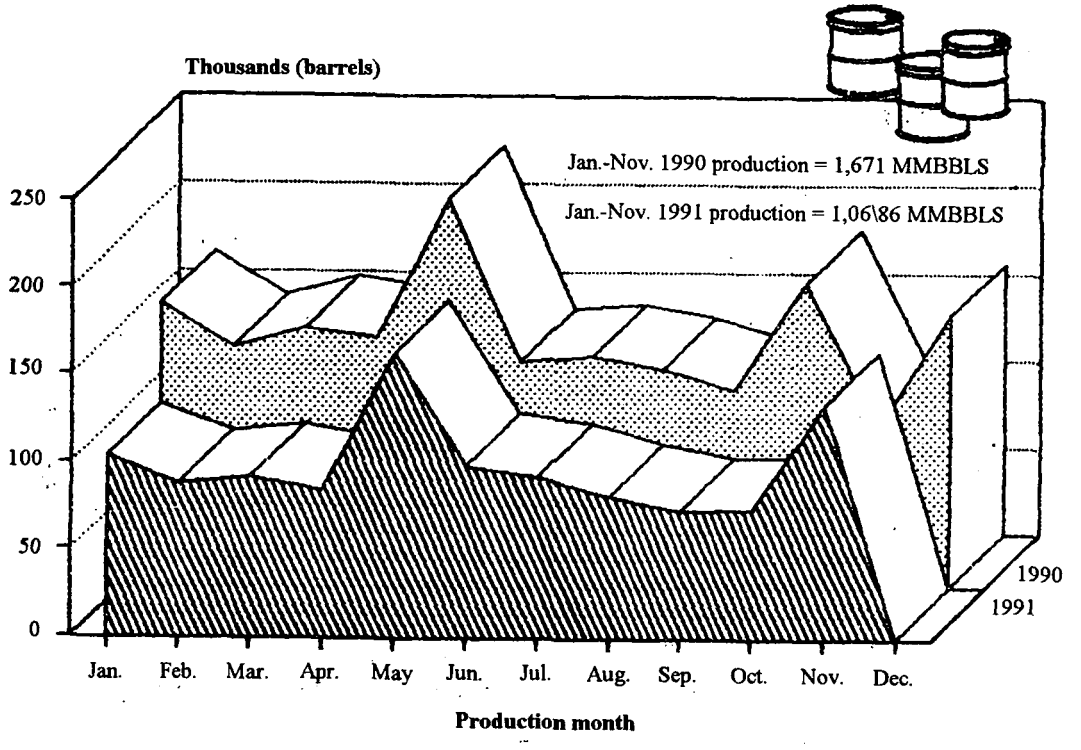
Since the start of the first commercial production from NW Palawan, a total of 40.7 million barrels of oil have already been produced. To date, ample reserves still exist in the area.

1991 monthly production

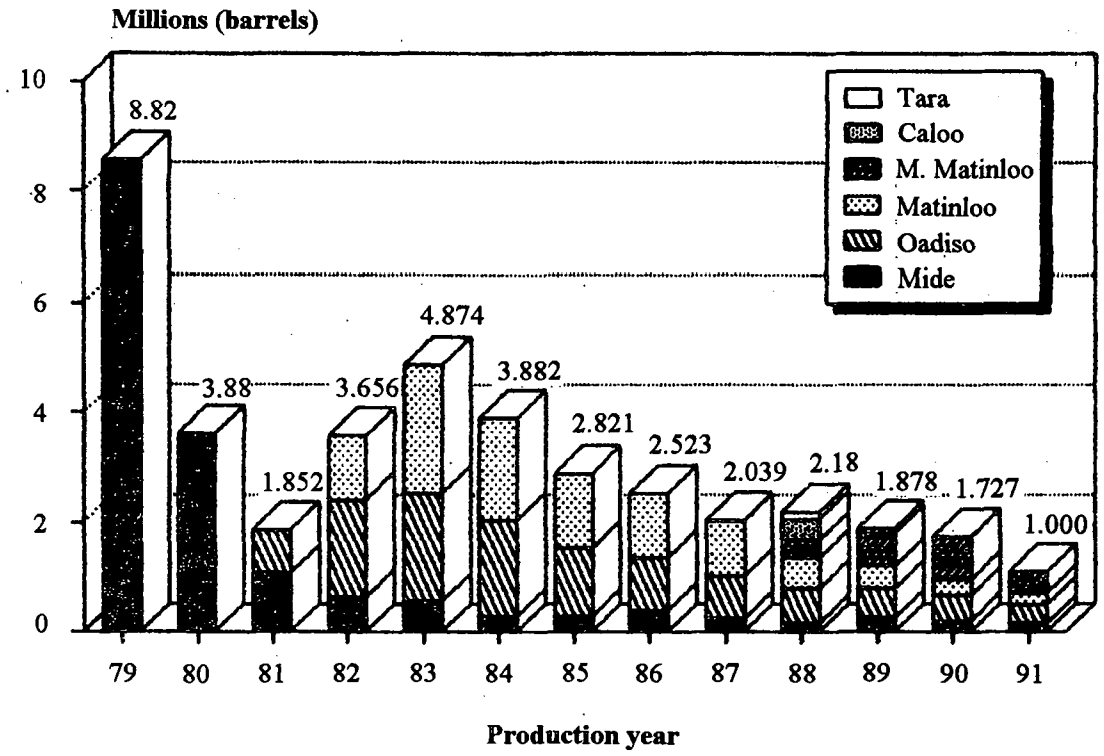


Production from off fields except for the Hide oilfield have been suspended to make way for the West Linapesan Development programme. Future reactivation of production from these fields will largely dopend on the economic feasibility of possible tie-up with the West Linapesan field.

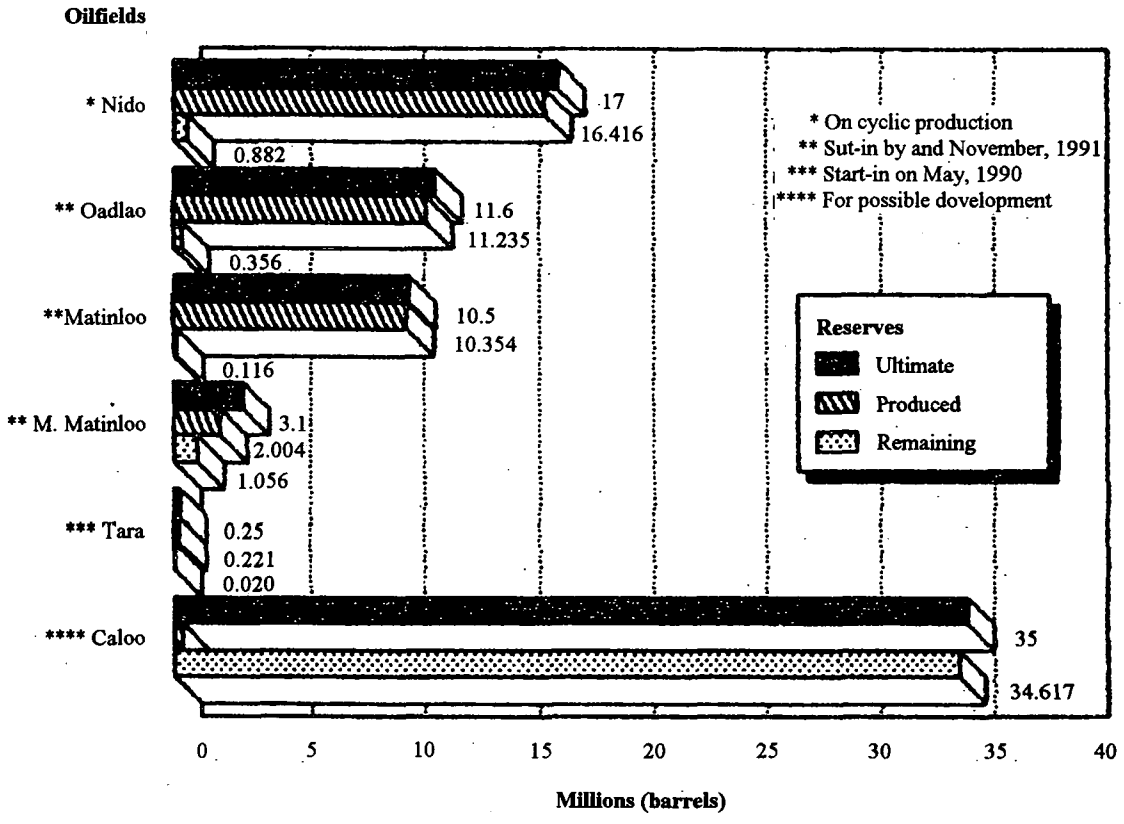
Comparison of crude oil production (1990 versus 1991)



Philippine crude oil production
(north-west Palawan oilfields)



Status of Philippine oilfields in NW Palawan



Production from these existing fields, except for Nido, which will maintain a cyclic production, will be suspended. This is in line with the West Linapacan Field Development Project under which refurbishment of the Floating Production Storage and Offloading (FPSO II) is needed. Reactivation of production from these fields will depend on the future viability of the individual fields.

Geophysical activities

In 1991, three seismic acquisition programmes were completed. Petrocorp/Fletcher Challenge obtained 730 line-km of seismic data in NW Palawan in April 1991 under GSEC 49. Shell Exploration B.V., on the other hand, conducted a 3D seismic survey over 130 sq km of the Camago-Malampaya area in NW Palawan. A total of 1,784 line-km was acquired during this 3D seismic survey under SC38. Crestone Energy Corporation acquired 402 line-km of seismic data in Sulu Sea. These bring the total amount of seismic data gathered within the year to 2,916 and under the service contract system to 160,320 line-km.

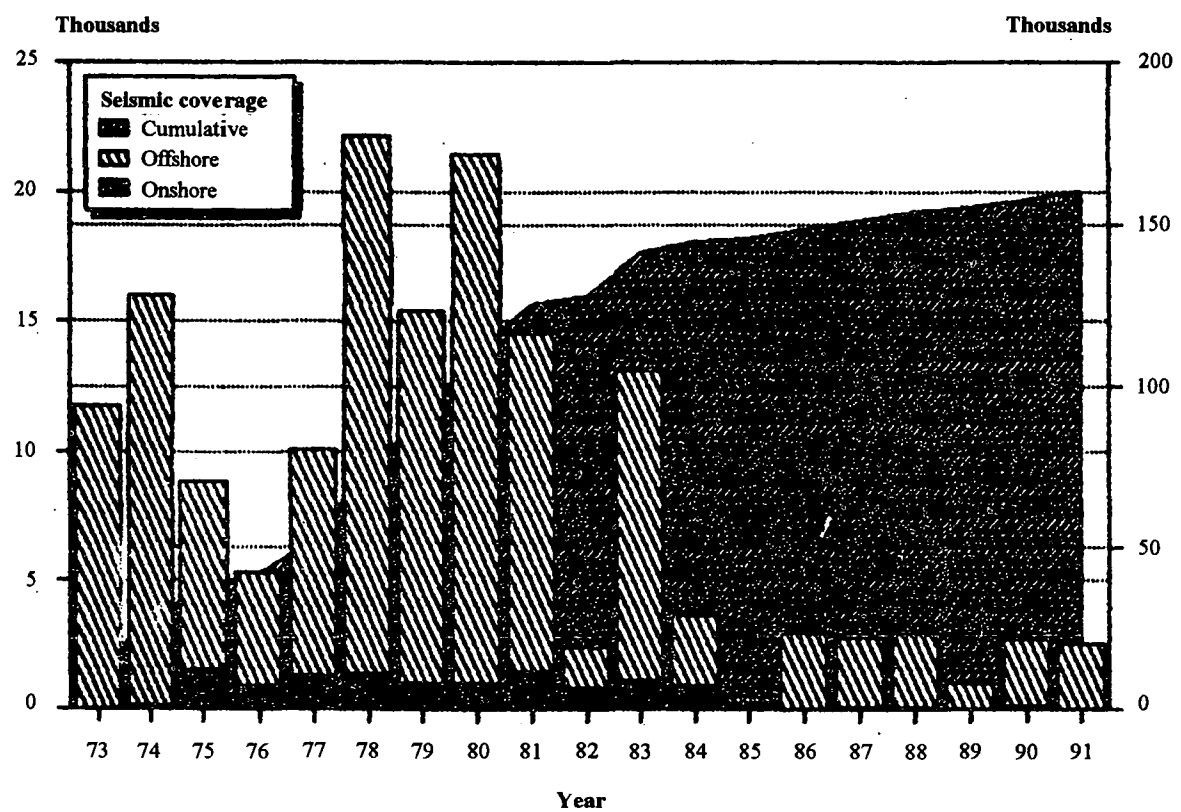
The seismic acquisition programmes of Kirkland in offshore South Mindoro are tentatively scheduled for the first quarter of 1992. Kirkland will acquire 1,235 line-km of seismic data. Furthermore, the RP-Australia Project will acquire 2,500 line-km of seismic data from selected areas in the Philippines from April to May 1992.

On the other hand, Arco has relinquished its GSEC 51 over North Tañon Strait in Cebu following the unsuccessful drilling of Bangus-1. Kirkland also relinquished its GSEC 52 over offshore South Mindoro but it remains optimistic and is currently applying for a GSEC over the same area. The contract is at present with the Office of the President for approval. TransAsia also relinquished GSEC 55 over offshore Batangas but is negotiating with the Office of Energy Affairs for GSEC over the same area. British Petroleum has reassigned its interest and operatorship of GSEC 54 to Crestone Energy Corporation after the disappointing results of the Sarap-1 drilling over West Palawan. Furthermore, after conducting a comprehensive regional study over their GSEC 56 covering deep water NW Palawan, BP relinquished the contract.

