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

VOLUME I



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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 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 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 resources 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.

OPENING STATEMENT BY THE EXECUTIVE SECRETARY OF ESCAP AT THE SEMINAR ON ISSUES ASSOCIATED WITH OFFSHORE INSTALLATIONS AND STRUCTURES IN THE EXCLUSIVE ECONOMIC ZONE

It gives me much pleasure to welcome you all to this Seminar, organized within the framework of the marine affairs programme, which was initiated by ESCAP in 1986 in response to the need of member countries for assistance in managing the new regime of the ocean deriving from the 1982 Convention on the Law of the Sea.

Though the Convention has not yet entered into force, pending ratification or accession by 60 States, the regime established thereunder is already being implemented by many countries of the Asian and Pacific region. It is also urgent to prepare for the Convention to come into force, and hopefully this will not be far off.

The issue of the removal of offshore platforms illustrates the fact that, together with the rights and jurisdiction over the marine resources on the continental shelf and in the exclusive economic zone, coastal countries have also had to accept the corresponding obligations and management responsibilities.

Article 60, paragraph 3 of the 1982 Convention stipulates *inter alia* that "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".

There are now over 1,000 offshore production structures in Asia alone and hydrocarbon exploration is continuing at an active pace. Most of these structures are located in shallow waters less than 100 metres in depth. They are often situated in very busy shipping lanes and on economically important fishing grounds.

Removal is not likely to commence on a large scale before 1990 but then the costs involved will be very significant and the legal fiscal and contractual regime in place will determine the responsibilities of the various parties involved.

We therefore think it timely to take up this issue now. The developing countries of the region should have a better understanding of the issues involved when the construction of platforms has been designed, contracts have been signed and fiscal and legal regimes agreed upon.

This Seminar will therefore consider a broad range of issues. Our aim is, first, to bring the debate on

removal to the Asian and Pacific region where it has yet to begin, and second to highlight the complexities of the matter. A third consideration is to examine the specific problems of platform removal in Asia with a view to preparing the ground for the various legal, contractual, fiscal and technical measures that will have to be taken when removal becomes an obligation that coastal States have to face. The experience in the North Sea and the Gulf of Mexico in removing offshore platforms and its relevance to the Asian and Pacific region will also be considered.

The multiplicity of interests at stake points to the necessity of adopting a multidisciplinary approach. We have attempted to bring together in the same forum all parties interested in the issue of removal, including the oil producers, the shipping and fisheries interests as well as the environment protection groups.

We are fully aware of the fact that the International Maritime Organization (IMO) is the competent international organization to establish international guidelines and standards for the removal of offshore installations and structures on the continental shelf and in the exclusive economic zone. Our purpose here is not to set up a parallel forum for the establishment of such standards and guidelines. Rather, we hope that the result of this Seminar's discussions can be submitted together with some recommendations to IMO before the international Standards and Guidelines for removal are finally adopted.

I am very pleased to see that the private sector has expressed interest in this exercise by sending highly qualified representatives. I am convinced that the presence of all parties concerned at this Seminar, the Governments, the State oil companies and the private sector, will contribute to a meaningful debate.

On the part of ESCAP, we stand ready to pursue this issue further, by organizing training programmes should the member countries express their need for assistance in this field.

Before concluding, I would like to express my sincere gratitude to the Government of the Netherlands, which has generously provided funds for this activity, and to the International Institute of Energy Law of the University of Leiden for providing the services of a senior consultant for the Seminar.

REPORT OF THE SEMINAR ON ISSUES ASSOCIATED WITH OFFSHORE INSTALLATIONS AND STRUCTURES IN THE EXCLUSIVE ECONOMIC ZONE, BANGKOK, 6-10 FEBRUARY 1989

SUMMARY

1. There are approximately 1,000 petroleum production installations in offshore areas in the Asian and Pacific region. The proportion of these located within the exclusive economic zones varies widely among countries. Several States in the region have removed some of their installations; the details were given during the Seminar, i.e., China, 2 units, and Japan, 8 units; Brunei Darussalam also had experience in that regard.
2. Some countries have accepted and are moving to implement the IMO Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, in some form applicable to their own circumstances, while others are still evaluating the implications within their own national organizations. While some concern was expressed as to the parameters used in the draft IMO Guidelines and their applicability to certain countries in the region, no major objections were raised by participants.
3. The complexity of offshore installation removal was exemplified by the experience in the North Sea and the Gulf of Mexico. Specific problems that will need to be addressed by countries in the Asian and Pacific region include the absence or inadequacy of State policies and legislation and the potential cost impact on the petroleum industry as well as on the national economy. Other issues include residual liability, alternative uses, and safety, as well as the need to consider the interests of other users of the sea, principally in the areas of defence, shipping, fishing, the environment and scientific research.
4. Participants considered that the papers presented and the discussions in the Seminar were useful in focusing attention on the issues and providing some ideas on how countries could proceed in the future.
5. However, it was recognized that it was ultimately the coastal States that would have to decide whether, to what extent, when and how they would implement policies on removal of installations. Given the size of that task, and the diversity of regimes and environments in coastal States, no single solution would be applicable

to all circumstances. Rather, there would be a need for flexibility in the application of the policies on a case-by-case basis, which was an approach consistent with the IMO draft Guidelines.

6. In that respect, ESCAP could establish and maintain regular contacts with IMO and the London Dumping Convention (Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972) by participating in the relevant meetings with a view to keeping member countries informed of developments concerning issues of interest, including removal and disposal of offshore installations.