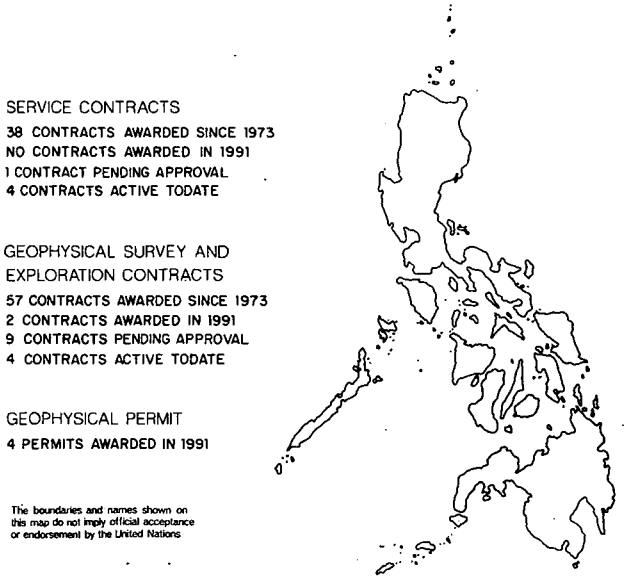
1. Geophysical permit

Four non-exclusive geophysical permits were awarded. They were awarded to Kirkland for Reed

Seismic surveys in the Philippines
(under the service contract system)



Status of petroleum exploration in the Philippines



Bank and Offshore South Mindoro and to Philodrill for Sulu Sea while their GSECs for the areas are being negotiated. Crestone Energy Corporation was awarded a permit for its seismic acquisition over Sulu Sea pending the approval of its GSEC.

Development of oil and gas fields

Only the West Linapacan structure has a definite development and production programme. The development of the Calauit oilfield will be contingent on the exploration drilling results of two (2) follow-up wells.

The other discoveries are being carefully studied by the operators and will be dependent on economics and the technology available. (Attachment 2).

1. West Linapacan Field

The development plan calls for the drilling of two appraisal/development wells West Linapacan A-2 (as of year end) and A-3 at depths of 6,000 feet and the deepening of the existing West Linapacan-A1. The three wells are to be subsea completed and connected by individual flowlines to a buoy and tanker. The development of this field is expected to be completed by may 1992 and production operations will commence immediately thereafter.

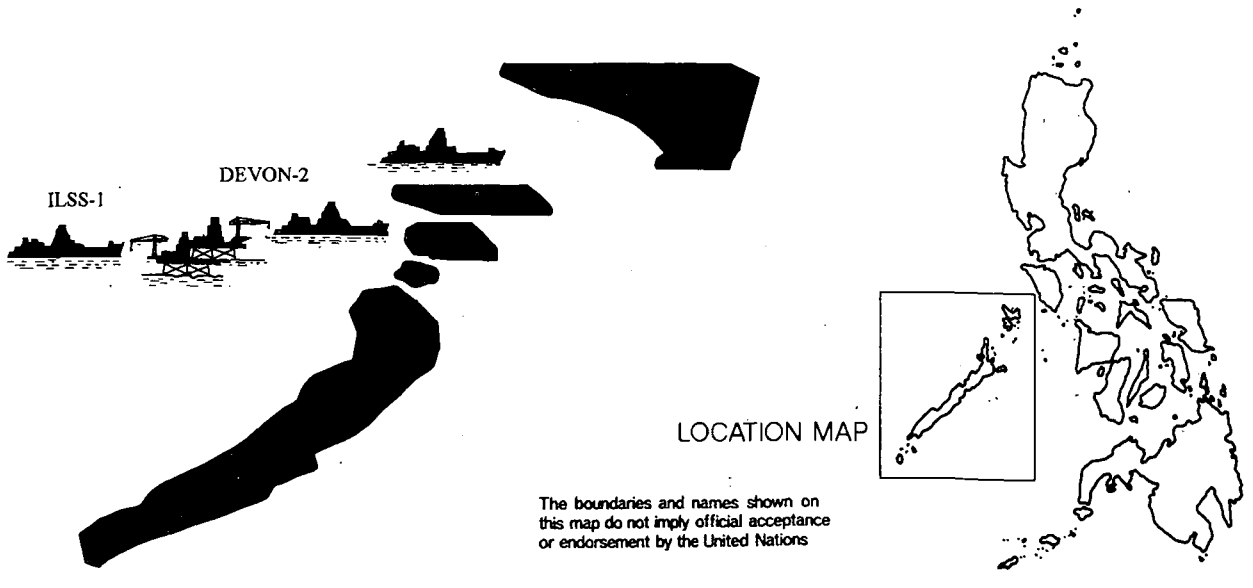
Production rate for 1992 is projected to be about 15,000 to 20,000 BOPD and the total development cost is estimated to be $48 million.

To put the West Linapacan oil field in commercial production by mid-1992, the existing floating production facility will be transferred from its present site in Cadlao to the West Linapacan field, thus putting Cadlao, North Matinloc and Matinloc fields on a suspension mode after the last lifting in November of this year.

2. Calauit oilfield

With the success of the Calauit-1B well, Petrocorp/Fletcher Challenge is optimistic that the recoverable reserves would be in

Upcoming drilling activities (1981-1988)
(Palawan and Mindoro islands)



the vicinity of 100 million barrels. Seismic test done during the first quarter of 1991 and further exploratory drilling of Calauit South-1 (ongoing as of year end) and Busuanga South-1 will define the areal extent of the Calauit structure and establish its producibility. The Calauit South-1 well was spudded in the last week of November and will be followed immediately by Busuanga South-1. The drillship Deepsea Duchess is utilized for this purpose.

3. Camago gasfield

After the Camago-1 drilling, a minimum proven reserve of 0.64 trillion cubic feet of gas was established. However, with the negative result of North Iloc-1, other prospects are being explored to come up with the 2.5 TCF economic threshold needed for commercial development as discussed by Shell Exploration operatives. One of the prospects being tested as the year ended was the Malampaya prospect, which will establish whither this prospect is contiguous with Camago, thereby forming a Camago-Malampaya gasfield complex. Once additional exploratory drilling confirms economic viability, the field is expected to go on stream by early 1998.

4. Octon gasfield

Reservoir assessment by Philodrill is continuing. Appraisal drilling will be done and the first of these wells, Octon-2, is tentatively scheduled to be spudded in the first quarter of 1992. The appraisal drilling is designed to confirm the Octon-1 gas/condensate discovery and to determine the existence of an oil leg within the Galoc sandstone and the producibility of the oil within the Nido limestone. Preliminary studies show the it has recoverable reserves of 180 billion cubic feet of gas and 15 million barrels of condensate.

5. San Antonio gasfield

The result of San Antonio-1A reconfirms the existence of gas in the San Antonio field. However, the well was not able to establish a confident reserves estimate.

6. Galoc oilfield

The viability of the field's development and production being tied with the West Linapacan structure is being studied. This may be possible if an adjacent structure, the West Linapacan B structure, contains oil which will warrant the construction and installation of a permanent platform.

OEA Circular No. 89-06-08

To: All petroleum service contractors

Pursuant to the provisions of PD 87, otherwise known as the Oil Exploration and Development Act of 1972, particularly with regard to the disposition of the materials, equipment, plants and other installations erected or placed on the service contract area, the following quidelines are hereby promulgated and are entitled thus:

GUIDELINES ON ABANDONMENT AND RELINQUISHMENT OF ONSHORE AND OFFSHORE PRODUCTION OPERATIONS

Article I. Definition

1. *Abandonment* — the act of returning or giving up by contractor of the delineated production area under a service contract to the Government of the Republic of the Philippines represented by the Office of Energy Affairs (OEA), *before the expiration of the term stipulated in the contract* if, in the opinion of the service contractor, the continued exploitation of the same is no longer economically or technically feasible.

2. *Relinquishment* — the act of surrendering the production area under the service contract to the Government of the Republic of the Philippines represented by the office of Energy Affairs, on *the termination or expiration of the period set forth in the contract or the period of extension given.*

3. *Contractor* — refers to the service contractor on operator under a service contract.

4. *Property* — refers to all materials, equipment, plants and other installations erected or placed on the production area.

Article II. Abandonment

Sector 1

Notice of abandonment. If continued exploitation of a production area is no longer economically or technically viable, the *Contractor* shall give written notice to the OEA of its intention to abandon the production area *not less than 12 months prior to abandonment*. In such event, the *Contractor* shall submit the following documents together will said notice to wit:

(a) An economic analysis and description of the delineated production area, showing in detail the reasons why continued exploitation is uneconomical or technically not feasible;

(b) An inventory list of all properties erected or placed on the production area otherwise classified as tangible investments;

(c) Detailed abandonment plans and procedures which the *Contractor* shall undertake and the estimated financial cost it will entail.

Section 2

Inventory. The inventory list to be submitted must contain all the properties erected and/or placed on the production site whether movable or immovable and specifying whether the immovables have been fully or partially amortized. In case of immovables which have been partially amortized, the date of acquisition thereof, the value of the same, the method of depreciation used and the remaining useful life of the property shall likewise be specified. On the other hand, if the immovable has been fully amortized, the same must be explicitly stated as well as the property's salvage value, if any.

Within 30 days from receipt of the inventory list, OEA shall audit and inspect the production site to validate the list given by the *Contractor*, the result of which shall accordingly be relayed within 30 days from the termination of such inspection. If OEA does not make any inspection within the period above stated or the *Contractor* does not dispute the findings made thereon within 30 days from receipt of validation/exception, the inventory list or the validation/ exception, as the case may be, shall be deemed admitted. On the other hand, if the *Contractor* does not submit an inventory list, the findings of the OEA shall become conclusive.

Section 3

Notice of OEA's Action:

(a) Within ninety days from receipt of the notice of abandonment, OEA shall notify the *Contractor* of its action thereon. If no action is made within the said period, the abandonment is deemed automatically approved.

(b) If OEA finds the abandnonment scheme unacceptable, it shall give the *Contractor* thirty (30) days within which to submit an acceptable proposal or correct whatever deficiency there is in the original abandonment scheme.

Section 4

Disposition of property. In the preparation of plans for abandonment, the following shall be considered:

(a) In the case of movable property, the *Contractor* shall remove the same from the production area within 12 months from date of approval of abandonment, otherwise title thereto passes to OEA. However, movable property which had been fully amortized belongs to OEA.

(b) In the case of immovable property, title/ ownership thereto passes to OEA upon approval of the abandonment.

(c) If any property is required to be removed from the production site, it shall be at the expense of the *Contractor*.

Section 5

Trust account. In all cases of abandonment/ relinquishment, the *Contractor* shall be obliged to bear the costs of removing all properties in the production area. Moreover, should OEA decide to take over the operations, the cost to be incurred in removing these shall be deposited by the *Contractor* under a trust account in favor of OEA.

Section 6

Approval/execution of abandonment. Upon approval and ninety (90) days prior to the actual execution of the abandonment plan, OEA shall either:

(a) Issue Notice to Proceed in accordance

with abandonment plan upon the *Contractor's* written request; or

(b) Require the *Contractor* to deposit in a trust account the abandonment cost, in which case, the *Contractor* shall be relived of its obligation to execute the abandonment plan.

Article III. Relinquishment

Twelve (12) months prior to the date of expiration, the *Contractor* must give written notice to OEA that no further extension is sought by the *Contractor* and that it will relinquish the production area upon expiration of the contract. The reasons for such relinquishment must likewise be expressly stated therein and attaching thereto the documents mentioned in Sect. 1, Art. II.

All other provisions relating to abandonment are likewise made applicable to relinquishment except that instead of approval, an acknowledgment of the expiration of the contract shall be given by OEA.

Article IV. Obligations of contractor

Section 1

Pending review and approval/acknowledgement of OEA of the request for abandonment or relinquishment, the *Contractor* shall observe the following:

(a) No pipelines, machinery, platform, pumps and other properties constructed, put up or built and used or employed by the *Contractor* in the production site shall be sold, removed or transferred from the production area without prior notice to and approval of OEA;

(b) Prior notice to and approval of OEA is likewise necessary before any productive well can be plugged except those wells or boreholes which have been previously approved by OEA to be plugged and abandoned; and

(c) The *Contractor* must maintain in good repair and condition and fit for future operation during the interim 12-month period, all boreholes and wells except those previously abandoned as authorized by OEA.

Section 2

Upon approval/acknowledgmenet of abandonment/relinquishment, the *Contractor* shall be obliged to do the following:

(a) Relinquish and turn over to the OEA all pipelines, platforms, pumps, machinery and other properties constructed, put up or built and used or employed by the *Contractor* in its operation on the production area and which are at that time necessary for continued production by the OEA or other parties designated in accordance with Sect. 3, Art. II hereof;

(b) Effect the transfer to OEA of all productive boreholes or wells drilled by the *Contractor* in good repair and condition and fit for further working, except such boreholes or wells which have been previously plugged and abandoned as authorized by OEA;

(c) Plug some or all production boreholes and wells if required by OEA;

(d) Remove or cause to be removed at the *Contractor's* expense from the abandoned or relinquished production area within one year from approval/acknowledgement, such production equipment and related property as identified by OEA, brought into the area by the *Contractor* or by any person engaged or concerned in the operations authorized by the *Contractor*; and

(e) The installations in the case of offshore facilities should continue to be lit in accordance with normal regulations following the end of production activity and prior to the completion of any partial or complete removal that may be required.

(f) Restore, at *Contractor's* expense and to the satisfaction of OEA, any or all destruction of land forms, land and marine life which may be affected by the pollution from *Contractor's* production and/or abandonment operations.

(g) Secure a Trust Account in favor of OEA; and

(h) Perform such other activities as contained

in the detailed plans and procedures submitted by *Contractor* which have been approved by OEA.

Article V. Effectivity

These guidelines shall become effective immediately.

Fort Bonifacio, Makati, Metro Manila, June 28, 1989.

(Signed by)
W.R. DE LA PAZ
Executive Director

THE OUTLOOK FOR PLATFORM REMOVAL IN THE GULF OF THAILAND*

Status of petroleum exploitation in the Gulf of Thailand

The rights for petroleum exploration in the Gulf of Thailand were first awarded to private oil companies in 1968 by virtue of the Mineral Act 1967, marking the beginning of offshore petroleum development in Thailand.

In 1971, the Petroleum Act and the Petroleum Income Tax Act were promulgated to govern petroleum operations. Many more oil companies were granted concession areas in both the Gulf of Thailand and the Andaman Sea.