7. It might be helpful for ESCAP members if a seminar were to be conducted at a later stage on the further development of guidelines and standards on removal and disposal, including implications from the approach of the Contracting Parties to the London Dumping Convention to the disposal issue.

I. ORGANIZATION OF THE SEMINAR

1. The Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone was organized by the Economic and Social Commission for Asia and the Pacific (ESCAP), and held at Bangkok from 6 to 10 February 1989.

Attendance

2. The Seminar was attended by 17 participants from the Governments and State petroleum companies of Australia, Brunei Darussalam, China, Indonesia, Japan, Malaysia, Norway and Thailand. A representative each of the International Maritime Organization (IMO) and the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) also attended the Seminar. Private oil companies were represented by 11 participants, from Atlantic Richfield Inc. (ARCO), BP Petroleum Development Ltd., Esso Australia Ltd., Mobil North Sea Limited, Phillips Petroleum, E and P Forum, PTT Exploration and Production Company Limited, Shell Companies in Malaysia and UNOCAL. Representatives of the Natural Resources and Transport and Communications Divisions of ESCAP also attended.

Opening of the Seminar

3. The Executive Secretary of ESCAP opened the Seminar and welcomed the participants. He pointed out that, although removal of offshore installations was not likely to commence on a large scale in Asia before 1990, it was timely to take up that issue now to enable proper planning.

4. The objective of the Seminar was to bring the debate on removal to the Asian and Pacific region where it had yet to begin, and also to highlight the complexities of the matter. Another goal was to examine the specific problems of removal of offshore installations in Asia taking into account the experience of countries in the North Sea and in the Gulf of Mexico. ESCAP had organized the Seminar in collaboration with IMO, which was the competent international organization to establish international guidelines and standards for the removal of offshore installations and structures in the exclusive economic zone and on the continental shelf. Finally he thanked the Government of the Netherlands for providing funds for that activity.

Officers of the Meeting

5. The participants elected Mr. Yeow Kian Chai (Malaysia), Chairman, Ms. Xing Zhifeng (China) and Mr. R.O. Hutapea (Indonesia), Vice-Chairpersons, and Mr. John Kjar (Australia), Rapporteur, of the Seminar.

II. PROCEEDINGS OF THE SEMINAR

A. Legal framework for removal of offshore installations (including structures)

6. The discussion on the legal framework for abandonment (removal) of offshore installations started with a presentation of the 1982 United Nations Convention on the Law of the Sea, and the relevant provisions on removal, namely article 60, paragraph 3.

7. The wide acceptance of the 1982 Convention in the ESCAP region, as demonstrated by the number of signatory countries, implied that the Convention was likely to be used as a reference by countries of Asia and the Pacific when establishing removal regimes.

8. The representative of IMO gave a historical overview of the negotiations for the IMO Guidelines and Standards. It showed that the Guidelines had been developed so far from the point of view of safety of navigation. They might still be modified on the basis of comments submitted by the United Nations Environment Programme (UNEP), Food and Agriculture Organization

(FAO) or the Contracting Parties to the London Dumping Convention, but they had already been circulated to IMO Member Governments in the form of a Maritime Safety Committee Circular with an invitation to take them into account when making decisions on removal of abandoned or disused installations. At the stage of incorporating the Guidelines and Standards in national laws and regulations, flexibility could be exercised to suit local requirements.

9. The presentation on the legislation of North Sea countries relating to removal in Denmark, the Netherlands, Norway and the United Kingdom of Great Britain and Northern Ireland showed that one of the main reasons for enacting a law had been the desire of coastal States to protect themselves against oil companies defaulting on their removal obligations. The Dutch legislation included the requirement for a guarantee agreement with respect to the cost of removing and the right to take action against the licensee to secure payment for those costs. The United Kingdom legislation allowed the Government to require the submission of an abandonment programme by the licensee, and the right to call for a financial guarantee by the parties named in the joint operating agreement.

10. The Norwegian legislation gave the Government four options regarding the take-over or removal requirement:

- To take over the installation free of charge after the expiration of the licence;
- To impose partial or total removal;
- To enter into an agreement with the licensee for temporary use of the installation;
- To require that measures shall be taken to prevent the installation from causing any damage or inconvenience.

11. The fact that the stringent legal measures adopted by the North Sea countries had not deterred investment that could be attributed first to the continued profitability of the North Sea oil fields, second, to the good relationship and continued dialogue between the Government and the oil industry, and third, to the fiscal measures introduced to alleviate the burden of the oil companies.

12. In countries of Asia and the Pacific, the concern was whether the introduction of such stringent legal measures would act as a disincentive for oil companies, given the prevailing situation of marginal oil fields and low international crude oil prices, that would inevitably influence the policies to be adopted.

13. The representative of the E and P Forum gave an outline of the industry standards and practices applied in the Gulf of Mexico, where over 400 offshore installations had been removed. The presentation emphasized the enormous costs involved in such operations – an average cost of US\$ 1 million per installation, and a total cost of approximately US\$ 5 billion for the removal of all installations in the Gulf of Mexico. The main concern of the industry was cost-effectiveness and safety in removal.

14. Similar technical and safety problems were likely to occur in Asia and the Pacific when installations were removed. The standards and practices applied in the Gulf of Mexico could therefore be usefully examined and applied, taking into consideration available technologies, cost-effectiveness and difficulty in enforcing safety measures.

B. Nature of the problems in Asia and the Pacific

15. The presentation of country papers by representatives of Australia, Brunei Darussalam, China, Japan, Malaysia and Thailand, as well as information provided by the participants from Indonesia, showed that the Governments in those countries were aware that they would have to face and resolve the issue of offshore installation abandonment according to their responsibilities under international agreements.

16. There was, however, in most cases a great deal of uncertainty on the policy to be adopted with respect to removal, especially with regard to the responsibilities of various parties in bearing the costs involved.

17. That uncertainty was generally shown by the absence of a specific law on removal, except in Australia and Thailand. In the latter case there was some vagueness in the removal obligations imposed on the concessionaire. Even in countries such as Malaysia, where an umbrella law provided for the Government to regulate removal, regulations had not been issued. In the case of Australia, the country with the most comprehensive regime on removal, there remained some grey areas with respect to residual liability and the taxation regime.

18. Under the Production Sharing Contract (PSC) systems used in Indonesia and Malaysia, the ownership of all assets, including offshore installations, rested with the State petroleum companies, PERTAMINA and PETRONAS respectively. In the case of Indonesia, the objective of the system was to provide certain favourable procedures for the contractor, such as free import duty facility and recovery mechanism of the investment in the

assets. On the other hand, the PSCs adopted in Indonesia and Malaysia contained no specific provisions regarding the removal of offshore installations.

19. In the case of China, where the contract specified that the abandonment costs should be borne by the production-sharing parties, the State petroleum company, the China National Offshore Oil Corporation, might bear a large share of the cost because of its potential holding of up to 51 per cent in the production-sharing contract.

20. Even in Brunei Darussalam and Thailand, which used the concession system under which the responsibility for removal lay with the operator, the Government ended up paying a large part of the costs since those were tax deductible.

21. In Japan, a reserve fund had been established to allow companies to make provisions for removal costs which were treated as company expenses and were thus tax deductible. In Australia, removal costs were allowed under some royalty regimes.

22. The main concern of Governments, State petroleum companies and private companies alike, was the huge costs involved in removing offshore installations if countries were to adhere strictly to the IMO Guidelines and Standards. Removal cost estimates varied considerably, from about US\$ 2 to US\$ 12 million per installation in Malaysia (a cost of between US\$ 1 and US\$ 2 billion for removing the existing 167 offshore installations) and about US\$ 25 million per installation in Japan.¹

23. Esso Australia Ltd. had completed a detailed study of the costs associated with removal of its installations in the Bass Strait. Full removal of the 13 installations was found to cost US\$ 530 million (in 1988 prices) and partial removal, to provide a 55 m navigation clearance, US\$ 500 million. Esso found that by dumping the installations in nearby deep water, the cost could be reduced to US\$ 430 million, and that by toppling some of the large installations *in situ*, the cost could be reduced to US\$ 350 million.

24. There was concern that those costs might render oil production uneconomical in the case of small oil fields and low international oil prices. That would entail a very difficult decision for countries such as Indonesia, which derived about 50 per cent of its revenue from hydrocarbons.

¹ These and the following statistics represent the order of magnitude of costs which vary with time, methodology and market forces.

25. There was, however, realization of the considerable hazards to navigation posed by abandoned installations, especially in very busy shipping lanes. In all countries, therefore, the interests of other users of the sea, including fisheries, shipping and defence, as well as environmental interests, needed to be considered when a removal policy was formulated and implemented.

26. There was also an attempt in all countries to study the feasibility of partial removal, utilization of the installations as an artificial reef for attracting marine life, or refurbishing the installations for use at another site, in order to alleviate costs.

27. It was recognised that in devising a policy on removal of installations, a balance should be struck between environmental considerations, the needs of other users, and the cost to the industry and to the community.

28. The view was also expressed that there was considerable flexibility possible in the application by coastal States of the IMO Guidelines and Standards, especially when extreme costs were involved or it was technically infeasible to remove the installations. There were several situations envisaged under the Guidelines where full removal could be avoided, in particular when the installations would serve a new use, such as an artificial reef, by toppling the structure, or where suitable alternative international shipping lanes were provided. That flexibility, and the discretion left to Governments under the Guidelines, would provide a useful basis for their consideration when drafting their national legislation.

C. Relevance of the experience in the North Sea and in the Gulf of Mexico to the Asian and Pacific region

29. The presentation of papers from the representatives of Mobil UK and UNOCAL, United States, highlighted some of the technical problems linked with removal of offshore installations in the North Sea and the Gulf of Mexico. The presentation by the representative of Norway addressed the technical issue, but also outlined the very important safety and economic aspects of removal in Norway.

30. The technical problems posed by removal were of a different magnitude in the North Sea and in the Gulf of Mexico. In the North Sea, where water depths ranged from 70 m to 300 m with wave heights up to 30 m, huge steel platforms and gravity structures were required to develop the petroleum resources. The size and weight of those installations required the use of very heavy marine

equipment for removal, which increased removal costs considerably.

31. Estimated costs for removing completely the existing 41 installations and those installations (about 9) for which development had been announced in the Norwegian sector of the North Sea would be around US\$ 5.8 billion, while partial removal would reduce the costs to US\$ 3.5 billion (1989 costs).