Up to the end of January 1992, 13 rounds of petroleum concessions had been announced and a total of 26 concessions had been awarded to 32 oil companies (see figure 1). To date, 37 petroleum fields have been discovered, with 19 offshore fields having both oil and gas (see figure 2).

At present, three well-known companies, British Gas Thailand Ltd. UNOCAL Thailand Ltd. and TOTAL Exploration and Production Ltd., are conducting field activities in the Gulf of Thailand. British Gas is currently drilling its first exploratory well in the B5/27 concession area. TOTAL is well on the way to producing gas from the Bongkot field where three wellhead platforms have now been installed and drilling for additional development wells is scheduled to commence in July 1992. UNOCAL, the most successful oil company in Thailand, is both exploring and producing gas and condensate. In total, four drilling ships/tenders are now active in the Gulf of Thailand; three ships/tenders are working for UNOCAL and the rest for British Gas. Other oil companies, such as Sun Oil (Thailand) and Kirkland Ltd., have just finished geophysical surveys in their concession areas.

At present, UNOCAL is the only oil company producing gas and condensate in the offshore areas. Its six gas fields are Erawan, Baanpot, Satun, Platong, Kapong and Funan. The Erawan field was the first to be discovered and has been on stream since August 1981. Offshore production is now at the rate of about 720 million cubic feet per day and 23,000 b/d for gas and condensate respectively.

Moreover, UNOCAL is in the final stage of production development for Surat field, which is scheduled to come on stream very soon.

TOTAL, as the operator, will be producing gas and condensate in May next year with the estimated initial rate of 150 MMSCFD of gas and 3,000 b/d of condensate, and for further development the production rate could be raised to 350 MMSCFD.

In summary, the total petroleum production in Thailand in 1991, including onshore oil and gas production, is equivalent to 187,000 barrels per day of Arabian Light Oil, which comprises approximately 34 per cent of the country's petroleum consumption.

Status of platforms and installations in the Gulf of Thailand

Offshore platforms were first installed by UNOCAL in the Erawan field in 1981, 10 years ago. At that time, there were only one floating storage unit and eleven platforms for various purposes; five wellhead platforms, four remote processing platforms, one central processing platform, and one platform for living quarters.

At present, sixty-six structures and one floating storage unit have now been installed in the Gulf of Thailand. Most of the structures belong to UNOCAL (and partners) with only three wellhead platforms belonging to TOTAL (and partners). Summary is given in table 1.

It is planned to install two more wellhead platforms each in the Erawan and Jakrawan fields. One central processing platform, one living quarters platform and one floating storage unit are scheduled

* Presented at the 1992 Seminar by Chamnan Duangjaras, Department of Mineral Resources, Thailand.

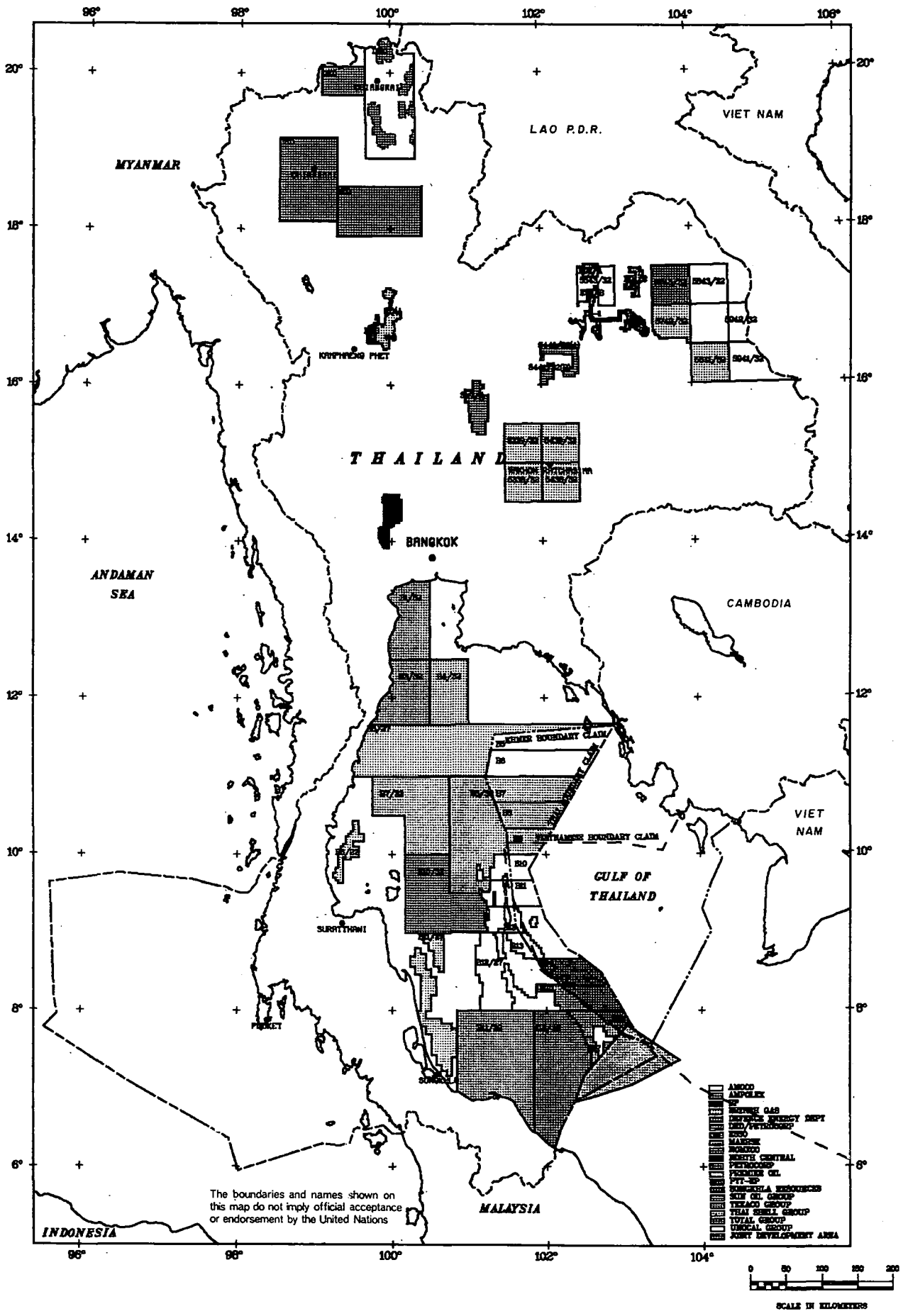


Figure 1. Petroleum concession map of Thailand

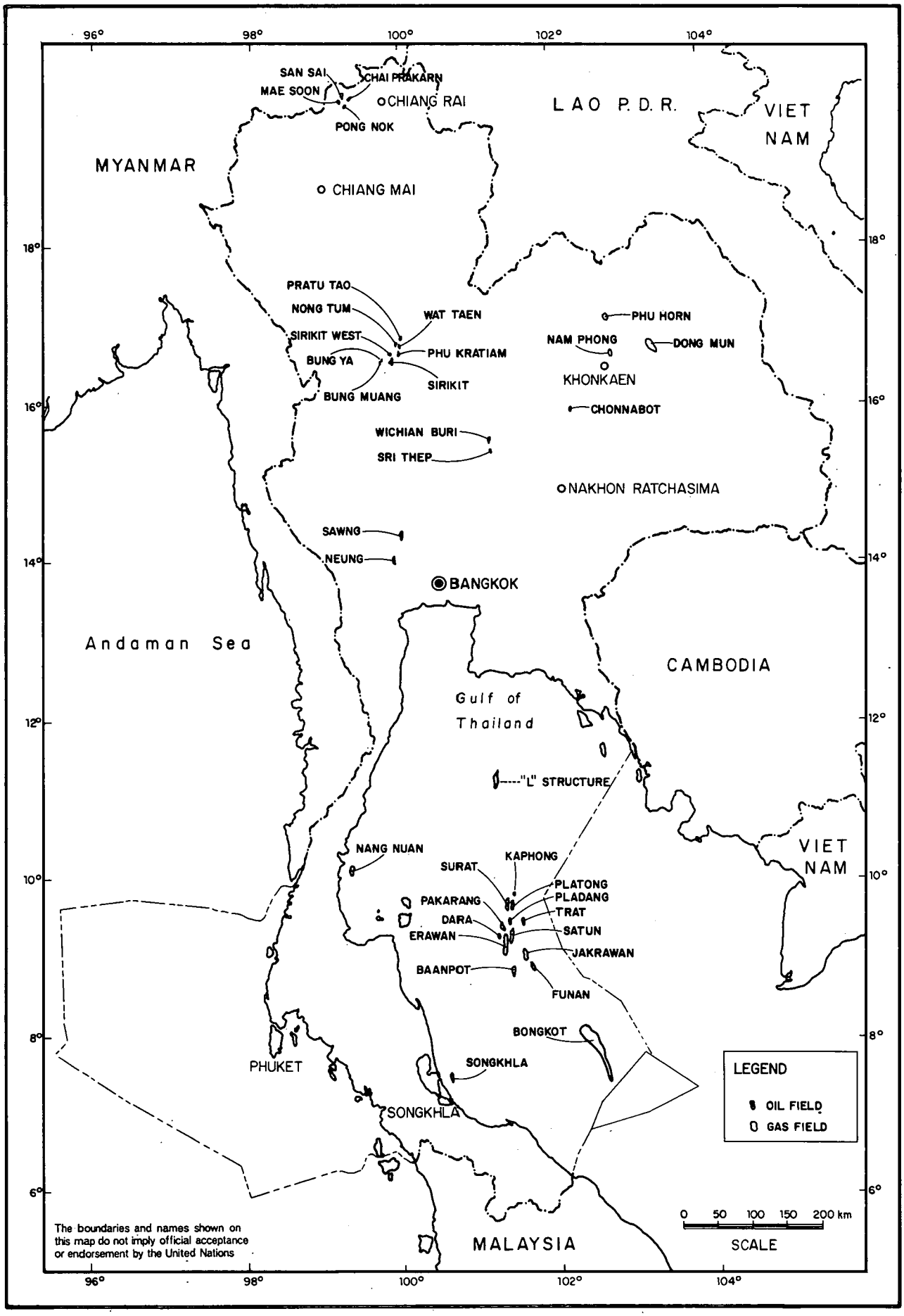


Figure 2. Wellhead platform comparison

Table 1. Structures installed in the Gulf of Thailand (as at May 1992)

Company	*Field*	*Structure*						
		CPP	*LQ*	*Flare*	*PP*	*WP*	*CP*	*Tanker*
Unocal	Erawan	1	2	2	4	16	1	1
	Baanpot	–	–	–	–	3	–	–
	Satun	1	1	1	–	11	–	–
	Platong	1	1	1	–	5	–	–
	Kapong	–	–	–	–	2	–	–
	Funan	1	1	1	–	6	–	–
	Surat	–	–	–	–	1	–	–
Total	Bongkot	–	–	–	–	3	–	–
	Total	4	5	5	4	47	1	1
	Grand total	66						1

Notes: CPP = Central processing platform. PP = Remote processing platform.
CP = Compression platform. WP = Well platform.
LQ = Living quarters.

to be installed in the Bongkot field at the end of this year.

All platforms are fixed-steel jacket structures (see figures 3 and 4) using steel piles of 1.06 metres diameter in general. The wellhead platform consists of 12 slots/conductors. The platform weight is about 1,500 to 3,000 tons. The average water depth in the areas of these platforms is about 67 metres. The platforms are organized in clusters about 2 to 5 kilometers apart (see figure 5).

Current legal framework for platform removal

The two basic laws governing petroleum operations in Thailand are the Petroleum Act and the Petroleum Income Tax Act, promulgated in 1971. The Petroleum Act deals with all aspects of upstream petroleum operations, such as exploration, production, windfall profit etc. The Minister of Industry is empowered to enforce the law in consultation with the Petroleum Committee through the Department of Mineral Resources. The Minister of Finance is in charge and control of the Petroleum Income Tax Act through the Revenue Department. The Petroleum Income Tax Act deals with revenue and tax.

These two basic laws were amended three times, in 1973, 1979 and 1989. Unfortunately, no provisions concerning platform removal have been amended. The current provisions on platform removal were originally stipulated in 1971, which is 20 years ago.

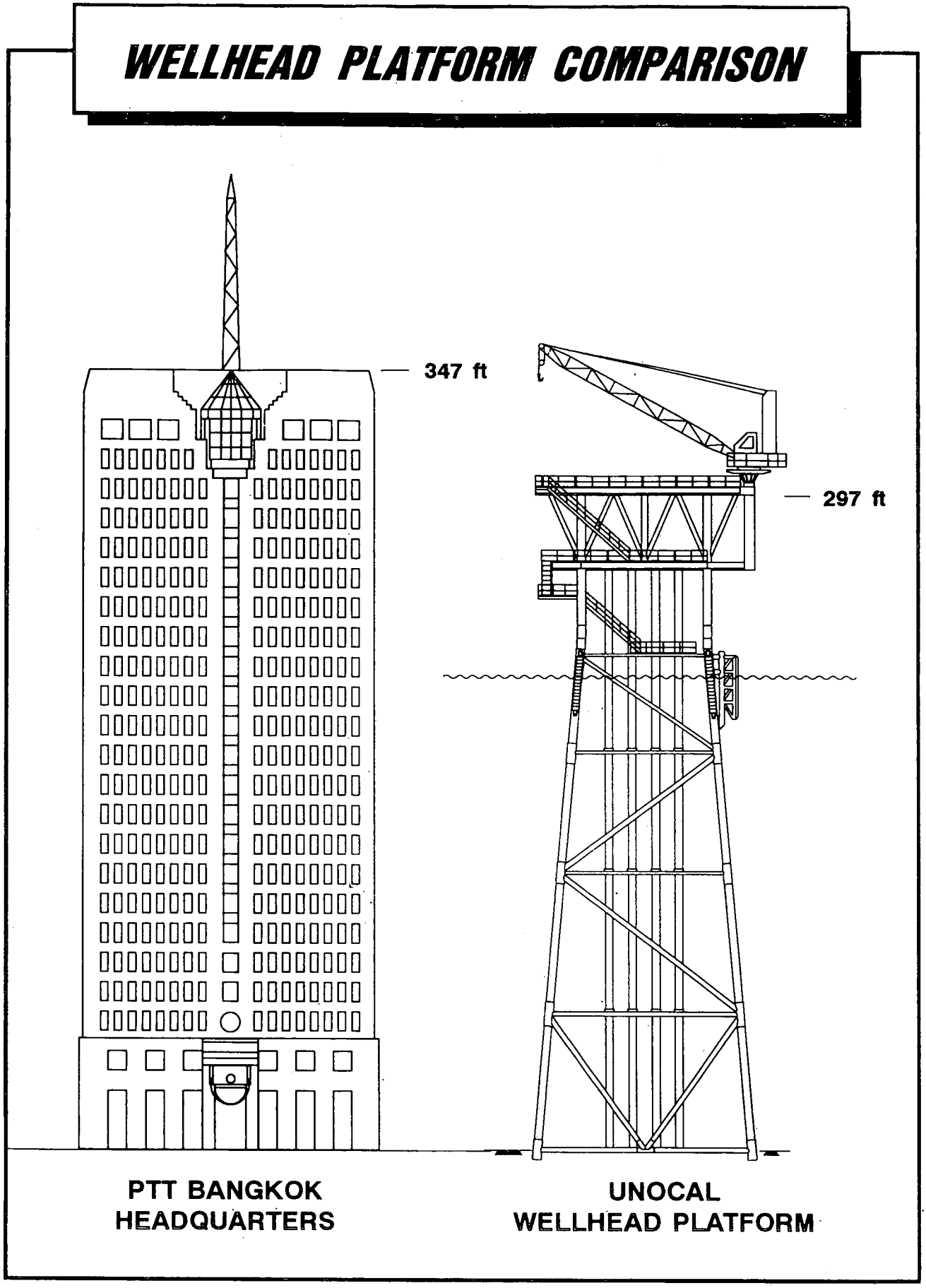

WELLHEAD PLATFORM COMPARISON
347 ft
297 ft
PTT BANGKOK
HEADQUARTERS
UNOCAL
WELLHEAD PLATFORM
Unocal Thailand, Ltd.

Figure 3.

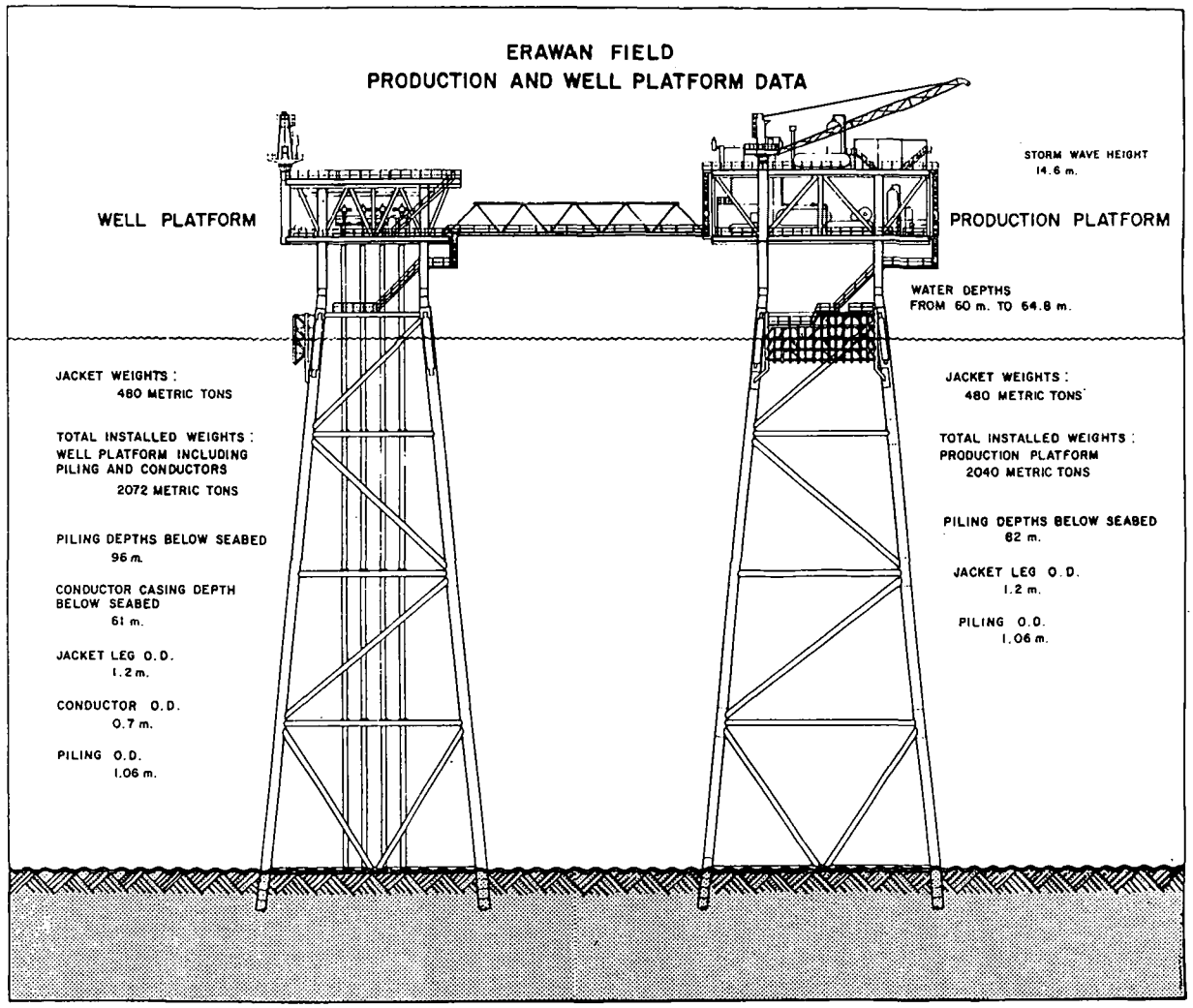


Figure 4. Erawan field production and well platform data

According to the current provisions, it can be seen that the removal is the concessionaire's liability, as stipulated in article 40 of Ministerial Regulation No 12. Moreover, under the provisions of article 15 of the model concession, it is stated that when the concession expires the concessionaire will demolish its properties which cannot be utilized within three months from the date of issuance of the Minister's instruction. In addition, the general guideline in section 80 of the Petroleum Act stipulates that the concessionaire will execute the petroleum operations in accordance with sound technical principles and good petroleum industry practice.

It is therefore obvious that there is a legal framework in the current legislation. However, no provisions concerning the details of platform removal have been included yet. The burden of the cost incurred is automatically borne by the concessionaire, and such cost is tax deductible. Equipment and machinery imported for the purpose of platform removal are exempted from import duty.

The status of platform removal under the current legal framework

Since the beginning of offshore petroleum development in 1968 there has been only one removal, by Thai Shell in 1985, when a jack-up production platform in Nang Nuan field was removed as the field was temporary shut in. To date, there has been no experience of removal of fixed offshore platforms in Thailand.

As mentioned earlier, the first fixed platform was installed in the Gulf of Thailand 10 years ago. This platform is expected to be in service for at least another 7 to 10 years. It is, therefore, hardly surprising that little effort by either the Government or the concessionaires has been made to examine the matter

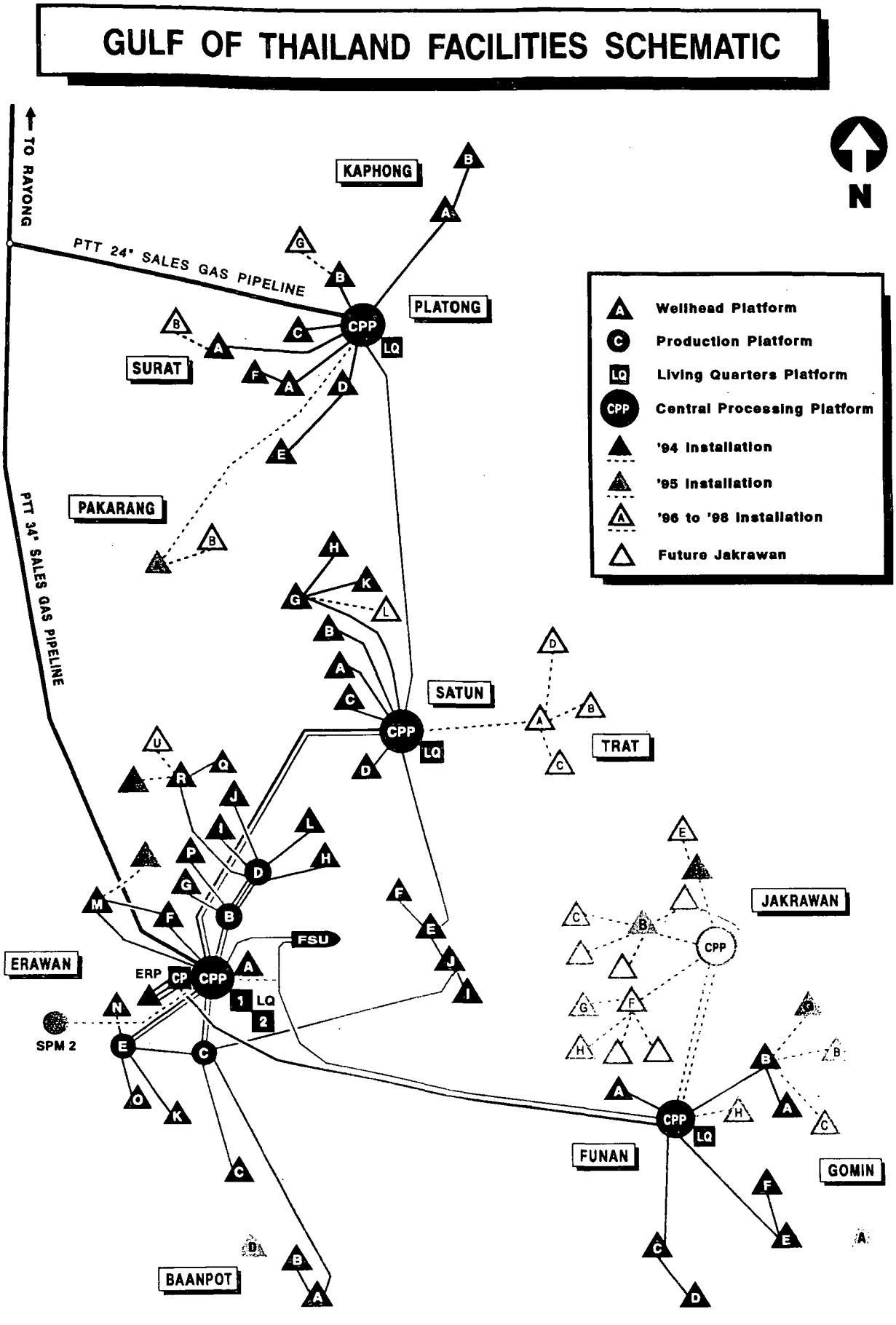


Figure 5. UNOCAL facilities schematic

of platform removal. However, the Department of Mineral Resources, as the government body responsible for the matter, recently recommended to the concessionaires that they should take the removal of platforms into account at an early stage of the production development plan. That is to say, in applying for production area approval, the concessionaire will have to prove that with the removal cost included in the total expense caculation the proposed project is still commercially viable (section 42 of the Petroleum Act). This matter has been treated positively by the Company. The estimated costs of platform removal and well abandonment are shown below. It may be noted that this is not an obligation for platform removal.

Well abandonment

(1) Recover the tubing to the top valve and squeeze the cement below this valve wherever it is possible.

(2) Cut and recover the casing and conductor below the sea floor.

Item	*Time (days)*
Kill the well	1.0
Set up the rig	0.5
Recover the tubing to the top valve	2.0
Squeeze below the valve	1.0
Cut and recover the surface casing	4.5
Total	9.0

Estimated costs of well abandonment		*US dollars*
Rig rate and fuel	9 days at $22 000	198 000
Supervision	9 days at $2 000	18 000
Transportation/logistics	9 days at $6 000	54 000
Outside services		150 000
Total		420 000

Estimated costs of platform removal		*US dollars*
(1) Mobilization and demobilization		270 000
(2) Cut deck, pipeline and legs	6 days x $13 000/d	80 000
(3) Derrick and barge work	5 days x $70 000/d	350 000
(4) Transportation		450 000
(5) Plastic explosive		120 000
Total		1 270 000

The platform above is a jacket steel structure using four steel piles of 1.06 metres diameter and with 12 slots. The platform is located in a water depth of about 65 metres; the total weight of the platform is about 2,000 tons.

From the details given, the deck is first cut and then removed. The casings and conductors are cut at a level below the sea floor. The total removal is then completed.

No further information or details have been submitted or are required at present. However, the Department of Mineral Resources must have access to the information on the removal plan of the concessionaire. The action will be taken later on.

Regarding the removal details, it can be seen from the above information that the concessionaire has to set out the detailed provisions itself in accordance with good industry practice. However, such provisions are, eventually, to be approved by the Minister and the criteria for approval are usually based on international guidelines and standards.

Platform removal will be the responsibility of the Government if the platform is transferred to the Government after expiry of the concession period.

It should be noted that a national oil company, PTT Exploration and Production Co. Ltd., was established in 1985 to conduct petroleum exploration and production as a private company. The company has since entered into various joint ventures with both onshore and offshore exploration and production activities. Therefore it will have to be responsible for platform removal in the future.

Conclusions

(1) Platform removal and related provisions have not yet been seriously discussed or planned by the Government and the concessionaire.

(2) A new ministerial regulation and/or concession agreement is probably the most appropriate means for dealing with details of platform removal.

(3) International guidelines and standards concerning platform removal will certainly be used as reference.

(4) Studies on the modes of removal and disposal, and also the financial framework, will be necessary.