32. It was pointed out that if the installations were left in place, the accumulated maintenance costs to prevent structural failure of steel platforms, in accordance with the IMO Guidelines and Standards, could, within a few decades, equal the cost of total removal. For concrete structures requiring less maintenance, it would take several decades before that point was reached. The option left to Governments was to bear those costs either now or later.

33. The techniques used for removal of installations in shallow waters in the Gulf of Mexico were probably more relevant to those that were likely to be used in the Asian region owing to its environmental similarity. Removal costs in the Gulf of Mexico were estimated to vary from a few thousand dollars for a small installation up to US\$ 100 million for a large installation. The average removal cost in the United States would be a little over US\$ 1 million per installation.

34. In all cases it was observed that the removal operation should, if possible, be the reverse of the installation sequence.

35. If one installation which was part of a bigger oil field system was abandoned, it could be preferable and more economic to wait until several installations could be removed at the same time, since approximately 50 per cent of the removal costs were accounted for by the marine equipment and labour.

36. Safety in removal operations was one of the paramount concerns of operators. Another major concern was to avoid residual liability and in some cases that had contributed to choosing the option of total removal as opposed to partial removal.

37. It was also emphasized that even though Governments in the North Sea and in the Gulf of Mexico imposed strict requirements on the operators, the Governments ended up paying a large part of those removal costs through the taxation regimes, as the (effective) tax rates varied from about 50 per cent in the United States to 80 per cent in Norway.

38. A panel discussion on the relevance of the North Sea and Gulf of Mexico experience for the countries of Asia and the Pacific followed the presentation of papers.

39. The advice arising out of the panel discussion was that the Governments themselves should take the initiative of defining a policy on abandonment of offshore installations after the necessary consultations among the various government agencies representing the various users of the sea.

40. To assist them in the definition of such a policy, Governments should request the operators to supply them with information on a removal (abandonment) plan, including information for the various options (full or partial removal or deferred removal), and proposals about alternative uses of abandoned installations.

41. In territorial waters, where the IMO Guidelines and Standards would not apply, removal or alternative uses of installations would be at the discretion of coastal States.

42. From the technical and economic point of view, the advice was that an operator should try to remove as many installations as possible at the same time, if that was feasible. Techniques used in the Gulf of Mexico might be applicable to the Asian and Pacific region, owing to the similarity of the environments.

43. A case-by-case approach was recommended when making decisions about removal of offshore installations. The panel recommended that Governments conduct a complete survey of existing installations, including the number, location, water depth and time at which abandonment might be required.

44. The panel discussion on the views of other users of the sea showed that national legislation on abandonment of offshore installations, where it existed, was primarily concerned with safety of navigation.

45. Clarification was sought by participants on the reasons for establishing safety limits of 55 m and 75 m water depths in the IMO Guidelines and Standards. Explanation on the background of those limits showed that the 55 m clear column of water requirement was meant to ensure safety of surface and submarine navigation.

46. Those limits were of concern to countries such as Brunei Darussalam, Indonesia and Malaysia, where many installations stood in less than 40 m of water.

47. It was reiterated that the IMO Guidelines and Standards were only meant to assist countries in drawing

up their own laws and regulations on abandonment, according to their own national priorities and environment. The panel indicated that the Guidelines and Standards, if accepted, would not have the full force of international law and therefore would not have any mandatory force on countries. Moreover, they allowed considerable flexibility in their interpretation and implementation.

D. Alternatives to installation removal in the ESCAP area

48. The discussion on alternative uses for disused installations started with a presentation on experience with artificial reefs in the United States and on instrumentation that could be used to verify removal of installations. That was followed by a presentation on possible alternative uses for installations no longer required for hydrocarbon production.

49. Ten artificial reefs had been constructed along the coast of Georgia, United States, from disused ships. Those reefs had produced an additional revenue of US\$ 620 million for that State. The reefs were used wholly for recreational fishing and had proved to be most successful.

50. The most likely use for decommissioned installations was thought to be as artificial reefs, whose purpose was to enhance fish stocks. The State of Florida had passed special legislation to relieve the donor of four disused installations from liability for future damage attributable to the installations. The resultant reef had since become a popular recreational fishing area.

51. Other possible uses were to house navigation aids and communications stations, for processing fish, as marine research and development establishments, and for power generation using wind, wave and solar energy. The high operating cost associated with offshore installations might preclude some or all of those alternative uses.

III. CONCLUSIONS

52. At the international level, the IMO Guidelines and Standards represented a careful attempt to balance the elements of constraint and flexibility. The adequacy of the Guidelines and Standards would become clearer when Governments acted to implement them in their national regimes. The Seminar experts alerted participants to the elements of flexibility and the various ways in which they might exploit them.

53. It was observed that so far only the removal issue had been considered by IMO, and that the London Dumping Convention had included the question of disposal in the work programme of the scientific group.

54. There was considerable uncertainty in the developing countries of Asia and the Pacific with regard to the abandonment policy to be adopted, as well as the legislation and standards to be applied.

55. There had been significant advances in the technology that could be applied in the removal of

offshore installations, but some concern remained as to the high cost and safety associated with the options.

56. Alternative potential uses existed for abandoned installations, whether left *in situ*, dumped in the sea to enhance the environment for fishing, or recovered and refurbished.