PETROLEUM AUTHORITY OF THAILAND: OFFSHORE PIPELINES AND INSTALLATIONS*

The Petroleum Authority of Thailand (PTT) is the Thai State enterprise which deals with the petroleum business. It was established under the Petroleum Authority of Thailand Act in 1978. Its scope of work includes offshore exploration and production. PTT has the same rights, interests and duties as if it were a concessionaire under the law on petroleum. When the Union Oil Company (now UNOCAL) discovered a gas/condensate well in the Gulf of Thailand, the Natural Gas Organization of Thailand (NGOT), before becoming PTT, contracted with UNOCAL to purchase gas and condensate at the production platform. In order to receive gas from the sea, NGOT has to lay down submarine natural gas pipeline for a distance of 425 kilometres from the coast of Rayong Province to Erawan field in the middle of the Gulf, and at this end, it emerges from water in the exclusive economic zone of Thailand near the UNOCAL production platform. This PTT pipeline is one of the longest offshore pipelines in the world. PTT has signed a second contract to purchase natural gas from UNOCAL from the Baanpot, Satun, Platong, Pladang and Kapong fields, and the pipeline has been extended to these wells and pipeline connections, in other words, offshore structures, have been increased simultaneously.

In 1985 PTT established PTT Exploration and Production Co. (PTTEP) and owns 100 per cent of its shares. It entered into a joint venture with Thai Shell Exploration and Production Co. to develop concession block S1 in the nothern Central Plains. Two years later, the Thai Government succeeded in negotiating the purchase of concession rights to natural gas fields in the Gulf of Thailand from Texas Pacific and a contract has been signed. PTT, as a national oil company, will develop the Texas field through PTTEP by entering into a joint venture with a gas operator company. It is certain that more offshore installations will be constructed in the exclusive economic zone of Thailand.

The opportunity afforded by being able to attend this Seminar and learn of the conclusions reached will give PTT awareness of the terms and conditions to be written into joint venture agreements in the future.

* Presented at the 1989 Seminar by Nitipant Leelakul, Petroleum Authority of Thailand.

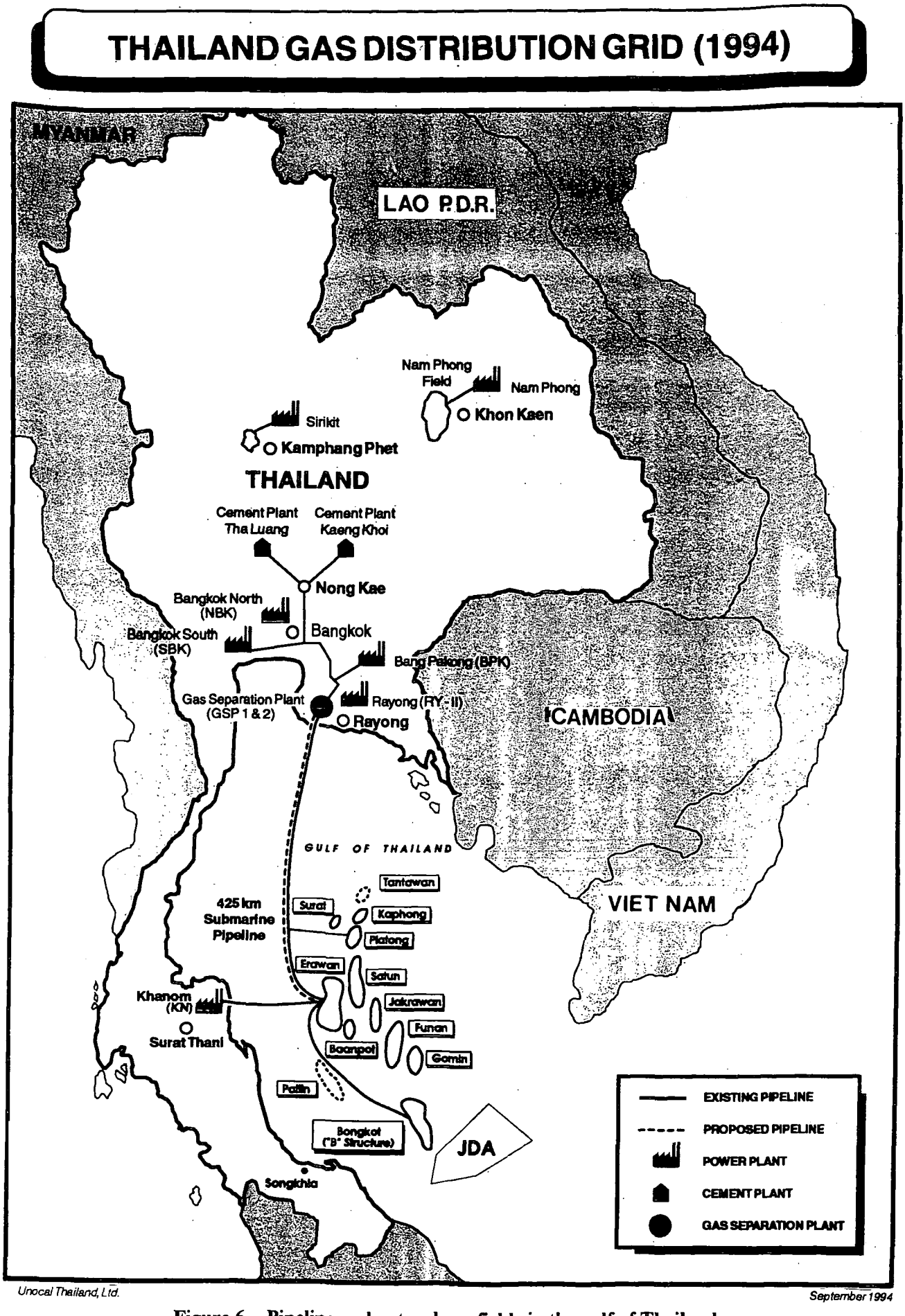


Figure 6. Pipeline and natural gas fields in the gulf of Thailand

OFFSHORE PETROLEUM ACTIVITIES IN THAILAND*

Introduction

Thailand has been dependent on imported oil and has imported a large volume of oil each year to meet domestic consumption. This has been a heavy burden on its social and economic growth. As the first step towards alleviating this problem. the Government has put greater emphasis on exploring and developing Thailand's own natural resources.

The present petroleum laws, promulgated in 1971 and amended in 1973 and 1979, were aimed at attracting foreign investment and technical expertise into undertaking domestic petroleum ventures while providing fair and satisfactory benefits to both the investors and the Government.

Offshore petroleum exploration began in 1968 in the Gulf of Thailand with geophysical surveys, and in 1971 with exploratory drilling. The first discovery was made in 1973, and later 12 gas/condensate fields of commercial interest were discovered. In 1979, the Erawan field was the first developed in the Gulf, starting production in 1981. Today, a total of four gas/condensate fields are on stream.

Offshore petroleum exploration in the Andaman Sea off the west coast of Thailand was carried out mostly in water depths greater than 200 metres. Unfortunately, there was no discovery, and only gas shows were encountered.

National energy policies

The main issues of the national energy policy proposed for the Sixth Economic and Social Development Plan (1987-1991) are as follows:

1. Development of diversified domestic energy supplies, and further reduction in energy import dependence.
2. Restructuring of energy, especially oil, prices.
3. Promotion of efficient energy use, particularly in the transport and manufacturing sectors.
4. Encouragement of private sector energy investment, defining clearly the roles of the Government and the private sector.

The major energy supply of the country today and in the foresseeable future is in the form of oil and gas. Although substantial progress has been made in exploiting the offshore gas/condensate and onland crude oil deposits in the past decade, Thailand may continue to be a net oil and gas importing country in the near future. Hence, the Government is striving to encourage more exploration and production in the country, both onshore and offshore.

Petroleum exploration and production in Thailand are conducted under the Petroleum Act and Petroleum Income Tax Act, which stipulate the rights and duties for concessionaires. The Department of Mineral Resources is the principal government agency overseeing upstream petroleum activities. The Revenue Department, on the other hand, is responsible for enforcing the Petroleum Income Tax Act.

Since 1982, the terms and conditions for offshore exploration and production have been softer than those for onland activities. The royalty for offshore production in water depths greater than 200 metres is 8.75 per cent of the value of petroleum sold or disposed of. This rate is lower than the normal rate of 12.5 per cent, which is applied to shallower water and onland production.

Offshore exploration

In Thailand, onland petroleum exploration had been carried out long before offshore exploration but without success at that time. In 1968, the Thai Government aimed at expediting offshore exploration, as successful offshore exploration and production had taken place in many other countries. The Gulf of Thailand was divided into 19 blocks, in which the average water depth was less than 70 metres. The offshore area in the Andaman Sea, off

* Presented at the 1989 Seminar of Sararit Pongpitak, Department of Mineral Resources, Thailand.

the west coast of Thailand, was divided into nine blocks, six in water depths of less than 200 metres and the rest in water depths of more than 200 metres.

Gulf of Thailand

Offshore exploration in the Gulf was commenced in 1968 by the Union Oil Company (now UNOCAL). Magnetic and seismic surveys were conducted in the southern part of the Gulf, and showed two major prospective Tertiary basins and several small prospective Tertiary basins. Exploratory drilling started in 1971 following the promulgation of the Petroleum Act and the Petroleum Income Tax Act. More geophysical work was then planned and conducted. In 1973, the first discovery was made as a gas/condensate well in Tertiary sandstone reservoirs. Exploratory drilling boomed in the Gulf in the following years. Almost all of the exploration wells in the Gulf were drilled by drilling ships, and a few by jack-up and semi-submersible rigs, encountering high geothermal gradients ranging from 2 to about 4°F/100 ft.

UNOCAL Thailand Ltd. has been the most successful in petroleum exploration and production in the Gulf, with 10 discovered gas/condensate fields, Baanpot, Erawan, Satun, Platong, Pladang, Funan, Jakrawan, Kaphong, Pakarang and Trat. The Company is currently producing natural gas and condensate from four fields, Erawan, Baanpot, Satun and Platong. Erawan was the first producing field, starting in August 1981. Kaphong is being developed and will be producing in the middle of 1989. Until now, UNOCAL has drilled 460 wells-68 exploration, 118 appraisal and 274 production wells. The current production facilities consist of 31 well platforms, 3 central processing platforms and 4 living quarter platforms. The present gas production rate is 560 million standard cubic feet per day, all being sent to an onshore gas plant at Rayong. The condensate production of 21,000 b/d is sent to both local and overseas refineries.

Texas Pacific is another successful company; it discovered two gas/condensate fields in the Gulf, the B-structure and the E-structure. At present, PTT Exploration and Production (PTTEP), on behalf of the Thai Government, has bought the concession back from Texas Pacific after long negotiations (more than 10 years). PTTEP plans to develop the B-structure by 1990.

Thai Shell Exploration and Production Ltd. has also been successful in the central part of the Gulf, finding oil accumulations in its first well, Nang Nuan-1, which was later declared Thailand's first commercial offshore oil discovery. In 1985, the Nang Nuan oilfield started production at rates up to 10,000 b/d. The field was recently shut in temporarily owing to a high water production rate.

Premier Oil Pacific Ltd., with a concession block south of that of UNOCAL, has also found oil accumulations in its first well, named Songkla-1, with a first test rate of 1,400 b/d. The well has recently been suspended temporarily and further surveys will be planned and conducted.

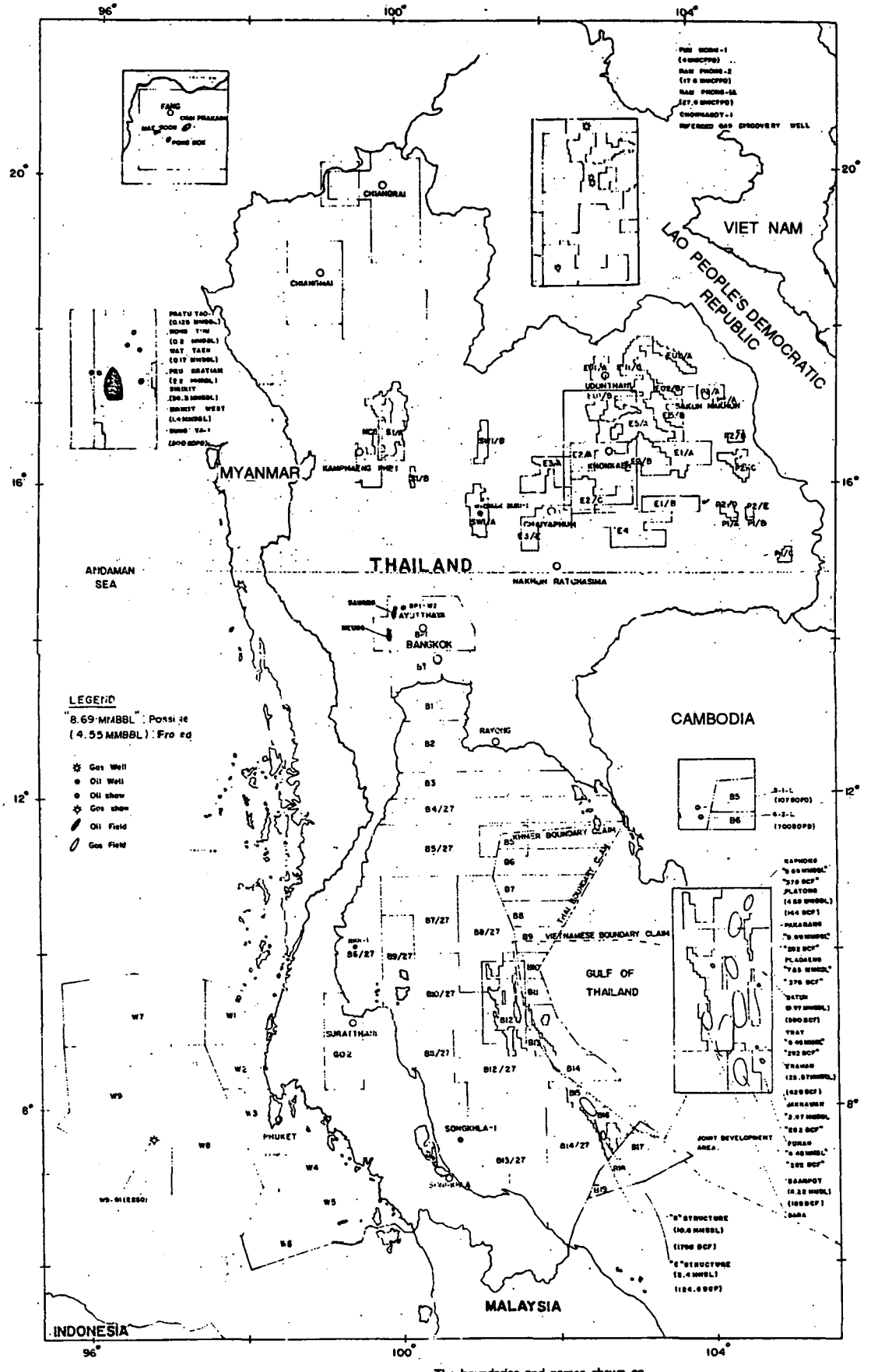
Andaman Sea

Exploration in the Andaman Sea started in 1971. The results of seismic surveys in the shallow-water concession blocks were unfavourable for drilling. Concessionaires had to relinquish their concessions voluntarily before the expiry of the exploration periods. Drilling operations in the deep water of the Andaman Sea concessions were started in 1975 by Esso Exploration and Production Thailand Inc., and by Union Oil Company of Thailand and its partners. In drilling the W9-E-1 well in 1976, Esso set a new world record of deep-water drilling for petroleum, at 3,461 feet.

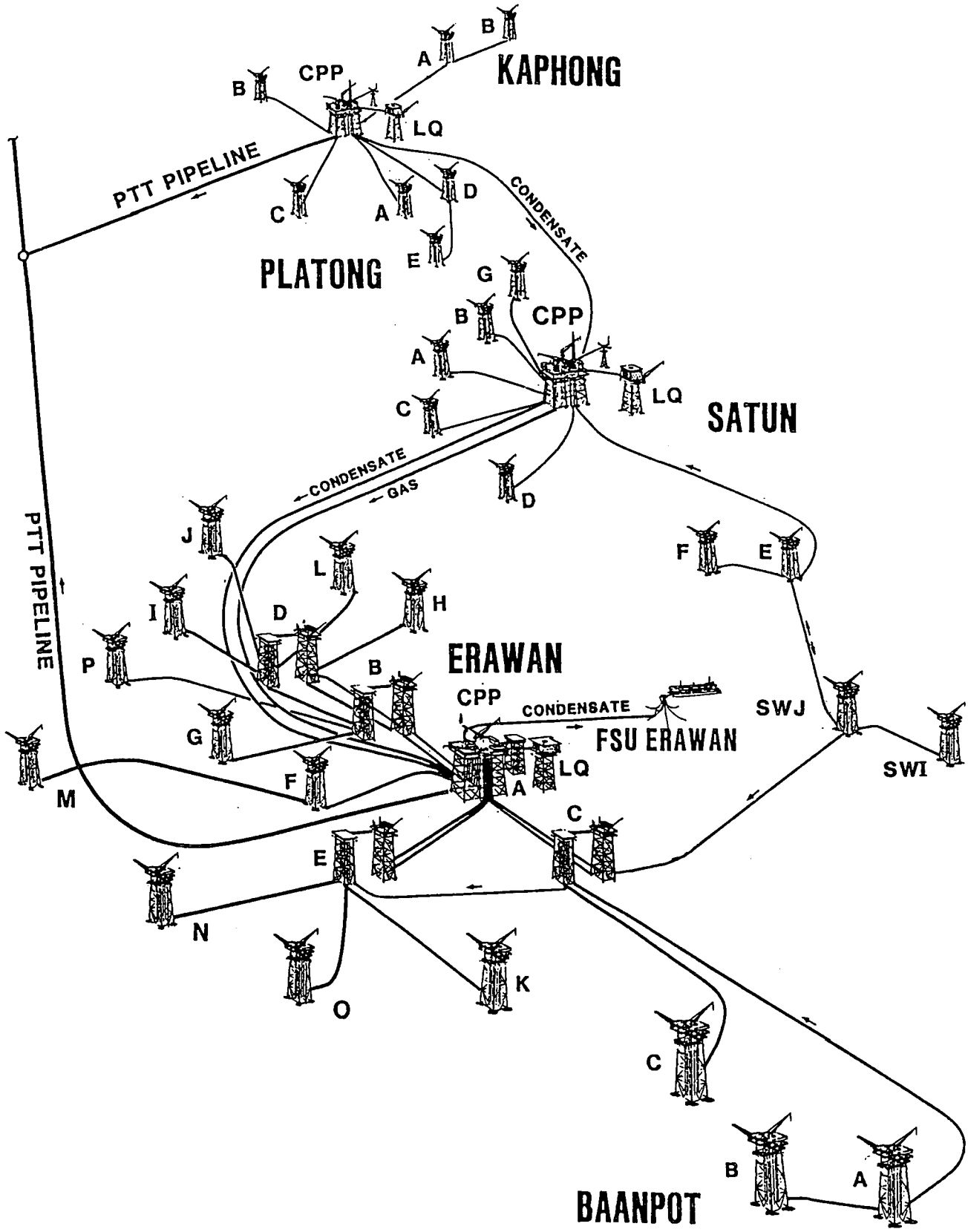
A total of 13 exploration wells have been drilled in the Andaman Sea, 5 by Esso, 6 by Union Oil, and 2 by Placid Oil, all in water depths in excess of 200 metres. Unfortunately, no discovery of petroleum of commercial interest has been found, with only gas shows in Tertiary sequences. By 1982, both the Esso and Union Oil concessions had been relinquished; Placid Oil relinquished its concession in 1987.

Offshore drilling, not only exploratory but also for appraisal and development, has been in the hands of concessionaires which are international oil companies, and of foreign service companies. Domestic participation has been limited by technological and financial resources. At present, 2 tender rigs and 1 drilling ship are working in the Gulf of Thailand, drilling development wells and extensive exploration wells for UNOCAL Thailand Inc.

Oil and natural gas map of Thailand



Gulf of Thailand facilities schematic



Production, sales, value and royalty of natural gas

	1981	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*Total*
Erawan field									
Production (MMCF)	10 670.40	47 145.90	54 097.30	68 179.50	67 574.70	58 963.20	76 331.00	79 058.30	462 020.30
Sales (MMCF)	10 037.82	46 631.05	53 308.13	67 256.80	65 966.26	58 050.19	74 923.21	77 295.45	453 468.91
Value (MMBaht)	576.31	2 634.53	3 242.70	4 169.67	4 445.38	3 819.77	3 995.55	3 756.52	26 640.43
Royalty (MMBaht)	72.04	342.68	409.78	521.34	555.67	477.47	499.44	469.57	3 347.99
Baanpot field									
Production (MMCF)	0.00	0.00	1 033.00	11 139.90	8 080.80	0.00	3 757.90	21 531.10	45 542.70
Sales (MMCF)	0.00	0.00	1 023.40	11 057.94	8 692.91	0.00	3 593.14	21 201.22	45 568.62
Value (MMBaht)	0.00	0.00	55.96	616.58	570.10	0.00	217.76	1 187.76	2 648.16
Royalty (MMBaht)	0.00	0.00	6.99	77.07	71.26	0.00	27.22	148.47	331.01
Satun field									
Production (MMCF)	0.00	0.00	0.00	0.00	24 969.60	32 614.80	62 037.40	72 282.30	191 931.10
Sales (MMCF)	0.00	0.00	0.00	0.00	23 703.35	31 694.20	60 204.63	70 399.94	186 002.12
Value (MMBaht)	0.00	0.00	0.00	0.00	1 493.45	1 994.13	3 396.58	3 979.62	10 863.79
Royalty (MMBaht)	0.00	0.00	0.00	0.00	186.68	249.27	424.57	497.45	1 357.97
Platong field									
Production (MMCF)	0.00	0.00	0.00	0.00	21 955.60	25 522.90	25 258.80	27 603.20	100 340.50
Sales (MMCF)	0.00	0.00	0.00	0.00	21 077.65	24 743.48	24 457.12	26 011.78	97 090.04
Value (MMBaht)	0.00	0.00	0.00	0.00	1 238.57	1 503.86	1 358.18	1 479.52	5 580.13
Royalty (MMBaht)	0.00	0.00	0.00	0.00	154.82	187.98	169.77	184.94	697.51
Srikit and Sirikit W. field									
Production (MMCF)	0.00	0.00	1 890.16	6 186.45	10 044.62	10 637.46	11 272.61	11 130.18	51 161.48
Sales (MMCF)	0.00	0.00	1 287.58	4 153.48	6 419.53	7 760.73	8 060.23	7 913.23	35 594.79
Value (MMBaht)	0.00	0.00	45.72	154.51	274.12	290.69	266.40	270.94	1 302.39
Royalty (MMBaht)	0.00	0.00	5.74	19.31	34.26	36.34	33.30	33.87	162.79
Nang Nual field									
Production (MMCF)	–	–	–	–	–	–	–	36.21	36.21
Sales (MMCF)	–	–	–	–	–	–	–	0.00	0.00
Value (MMBaht)	–	–	–	–	–	–	–	0.00	0.00
Royalty (MMBaht)	–	–	–	–	–	–	–	0.00	0.00
Total									
Production (MMCF)	10 670.40	47 145.90	57 020.46	85 505.85	132 625.32	127 766.36	178 657.71	211 641.29	851.032.30
Sales (MMCF)	10 037.82	46 631.05	55 619.12	82 468.23	125 859.71	122 248.59	171 238.33	203 621.62	817 724.47
Value (MMBaht)	576.31	2 634.53	3 344.38	4 940.76	8 021.63	7 600.46	9 234.47	10 674.36	47 034.89
Royalty (MMBaht)	72.04	342.68	422.49	617.72	1 002.69	951.06	1 154.30	1 334.29	5 897.27

Notes: MMCF = millions of cubic feet.
MMBaht = millions of baht.

Production, sales, value and royalty of condensate/crudet

	1981	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*Total*
Erawan field									
Production (MMBBL)	0.45	2.04	2.20	2.40	2.60	2.44	2.32	2.29	16.73
Sales (MMBBL)	0.41	1.60	2.13	2.70	2.66	2.41	2.19	2.30	16.40
Value (MMBaht)	310.64	1 197.57	1 397.98	1 775.28	1 943.59	936.45	979.82	901.13	9 442.45
Royalty (MMBaht)	38.83	149.70	174.75	221.95	242.95	117.06	122.47	112.64	1 180.33
Baanpot field									
Production (MMBBL)	–	–	0.07	0.61	0.35	0.00	0.15	0.84	2.01
Sales (MMBBL)	–	–	0.00	0.63	0.38	0.00	0.10	0.82	1.92
Value (MMBaht)	–	–	0.00	415.20	278.52	0.00	48.23	320.03	1 061.98
Royalty (MMBaht)	–	–	0.00	51.90	34.81	0.00	6.02	40.00	132.73
Satun field									
Production (MMBBL)	–	–	–	–	1.05	1.23	1.73	1.99	6.00
Sales (MMBBL)	–	–	–	–	0.98	1.24	1.58	2.03	5.83
Value (MMBaht)	–	–	–	–	731.41	464.70	729.34	801.38	2 726.82
Royalty (MMBaht)	–	–	–	–	91.42	58.09	91.16	100.17	340.84
Platong field									
Production (MMBBL)	–	–	–	–	1.21	1.54	1.32	1.44	5.51
Sales (MMBBL)	–	–	–	–	1.12	1.56	1.25	1.47	5.40
Value (MMBaht)	–	–	–	–	835.33	585.11	575.34	584.96	2 580.73
Royalty (MMBaht)	–	–	–	–	104.42	73.14	71.91	73.12	322.58
Sirikit and Sirikit W. field									
Production (MMBBL)	–	–	2.22	5.10	7.59	7.34	6.10	6.55	34.90
Sales (MMBBL)	–	–	2.18	4.93	7.55	7.31	6.07	6.49	34.54
Value (MMBaht)	–	–	1 324.13	3 092.74	5 200.08	2 761.30	2 549.59	2 306.33	17 234.16
Royalty (MMBaht)	–	–	165.52	386.59	650.01	345.16	318.69	288.29	2 154.26
Nang Nual field									
Production (MMBBL)	–	–	–	–	–	–	–	0.47	0.47
Sales (MMBBL)	–	–	–	–	–	–	–	0.48	0.48
Value (MMBaht)	–	–	–	–	–	–	–	156.14	156.14
Royalty (MMBaht)	–	–	–	–	–	–	–	19.52	19.52
Total									
Production (MMBBL)	0.45	2.04	4.49	8.11	12.80	12.55	11.62	13.57	65.63
Sales (MMBBL)	0.41	1.60	4.31	8.26	12.68	12.52	11.19	13.59	64.56
Value (MMBaht)	310.64	1 197.57	2 722.11	5 283.22	8 988.92	4 747.56	4 882.32	5 069.97	33 202.29
Royalty (MMBaht)	38.83	149.70	340.26	660.44	1 123.60	593.44	610.25	633.74	4 150.27

Notes: MMBBL = millions of barrels per day.
MMBaht = millions of baht.

PETROVIET NAM's PETROLEUM ACTIVITIES AND POTENTIAL PROBLEMS RELATED TO THE REMOVAL AND DISPOSAL OF OBSOLETE OFFSHORE INSTALLATION AND STRUCTURES*

Viet Nam Oil and Gas General Department (PetroViet Nam) established in 1975.

Petroleum exploration

— Carried out seismic and Geophysical survey of approximately 200,000 km line 2D and 8,000 km line 3D.

— About 300 petroleum prospective structures discovered.

— Exploration wells: 70.

— Record of deep drilling: 4,500 m.

— Fields in production: 2 (Tien Hai gas field and White Tiger oilfield).

— Petroleum-bearing structures discovered but not yet appraised (1989): a total of 9, of which 6 bear (crude oil and 3 bear natural gas.

Development and production

— Commencement of natural gas production in 1981: Tien Hai field.

— Commencement of oil production 1986: White Tiger field.