IV. ACCEPTANCE OF THE REPORT

57. The report was accepted on 10 February 1989.

Annex

LIST OF PARTICIPANTS

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**MESSAGE FROM THE EXECUTIVE SECRETARY OF ESCAP TO THE ESCAP/CCOP/
LEMIGAS SEMINAR ON REMOVAL AND DISPOSAL OF OBSOLETE OFFSHORE
INSTALLATIONS AND STRUCTURES IN THE EXCLUSIVE ECONOMIC ZONE
AND ON THE CONTINENTAL SHELF**

It gives me great pleasure to send this message on the occasion of the inauguration of this Seminar, which has been organized by ESCAP and the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas in collaboration with the Oil and Gas Technology Development Centre of the Government of Indonesia.

This Seminar is a follow-up of the earlier Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone held at Bangkok in February 1989. The appropriate guidelines and standards for removal and disposal of offshore structures, as drafted by the International Maritime Organization (IMO) in accordance with article 60 of the 1982 United Nations Convention on the Law of the Sea, were adopted by its Governing Council in 1990. However, there have been certain difficulties with respect to article 216 of the Convention as to whether a coastal State has jurisdiction at present over dumping activities on its continental shelf (or exclusive economic zone) and to what extent such activities will be harmonious with the Convention after enacting national legislation in this regard.

The Seminar in 1989 indicated that removal of obsolete structures had already commenced in the Asian and Pacific region and that the costs involved would be quite significant. However, since the IMO guidelines are only meant to assist countries in drawing up their own laws and regulations on removal or abandonment according to their own national priorities and marine environment, there is some flexibility in such operations. Maritime countries should be considered of each other's concerns about marine pollution and navigational requirements when deciding on a removal regime, as these activities will infringe on the global marine environmental concerns. A healthy balance has to be identified between offshore activities which have a direct bearing on the growing energy requirements of the countries and their long-term plans to achieve sustainable development for the benefit of future generations.

We have again brought together at this forum all governmental and private parties interested in this

subject, namely oil producers, shipping, fisheries and environmental experts and those specialized in the various international conventions, such as the 1982 United Nations Convention on the Law of the Sea, the London Dumping Convention forum and those of the Paris, Oslo and Helsinki Conventions. We are also confident that IMO, which is the international organization competent to develop the standards for the removal of abandoned or disused offshore installations and structures, will interact effectively with the participants from the Asian and Pacific region with the major objective of identifying a suitable removal regime acceptable to all. We realize that this task is exceedingly complex, especially in view of the multidisciplinary nature of the subject. However, effective deliberations will eventually lead to a closer understanding of each other's concerns on this complex problem.

The Seminar will undoubtedly help in disseminating the latest methodologies involved in the removal and disposal of offshore installations and structures which should be cost-effective and in accordance with internationally accepted guidelines and standards. These methodologies have to be refined continuously and modified appropriately, especially in view of the fact that all installations emplaced on or after 1 January 1998 and standing in less than 100 metres of water should be completely removed.

Our purpose in this Seminar is to catalyse debate on an appropriate removal regime in the Asian and Pacific region in accordance with the priorities of the countries of the region.

I would like to express my sincere gratitude to UNDP, which has generously provided funds for the participants to attend this Seminar. I would also like to express my thanks to the Government of Norway for the provision of a resource person from the Norwegian Petroleum Directorate on a self-financing basis. I also express my appreciation and gratitude to the Government of Indonesia for hosting this Seminar in Jakarta. Further, I take this opportunity to thank CCOP for its collaborative efforts in the organization of this Seminar in association with ESCAP.

REPORT OF THE ESCAP/CCOP/LEMIGAS SEMINAR ON REMOVAL AND DISPOSAL OF OBSOLETE OFFSHORE INSTALLATIONS AND STRUCTURES IN THE EXCLUSIVE ECONOMIC ZONE AND THE CONTINENTAL SHELF, HELD AT JAKARTA FROM 25 TO 28 MAY 1992

I. ORGANIZATION OF THE SEMINAR

1. The Seminar on Removal and Disposal of Obsolete Offshore Installations and Structures in the Exclusive Economic Zone and the Continental Shelf was organized by the Economic and Social Commission for Asia and the Pacific (ESCAP) and the Committee for Coordination of Offshore Prospecting for Mineral Resources in Asian Offshore Areas (CCOP), in collaboration with the Oil and Gas Technology Development Centre (LEMIGAS) of the Government of Indonesia, and held at Jakarta from 25 to 28 May 1992.

Attendance

2. The Seminar was attended by 61 participants from Government, State and private petroleum companies of China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. A representative of the Office of the London Dumping Convention of the International Maritime Organization (IMO) and two from the CCOP Technical Secretariat, Bangkok, also attended the Seminar. Resource persons from the Norwegian Petroleum Directorate and the E and P Forum also participated. Private oil companies were represented by 25 participants from Phillips Petroleum Co., United States of America, Idemitsu Oil Development Co., Ltd., Japan, Shell Petroleum Company of Brunei Darussalam, Shell Malaysia Ltd., Petroleum Authority of Thailand (PTT), UNOCAL Thailand Ltd., Sarawak Shell Berhad, Malaysia, Job Petromina-Japex North, Indonesia, Petroleum Enterprise Oil Bawean Ltd., Lasmo Oil, Mobil Oil Indonesia Inc., PT Indospec Asia, Conoco Indonesia Inc., UNOCAL Indonesia, Marathon Petroleum Indonesia Ltd. and Teikoku Oil Co., Tokyo. Seven participants from research institutes also participated. Representatives of the Natural Resources, Industry, Human Settlements and Environment and Transport and Communications Divisions of ESCAP attended the Seminar (see annex).