— Annual production:

Year	*Crude oil (millions of tons)*	*Gas (millions of cubic metres)*
1981	–	8.4
1982	–	21.4
1983	–	34.5
1984	–	35.2
1985	–	35.2
1986	0.04	42.4
1987	0.28	66.7
1988	0.68	128.0
1989	1.50	287.3
1990	2.70	491.6
1991	3.96	712.5
1992 (projected)	5.00	1 000.0

Petroleum processing

— Preparation for building the refinery plant.

— Preparation for laying offshore gas pipelines and construction of LP6 plant.

Production sharing contracts: 14.

Offshore installation and structures installed

— 10 drilling and production platforms

— 1 central processing platform

— About 20 km of pipeline

* Presented at the 1989 Seminar by Nguyen Van Minh, University of Hanoi.

DEVELOPMENT OF OFFSHORE PETROLEUM PLATFORM REMOVAL POLICY IN AUSTRALIA*

Introduction

International interest in the disposal of obsolete or disused oil and gas platforms has developed rapidly in recent years, with significant implications for coastal States and petroleum companies. Some platforms are approaching redundancy and the level of redundancies will increase over the next two decades.

Although the Australian offshore petroleum industry is relatively small by international standards, this issue is seen as important in the Australian context. Australia has participated in the IMO consideration of the draft guidelines and standards for the removal of offshore installations and structures. Today I intend to discuss briefly some of the main areas of interest in Australia over this issue.

The Australian Government has been concerned to seek a balanced solution in the IMO consideration of the guidelines so that a realistic framework is provided for safety of navigation and there are adequate environmental safeguards, while at the same time unreasonable costs are not imposed on the industry, and indirectly the Australian community.

The IMO guidelines have been accepted by the Government subject to any removal proposals being considered on a case-by-case basis taking account of environmental concerns, the interests of other users of the sea and the safety of personnel associated with platform removal.

International context

The disposal of obsolete or disused oil and gas installations is an international problem and has achieved prominence over the last couple of years through the consideration in the IMO Maritime Safety Committee of draft guidelines for removal. The focus of this consideration has been on the safety of navigation aspects but it has implications for defence, the fishing industry, environment protection, the oil industry and government regulatory/taxation agencies.

In April 1988, the IMO Maritime Safety Committee adopted draft Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone of coastal States. These are scheduled to be considered by the IMO Assembly late in 1989.

Adoption will bring into focus the relationship of article 5.5 of the 1958 Geneva Convention on the Continental Shelf and article 60, paragraph 3 of the 1982 Convention on the Law of the Sea. Article 5.5 requires that all abandoned or disused installations on the continental shelf must be "entirely removed" Article 60, paragraph 3, on the other hand, requires that such installations only be removed "to ensure safety of navigation, taking into account any generally accepted international standards established in this regard by the competent international organization" and having "due regard to fishing, the protection of the marine environment and the rights and duties of other States". Appropriate publicity is also to be given to the depth, position and dimensions of installations "not entirely removed".

The Australian context

The construction of offshore petroleum installations in Australian waters is controlled under the Petroleum (Submerged Lands) Act 1967. The legislation empowers government authorities to direct the removal or partial removal of installations, but does not specify any standards for removal.

There are 20 offshore petroleum production facilities in Australia at present - 13 in Bass Strait (adjacent to Victoria) and 7 in waters to the north-west of Australia. Most of the offshore producing fields have fixed steel structures connected via submarine pipelines to land-based storage and transportation facilities. The exceptions are the Jabiru and Talisman fields, where floating production systems are employed.

* Presented at the 1989 Seminar by J. Kjar, Department of Primary Industries and Energy, Australia.

A number of offshore production facilities of various kinds are likely to be installed in future years and the method or extent of disposal required will have significant financial implications for the future planning and construction of such offshore structures.

Most of the fixed platforms in Australia are of medium size by world standards, consisting of tubular steel jackets and steel decks. The platforms are secured by piles driven into the seabed. Platform sizes in Australia vary with water depths, which range from less than 50 metres to 125 metres, field size and complexity of on-platform production facilities.

Weather conditions in Bass Strait and the North West Shelf are quite severe by world standards and platform design and construction are therefore more rugged than, for example, in the Gulf of Mexico.

The cost of removing platforms in Australia is expected to be comparable with that of other locations in the world, subject to the availability of the large equipment necessary for such procedures and the hostile weather in Bass Strait. The cost of complete removal in Australia is estimated to avarage about $50 million for each platform. This would, of course be markedly reduced if partial removal or toppling *in situ* is permitted for particular cases.

Australia has not set up any trust funds to ensure the adequate provision of funds to cover the cost of removal - this is a matter for individual producers. However, the offshore petroleum legislation does provide a legal remedy in the event of failure of producers to remove platforms. Under the legislation, if a producer fails to honour his obligation to remove a facility the relevant authority may authorize such action as necessary to remove the structure, sell any remaining material and, if costs exceed the proceeds from the sale of material, recover these costs through the courts.

If coastal States are concerned about the prospect of companies not satisfying their obligations to remove offshore facilities, other models do exist to ensure that financial resources are set aside.

The taxation treatment of platform removal costs is also a matter for consideration. In Australia, these costs are not currently eligible deductions for company tax purposes, but the Government is considering this matter. The situation in relation to treatment of such costs for royalty and secondary tax purposes in Australia is more complex. In the case of new developments under the resource rent tax regime, platform removal costs are an eligible deduction against assessable receipts. If the platform removal costs (together with other closing down expenditures) exceed assessable receipts in any tax year, then the developer is entitled to a credit of 40 per cent of the excess, provided that total project credits do not exceed the amount of resource rent tax payments over the life of the project.

In the case of projects subject to royalty and excise — and this includes all the current facilities in the Bass Strait and the North West Shelf gas project — costs associated with platform removal are allowed under some royalty regimes but not others. No allowances are provided under the excise regimes.

Issues for consideration

While it is not expected that it will be necessary to remove any offshore platforms in Australian waters for a number of years, the development of international guidelines has focused attention on the issue and a number of differing views on it have been raised in Australia.

Petroleum industry perspective

On one side, the petroleum industry is concerned to minimize costs and establish clearly the requirements they will need to fulfil when the time comes to abandon a platform. While the question of the depth to which platforms should be removed, where partial removal is permitted, is still questioned by the Australian industry, companies generally recognize that the IMO guidelines represent the best achievable outcome, given the pressure from some groups for mandatory removal of all offshore facilities.

The Australian industry is currently seeking an amendment to the taxation laws to enable the cost of removing platforms to be deducted from their taxable income. As I mentioned, the Government is currently examining this proposal. The other more complex question facing the Government and the

industry is that of residual legal liability, which I will return to later.

Fishing industry perspective

Although the space occupied by abandoned platforms etc. is likely to be quite small as a percentage of the total available seabed, it may be significant for certain trawl fisheries in Bass Strait. However, when compared with the situation in parts of the North Sea, the effect on fishing in Australia is expected to be minimal if parts of the structures are left on the seabed. Risks to fishing vessels from gear entanglements could be minimized by proper charting of foul ground.

The debate over the use of rigs as artificial reefs to encourage the breeding of fish has not reached any great heights in Australia. Apart from some indications that there may be benefits from such proposals for sports fishermen, the organizations representing commercial fishing interests discount this alleged benefit in favour of fewer obstacles for their operations.

To prevent unauthorized intrusion into the Bass Strait oilfields, the area has been declared and accepted by IMO as an "area to be avoided" and a 24-hour radar surveillance is maintained. The 13 platforms currently in the Bass Strait are contained in this designated area. It is unlikely that the "area to be avoided" status will be removed until all production activity in the area ceases.

Defence perspective

In Australia, defence interests sympathize with the view that residual platform structures may pose a threat to submariners, either by being obstacles or through providing hostile submarines with a place to hide.

Although submarines are fully equipped with sonar equipment capable of detecting the presence of any significant obstacle, they are, by the nature of their role, frequently forbidden to make use of such equipment, as it could lead to their detection. In these circumstances they have to rely on dead reckoning and periodic satellite fixes, which can lead to uncertainty regarding their exact position. For this reason, it is understandable that defence interests object to residues remaining in narrow straits, channels or other restricted waters, but well charted and fixed residues in most open sea locations should not present insurmountable problems.

It should also be remembered that the seabeds of the world are not unobstructed and pristine environments, but are instead littered with debris. If platform removal is effected according to the IMO guidelines, only a small proportion of the 6,000 odd platforms in the world would be candidates for partial removal and would not increase the amount of debris significantly.

It should also be noted that fixed debris from platform removal will under the guidelines be charted, unlike many of the thousands of shipwrecks which are uncharted and which are frequently of uncertain depth below the surface. Despite preferring complete removal, defence interests in Australia have accepted the IMO guidelines.

Environment perspective

The IMO guidelines require that any structures or parts remaining above sea level are fully maintained, that a full scientific evaluation of environmental risk factors is made and any residual material is monitored. They consider that an assessment of environmental impact of removal proposals on a site-by-site basis would be desirable. This assessment is important because the act of removal under some circumstances may cause more harm to the environment than allowing the structures to remain undisturbed.

It is generally agreed in Australia that the IMO guidelines provide a framework which will enable adequate assessment of the environmental and other implications of removal of offshore structures.

The actual regulation and control of the disposal of offshore installations and structures will be a cooperative exercise between the Australian authorities responsible for administering the offshore petroleum legislation and the authorities responsible for approvals under the Environment Protection (Sea Dumping) Act 1981. This Act provides the legislative basis for meeting Australia's commitments under the London Dumping Convention.

Legal liability

The question of residual liability is a matter still under consideration in Australia. The industry

has argued strongly that an operator complying with international standards for removal of its offshore installation, and with any additional requirements imposed by the particular coastal State, should be expressly released by the coastal State from any future liability or obligation whatsoever relating to the offshore installation. This aspect may have an influence on the extent of removal proposed by companies and required by Governments.

On the other hand, if under the guidelines less than complete removal is permitted for certain facilities, the immediate benefit of such a decision accrues to the party responsible for removal, through lower costs, while the residual risk of damage to other parties is higher. In such circumstances it is unlikely that host Governments will willingly accept the transfer of legal liability to the State and, as a result, companies may well assess that complete removal is on balance the safer decision.

This is a complex question which will vary in importance depending on the laws in particular coastal States. Where State-owned oil companies hold title to offshore structures, this question does not arise.

Conclusion

While the Australian offshore petroleum industry is much smaller than that in many other countries, the issues facing the industry and the Government over removal of offshore structures are similar. Subject to consideration of removal proposals on a case-by-case basis, the international guidelines do in our view offer a reasonable basis for coastal States to provide a framework which facilities safe navigation while at the same time striking a balance between the needs for industry planning and the protection of the marine environment.

TECHNICAL AND ECONOMICAL STUDY ON THE DECOMMISSIONING OF AN OFFSHORE PLATFORM IN JAPAN*

Introduction

In the process of the development of offshore oil and gas fields in Japan, the offshore structures were kept small in scale and further installed in a shallow sea area so that it was possible to decommission these at a low cost. On the other hand, nowadays some large-scale platforms have been installed in a deep sea area. It will be necessary at some time in the future to decommission these at the termination of their service life. It is this that has stimulated the consideration of legal, technical and economical problems. This report introduces a study on the case in Japan.

1. Present state of offshore structures

Four platform units were installed offshore Akita 15-17 m deep from 1960 to 1964. They supported two or three production wells per platform and weighed about 200 tons; they were therefore rather small in size. They were decommissioned in 1979 owing to the fact that the oilfield ran dry and have since been used as an artificial reef.

Furthermore, 4 steel platform units weighing 700-900 tons were constructed during the period 1960-1968 offshore Niigata, 6-25 m deep, each platform being provided with 4, 8, 9 and 16 production wells, respectively. All of them have already been decommissioned owing to the oilfield running dry.

At present, three steel platform units are still operating in Japan, as follows:

A platform weighing 8,340 tons installed offshore Niigata 83 m deep

A platform weighing 10,150 tons installed offshore Niigata, 90 m deep

A platform weighing 32,850 tons installed offshore Fukushima, 154 m deep

2. Present state of laws and regulations

Before the decommissioning of the steel platforms, the production wells should be plugged by cement etc. in the same way as is generally used in the oil industry in accordance with the Petroleum Mine Safety Regulation.

For the decommissioning of offshore structures, the Law Relating to Prevention of Marine Pollution and Marine Disasters will be mainly applied. This law prescribes not only the prevention of marine pollution resulting from the discharge of oil and toxic materials and other activities but also the offshore waste delivery from ships, offshore facilities and airplanes (hereinafter referred to as "ships and others"). According to this Law, the ships and others cannot be abandoned offshore as a rule. However, the Law includes a further provision that, regardless of the above provisions, an exception is granted when the ships and others which were wrecked and could not be removed easily from the place of the wreck are left as they are or when the ships and others are abandoned in a predetermined way in the area destined for disposal.

Consequently, the Japanese oil industry is obligated substantially by the present law to prevent marine areas from pollution, plug wells and complete decommissioning of platforms, keeping cooperative relations with the fishing industry. This means that, in addition to the huge amount of capital expenditure required for the discovery of offshore oil and gas fields at the stage of the development, large expenditure will be needed at the stage of well abandonment at a time when the income drops sharply owing to a reduction in production capacity.

In order to solve these problems, a reserve fund system for well and mine abandonment was established in 1986, in which an enterprise can reserve an estimated amount of costs for mine and well abandonment as an annual expense in financial institutions.

* Presented at the 1989 Seminar by Haruo Norimoto, Deputy General Director, Technical Department, Japan National Oil Corporation.

However, a complete solution has not yet been found. It is believed that it is necessary to study the disposal standards and others which are now under discussion in the appropriate international organization, i.e. IMO.

3. Technical and economic study

The Japan National Oil Corporation made a trial study of the cost involved in decommissioning a platform installed at a sea depth of 90 m, on the basis of selected decommissioning methods and selected technical tasks. The outline of the platform is shown in figure 1. The decommissioning work is carried out in the reverse sequence of the construction work, as shown in figure 2. (Main work spread).