Opening of the Seminar

3. Mr. Suyitno Patmosukismo, Director-General of Oil and Gas of the Ministry of Mines and Energy of the Government of Indonesia, opened the Seminar. In his keynote address, he stated that the rapid increase in the number of offshore structures for exploration activities

in the exclusive economic zone of Indonesia had made it necessary for the country to adopt new regulations for their disposal. There were approximately 370 offshore platforms and other offshore installations in Indonesia, and two thirds of the country's hydrocarbon resources were estimated to exist in offshore sedimentary basins.

4. The Executive Secretary of ESCAP, in his message, stated that the Seminar was a follow-up of the earlier Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone, held at Bangkok in February 1989. The purpose of the current Seminar was to catalyse debate and continue attempts to identify an appropriate removal regime for the removal and disposal of those obsolete offshore installations in accordance with international conventions and the priorities of the countries in the region. Finally, he expressed deep gratitude to the Government of Indonesia and LEMIGAS for providing funds and hosting the Seminar, and also thanked UNDP for its financial support of the activity.

Officers of the Seminar

5. The participants elected Mr. Zainal Abidin Mahmood (Malaysia), Chairman, Mr. Chamnan Duangjaras (Thailand) Vice-Chairman, and Mr. W.S. Griffin, Jr. (E and P Forum) Rapporteur of the Seminar.

II. PROCEEDINGS OF THE SEMINAR

A. Legal framework of removal and disposal of disused offshore platforms

6. The discussion of the legal framework for abandonment (removal) of offshore installations and structures commenced with a presentation by the representative of IMO on the 1958 Geneva Convention, the 1982 United Nations Convention on the Law of the Sea, and the IMO Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone. The 1972 London Dumping Convention and 1991 Oslo Commission Guidelines for the Disposal of Offshore Installations at Sea, as presented by the ESCAP senior expert in environmental management, were also discussed and reviewed.

7. The wide acceptance of the 1982 United Nations Convention on the Law of the Sea and the 1989 IMO Guidelines and Standards implied that those legal frameworks were likely to be used as a reference by countries of Asia and the Pacific when establishing removal regimes.

B. Nature of the problems in Asia and the Pacific, interpretation and application of principles of international law to national policies, legislation and contracts with the oil industry

8. The presentations of countries with a removal regime in the North Sea included the following: Denmark, Germany, the Netherlands, Norway and the United Kingdom of Great Britain and Northern Ireland. It was noted that the major reason for enacting the laws and regulations in the region had been the desire of coastal States to have effective control of the removal obligations.

9. In regard to countries with production-sharing contracts within the region, the representative of Indonesia stated that the country currently had no solution as to how to handle removal costs with production-sharing contracts, but was exploring for possible solutions.

C. The economic and financial framework of removal and disposal of obsolete offshore platforms

10. The presentation of country papers by representatives of China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam indicated that the Governments in those countries were aware that they would have to face and resolve the issue of abandonment of offshore installations according to their responsibilities under international agreements.

11. Further, there was uncertainty on the policy to be adopted with respect to the responsibilities of various parties in bearing the costs.

12. Under the production sharing contract systems used in Indonesia and Malaysia, the ownership of all assets, including offshore installations, rested with the State.

13. In the case of Indonesia, it was reported that there were approximately 370 offshore platforms, many of which would be obsolete in the near future. Indonesia had existing regulations that required offshore platforms

to be completely removed, but no procedures or detailed requirements as to how that was to be done. It was further noted that the State Oil Company, PERTAMINA, and the production sharing contractor would undertake a joint study of the problem and identify alternative removal and disposal methods that had a cost/benefit or identify methods of reuse of those structures and installations.

14. In Malaysia, the high costs of abandonment had prompted PETRONAS and the Government to review the existing procedures and practices. The role and responsibilities of the production sharing contractors and the latest abandonment technology had to be further defined.

15. In the Philippines, the administrative guidelines for offshore exploitation stipulated that companies should remove all structures or contribute to a trust fund which would fulfil that requirement at the end of the project whereby the offshore facilities were returned to the State in good condition.

16. In Thailand, the platform removal and related administrative mechanisms had not been seriously discussed by the Government and the companies holding concessions. A new ministerial regulation was probably the most appropriate arrangement under which oil companies could submit platform removal plans to the Government. A comprehensive financial framework still had to be identified.

17. The petroleum legislation of Viet Nam was now under review and it was envisioned that it would contain clauses for the removal of structures.

18. Japan had removed several offshore platforms, some of which had been converted to a new use as an artificial reef.

19. Currently, there were no obsolete offshore platforms in China. The related regime for such removal activities, including the legal, economic and financial aspects had still to be established. However, there were related regulations connected with the prevention of dumping of wastes at sea.

20. The main concern of Government, State petroleum companies and private companies alike was the huge costs involved in the removal of offshore installations if countries were to adhere strictly to the IMO Guidelines and Standards. There was concern that those costs might render oil production uneconomic in the case of small oilfields and the low international oil prices.

21. There was however, a realization of the considerable hazards to navigation posed by abandoned installations, especially in very busy shipping lanes. In all countries, the interests of other users of the sea, including fisheries, shipping and defence, as well as environmental interests, needed to be considered when a removal policy was formulated and implemented.

22. There was also an attempt in countries to study the feasibility of partial removal, utilizing redundant installations as reefs for attracting marine life or for reuse at another location.

23. It was recognized that in devising a policy on removal of installations, a balance should be struck between environmental considerations, the needs of other users, and the cost to the community and industry.

24. It was also noted that there was considerable flexibility possible in the application by coastal States of the IMO Guidelines and Standards, especially where extreme costs were involved or it was not technically feasible to remove the installation. There were situations under the guidelines where total removal could be avoided, in particular when structures were converted to a new use, such as an artificial reef. That flexibility, and the discretion given to Governments under the guidelines, would provide a useful basis for consideration when drafting their national legislation.

25. With regard to taxation regimes of offshore installations and structures, it was indicated that there was no specific legislation in force in the countries of the region. However, administrative guidelines as enacted by law existed in the Philippines. The other countries were still in the process of developing a framework for taxation.

26. The case of Norway was of special interest because it treated removal costs separately from the existing petroleum tax system. If removal took place, the State should pay its share of the total expenses. The State's share of removal costs should be equal to the sum of income taxes paid by the licensee during the years the installation to be removed had been in use, divided by the sum for the same years of the tax base.

27. In the case of the taxation regimes for the United States of America and the United Kingdom of Great Britain and Northern Ireland, the companies were allowed to deduct the removal expenses. There were differences in tax incentives and carry-back and carry-forward procedures for taxation in the two countries.

D. Technical aspects of removal and disposal

28. The presentation of the paper by the representative of the E and P Forum highlighted the technical aspects of platform removal with special emphasis on total versus partial removal and the transport and disposal of removed parts. As oil and gas resources in the Asian region became exhausted, the 1,000 associated field platform installations would be decommissioned and considered for removal to comply with the IMO Guidelines and Standards of the coastal States. The IMO Guidelines and Standards allowed the coastal States to exercise discretion in the disposition of platforms that would be extremely costly or hazardous to remove or that could be converted to a new use. Therefore, there would be instances where platforms were not removed or only partially removed. The estimated cost to remove totally all platforms currently in place in the Asian region would exceed \$US 2.0 billion. Any reduction in the degree of removal would reduce that cost. There had been over 800 platforms removed from the U.S. Gulf of Mexico where the structures were of similar size and construction to those in the Asian region. The experience obtained in removing the Gulf of Mexico structures was illustrated to discuss the principles of removal along with current technology in areas such as decommissioning, making work safe, cutting, lifting and sea fastening for transport. The normal disposal practice for removed parts and structures was to bring them ashore for recycling into the steel market, but there was a potential for some redundant structures to be dumped in deep water, used for artificial reefs or refurbished for use at other locations to produce oil and gas.

E. Environment, safety and alternate use

29. A representative of the salvage industry gave a presentation on the experience gained from the removal of installations around the world. In addition, the elaborated on the safety and environmental aspects related to the cutting, lifting, toppling, transporting and salvaging of disused offshore platforms.

30. A representative of ESCAP presented a paper on possible alternative uses for installations no longer required for hydrocarbon production. Such continued uses were emphasized and not only should they be considered part and parcel of the management of declining oil provinces, but new research and development of related uses might both facilitate the monitoring of the effects of the recycling process and

result in new, viable business uses (and an extended useful life) for those structures by their postponing disposal decisions and disposal costs. The maintenance costs incurred would be charged against the budget of the successor research and development companies engaged in long-term research on a contractual basis.

F. Conflicting uses of the sea

31. A representative of ESCAP noted that the concerns of the shipping industry were that the national laws, and the financial and professional resources to implement them, might be inadequate to cover the post removal situation. Once a facility had been removed, a thorough survey of the area to check that removal had to be carried out in accordance with the government permit, and a survey of the location where it had been moved, if dumped at sea, were prerequisites. The ongoing responsibility for the remains of the facility, whether dumped in deep water, only partially removed, used to develop an artificial reef, or converted to an alternate purpose, also had to be precisely defined in law with the ongoing authority clearly vested in a specified government entity so as to ensure that it never became a navigational hazard.

III. RECOMMENDATIONS AND CONCLUSIONS

1. CCOP member countries

32. The recommendations and conclusions of representatives of the following CCOP member countries were as follows:

China. All discussions were very beneficial. China currently had no redundant platforms but wanted to start planning how it would handle the problem in the future. China really appreciated the efforts that went into preparing and presenting the Seminar, but was not in a position to offer ideas on the subject.

Indonesia. Indonesia should enter into an agreement with the contractor so that the legal, economic and technical aspects of removal were understood by both the Government and the contractor. It was the responsibility of the both of them to remove the structures. There was need for a compromise between the two for an allocation of production to cover the cost of removal. There was need to be more specific in identifying platforms in major shipping lanes that must be removed and to identify possible dumping sites.

Japan. There must be more investigations concerning the environment and the cost of removal. There must be further study concerning how the platforms affected fishing interests. From an environment point of view, Japan would follow the IMO Guidelines and Standards. Finally, there must be more discussions on the legal framework.

Malaysia. The cost of removal must be considered in relation to the development needs of the country. PETRONAS had recommended that all offshore structures should be removed within the 12 nautical mile limit and the rest be partially removed to an agreed depth. That recommendation was currently being considered by the National Task Force comprising the relevant departments of the Government. The 1982 United Nations Convention on the Law of the Sea might also be used as a guideline for platform removal. Navigational safety, alternative uses, and environmental and financial aspects, such as sources of funds, taxation, etc. would need detailed analysis prior to the adoption of any firm policy. Similar meetings should continue to be held among member countries with legitimate interests in the region. ESCAP was requested to develop a proposal on the strategy and timing to resolve the issue and submit it to member Governments for review and approval.