Crane barge
Winch barge

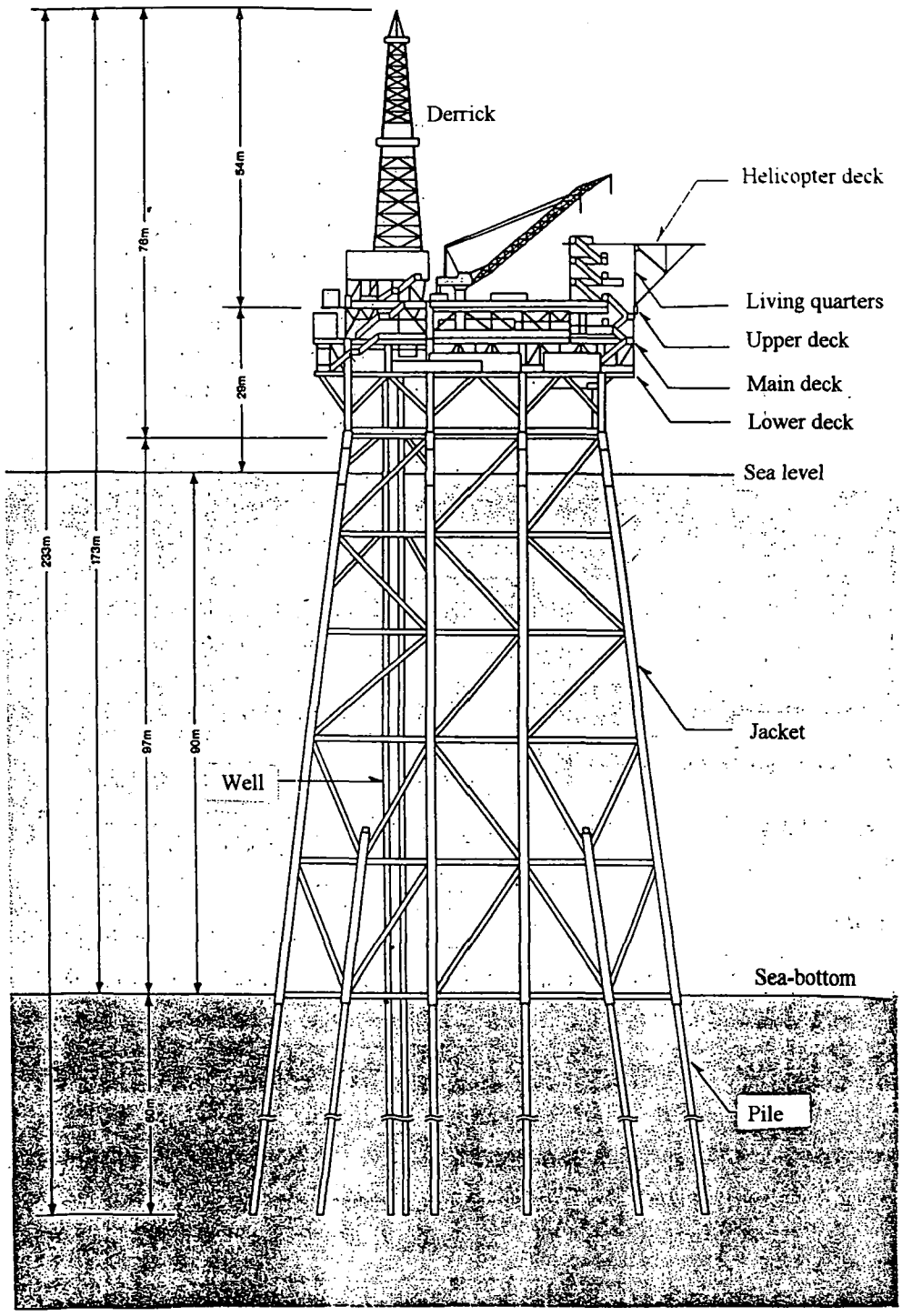


Figure 1. Outline of platform

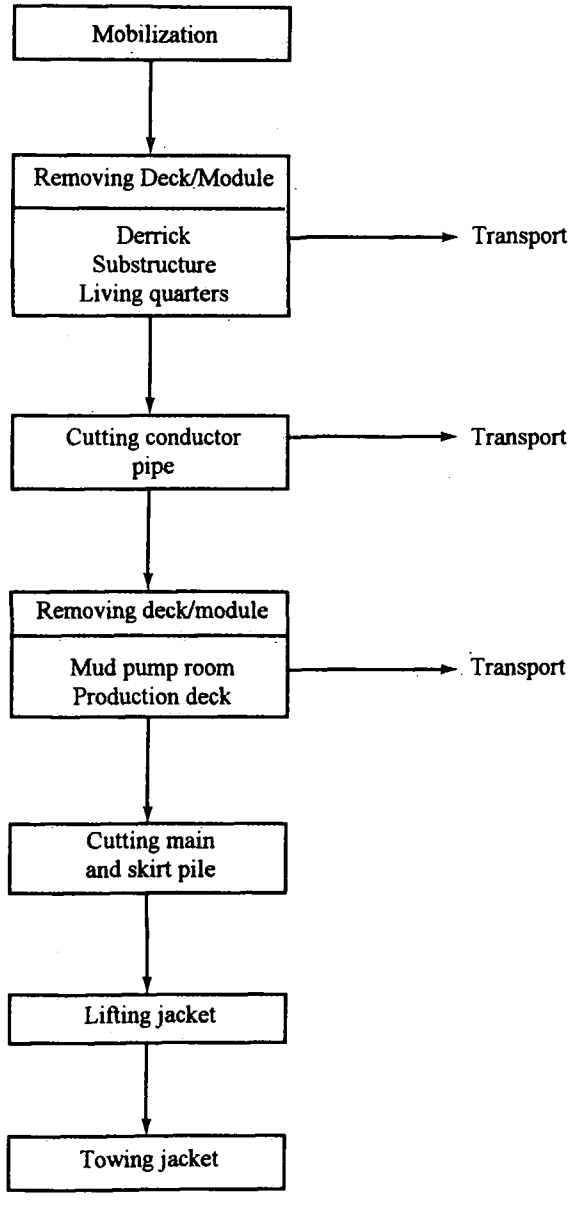


Figure 2. Decommissioning sequence

Transport barge
Tug boat

(1) Removing deck/modules

The deck/module is recovered into the transport barge by means of the crane barge after it has been divided into five components: a derrick (63 tons), a substructure (520 tons), living quarters (770 tons), a mud pump room (674 tons) and a production deck (1,567 tons).

(2) Cutting and removing conductor pipes

The conductor pipe, with a total length of 113 m, is cut at a depth of 5 m under the sea floor and divided into four sections 23-30 m in length for each. The cutting work is carried out on the main deck.

(3) Removing jacket

The pile is cut at a depth of 5 m under the sea floor and the jacket is removed as an integral unit.

Based on the assumed case, including the removal of a boat landing, a barge bumper, a riser, a riser guide etc. and the drainage of main pipe legs, the weight of the jacket is 4,527.6 tons and its buoyancy 3,982.7 tons. The jacket is transported with four pieces of floater fixed at the upper portion of the jacket and further by lifting the lower portion of the jacket by the winch barge on the basis of the assumption that the weight of the jacket is 4,527.8 tons and its buoyancy 4,626.8 tons.

(4) Cost

The total decommissioning cost is estimated by an approximate calculation at 20-25 million dollars.

4. Conclusion

In proportion to the increased water depth, offshore facilities to be used become large in size; as a result, the decommissioning work will be more difficult technically and enormous costs will be incurred.

Finally, as in many countries, Japan will study the reuse of a platform, its utilization as an artificial reef and partial decommissioning.

DECOMMISSIONING OF OFFSHORE STRUCTURES IN THE NORTH SEA*

Abstract

The decommissioning and removal of offshore structures represent a significant challenge for the oil industry, the Government, offshore constructors and other parties involved. As oil and gas become exhausted, associated field platform installations will be decommissioned and considered for removal in some measure to comply with the International Maritime Organization (IMO) Guidelines and Standards. These derive from a general obligation to remove abandoned or disused offshore installations and describe the circumstances in which non-removal or partial removal may be allowed. The present paper will focus upon the technical, legal and economic aspects related to the decommissioning and removal of offshore installations in the North Sea region.

Introduction

There are currently in excess of 6,500 platforms worldwide which must be considered for removal after disuse. Estimates to remove all 6,500 range in excess of US $ 30 billion. About 300 platforms are operating in the North Sea region today. The offshore industry had its beginnings in 1947 in 20 feet of water in the Gulf of Mexico. Technology has advanced in more than 40 years to where fixed structures now exist in water depths of about 400 metres in the Gulf of Mexico and installations as large as 700,000 tons are being designed for the Norwegian sector. These structures will be extremely costly and difficult to remove. Some may also be impossible to remove with current technology.

1. Alternatives for redundant installations

Five main alternatives exist;

(a) *Complete removal of the installation.* Concrete platforms are refloated with deballasting or overpressuring in the skirt chambers. Steel platforms are cut off 5 metres below the mud line. The facility is taken to land or towed out to deep water for dumping.

(b) *Toppling.* The installation is removed by cutting off the legs a little above the mud line. Then it tips over and remains on the sea floor. This is a nearly impossible method for concrete platforms.

(c) *Partial removal.* The entire deck and a portion of the supporting structure are removed down to a given free navigation height. In practice this appears to be quite complicated for concrete platforms. With the current technology it would certainly be disproportionately expensive to cut the concrete legs off x metres below the sea surface.

(d) *Reuse.* The use of refurbished platforms is gaining popularity in some regions. One advantage of refurbished structures is a quick turn-around time.

(e) *The installation remains standing.* Included in this option is the complete or partial removal of modules and the on-deck equipment. This means that the entire supporting structure, possibly with a simplified deck arrangement, remains standing.

2. Legal framework

2.1 International standards

The Geneva Convention of 1958 states that any installations which are abandoned or disused must be entirely removed. However, the determination of the Geneva Convention with regard to the absolute removal requirement was relaxed in the Convention on the Law of the Sea of 1982. One of the reasons for this was that petroleum activity had moved out to increasingly greater water depths. In some areas installations are used that, technically speaking, can be difficult to remove completely, or which would invalve a disproportionately high cost to remove.

* Presented at the 1992 Seminar by Olav Fjellsa, Norwegian Petroleum Directorate.

The Convention on the Law of the Sea does not impose any absolute requirements on removal. The Guidelines and Standards for offshore platform removal which were adopted by IMO in 1989 derive from a general obligation to remove abandoned or disused offshore installations and describe the circumstances in which non-removal or partial removal may be allowed. The principal points of the Guidelines are;

(a) All abandoned or disused installations or structures standing in less than 75 metres of water and weighing less than 4,000 tons in air, excluding the deck and superstructure, should be entirely removed.

(b) For other installations, the question of removal will depend on a specific evaluation from the individual coastal State. The Guidelines list some barriers here to the discretionary authority of the coastal State:

— The installation has to be removed if there is unjustifiable interference with other uses of the sea. However, the installation, or parts of it, can remain standing if its removal is technically not feasible or would involve extreme cost or an unacceptable risk to personnel or the marine environment.

— If a coastal State determines that an installation shall be removed to below the surface of the sea, there shall be a free water column to the surface of the sea of at least 55 metres.

— If a coastal State determines that an installation shall be left completely or partially standing, such that it projects above the surface of the sea, it should be adequately maintained to prevent structural failure. The adoption of the IMO Guidelines would necessitate the entire removal of more than 90 per cent of the platforms installed worldwide. For the remaining platforms (the biggest and most costly to remove) it is up to the coastal State to decide what to do. These platforms will be considered on their own merits, in the light of all the circumstances at the time, taking full account of the interest of other users of the sea as the Guidelines require. The case-by-case approach, involving prior consultation with fishermen and other relevant interested parties, is an essential feature of the abandonment policy.

2.2 Abandonment in the North Sea region

North sea area	*Number of platforms*	*Number of platforms probably to be removed entirely*
Denmark	25	25
Germany	5	5
Netherland	45	45
Norway	50	5
United Kingdom	160	110
Total number of platforms	About 285	About 290

The North Sea region's approach to abandonment offshore structures:

Denmark

Number of platforms: 25

Removal strategy: Not decided yet; Probably all platforms to be removed

Timetable: From the late 1990s

Disposal option: Not considered yet

United Kingdom of Great Britain and Northern Ireland

Number of platforms: 160

Removal strategy: Case-by-case evaluation

Principles:

— Floating platforms to be removed entirely

— Steel platforms in depths up to 55 m to be removed entirely

— Steel platforms in depths greater than 55 m to be removed entirely or partially in accordance with international standards

— Concrete platforms — not determined yet

Timetable: From 1994

Disposal option: Not decided yet, but options being considered:

— Dumping in a deep-water site

— Dumping *in situ*

— Disposal on land

Germany

Number of platforms: 5

Removal strategy: Platform to be removed down to seabed

Timetable: Not known

Disposal option:

— Taking to shore is considered for steel platforms

— Caisson may remain as artifical island

— No dumping

Netherlands

Number of platforms: 45

Removal strategy: All platforms to be removed entirely

Timetable: From 1988

Disposal option: Shore disposal

Norway

Number of platforms: 50

Removal strategy: Not decided yet; strategy is being discussed; probably case-by-case evaluation

Tietable: From 1993

Diposal option: Not decided yet; probably case-by-case evluation

3. The cost of decommissioning and removal in the North Sea

Thre is little experience as a basis for data with regard to esimating the removal costs for installations of the size found on the Norwegian shelf and part of the United Kingdom shelf. This is because the installations are located in deeper water, weigh more, are larger integrated units, constructed to withstand a much rogher climate, use concrete, etc., as compared with intallations in other areas.

It seems that as long as we still do not have North Sea-related exerience data for bigger installations as a basis, this type of calculation will be associated with a relatively high degree of uncertainty.

A rough estimate covering all platforms in the North Sea, including the smaller onces located outside Denmark, and Germany, and the Netherlands indicates a total removal cost of US$ 16 billion.

Estimated total removal costs in the North Sea

	Billions of US dollars
Denmark	0.4
Germany	0.1
Netherlands	0.6
Norway	5.8
United Kingdom	9.1
Total costs	16.0