Philippines. The Seminar had been very helpful. The Philippines was now aware of some of the potential problems associated with platform removal. It was recognized that a premium had to be paid to preserve the environment and that premium need not be shouldered solely by the host country, a contractor or the consumer, but might be shared depending on the situation that arose. The Philippines requested help from other countries as to how much money should be put into a fund to cover the perpetual liability or residual liability associated with partial removal. It was also noted that the inclusion of the cost of removal could hinder the development of marginal fields, ESCAP was requested to help member States keep in touch with each other on that issue through seminars, workshops or other means.

Thailand. The Seminar had been very useful in many aspects. Delegates would inform their Governments of the information obtained through Seminar. More studies were required as to how the IMO Guidelines and Standards applied to the particular circumstances in Thailand. Help would be required from ESCAP to learn more about the legal, technical and economics concerning removal.

Viet Nam. The Seminar had been very helpful. Viet Nam had learned about the legal, technical and economic aspects of removal, and would use that information to develop its own removal regime. Viet Nam wanted to work with other CCOP members. ESCAP and CCOP were requested to help Viet Nam learn more about all aspects of the removal and disposal of offshore structures and installations.

2. International Maritime Organization

33. The representative of IMO, in response to a question from ESCAP concerning the future involvement of IMO in that field, responded that IMO would investigate the possibility of supporting future seminars, in particular with regard to the aspects of environmental and safety at sea. The cooperation of ESCAP and other relevant agencies, such as FAO and UNEP, should also be sought. IMO would also be in a position to provide specific advice to countries in the above field by providing expert consultancies, if so requested. The items emphasized by IMO as needing particular attention were the following :

Criteria for the evaluation of removal and disposal options, including a comparative assessment of alternatives concerning:

- Human health risks and hazards (including accident) associated with treatment, transport and disposal;
- Environmental impact;
- Economics;

- Exclusion of other future uses of the disposal area.

Criteria for the selection of sites for disposal or alternative uses of obsolete installations and structures taking into account:

- Locations in relation to other uses of the sea, to example amenity areas, fishing areas, maritime transport; and uses of the sea floor;
- Hydrographic conditions, bottom characteristics and geology of a site.

Criteria for monitoring potential effects

- Accumulation and deterioration of materials;
- Composition of benthic communities.

34. Resource persons suggested that in future seminars and workshops the number of participating countries should be limited so that specific issues related to each country could be discussed in more details and were effectively. ESCAP was requested to coordinate the necessary expertise for such seminars or workshops.

35. A representative of the oil industry stressed the need to the industry to work with the respective Governments in developing removal regimes.

IV. ADOPTION OF THE REPORT

36. The report was adopted on 28 May 1992.

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**CONTROLLING THE REMOVAL OF OFFSHORE PETROLEUM STRUCTURES
IN THE ASIA-PACIFIC REGION:
PROBLEMS AND SOLUTIONS***

* Presented at the 1989 Seminar by Peter Cameron, International Institute voor Energierecht, University of Leiden, the Netherlands.

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TERMS OF REFERENCE

The author of this report was requested to examine present problems and solutions to removal and utilization of disused offshore hydrocarbon platforms based on recent North Sea experience in this area. The study includes an overview of the problems which coastal States in Asia could face in the 1990s when their production platforms become redundant. An attempt is made to assess how the experience in the North Sea in the legal, economic and technical aspects of removing offshore platforms might be used in the Asian region.

To obtain background information for the report, missions were made to the following countries: Brunei Darussalam, China, Indonesia, Japan, Malaysia, the Republic of Korea and Thailand.

The study was commissioned by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). Its purpose is to provide background for the Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone to be held at Bangkok in February 1989.

1. The Problem of Removal

It is a measure of the progress which has been made in offshore petroleum exploration and production that in the 1980s discussion had commenced on the problems of removing production platforms and structures. Forty years ago there was only one mobile drilling rig in existence, capable of drilling in only six metres of water¹. There are now over 1,000 production structures in Asia alone.

Maturity is not the only variable with an impact on removal, however. Oil price movements also have an influence. Lower oil prices mean that high-cost fields can very quickly become marginalized. In the North Sea, the issue was raised at a time when oil prices had fallen substantially from the peaks of the late 1970s. The fact that some fields were reaching maturity was less important than the fact that the prospect of removal represented an additional – and potentially substantial – cost at a time of declining rates of return.

Clearly, the removal and utilization of disused offshore petroleum platforms are matters with important technical and economic aspects. However, they also raise legal questions which are no less significant. The maximum economic and technical efficiency will not be achieved without a legal framework for these activities. Three levels can be distinguished at which the legal variable plays a key role:

1. The international level

(what rights do coastal States have in international law?

The key document here is the 1982 Convention on the Law of the Sea);

2. The national level

(How should a government incorporate the nation's sovereign rights into domestic law? What measures should it take to control the removal process?).

3. The relations between the participants in oil operations (how do parties to a joint venture divide up their mutual obligations regarding abandonment? In Asia, the national oil corporations will play an important role at this level).

At each level the legal variable will have an important impact upon the range of technical options available to a coastal State, as well as upon the

determination and allocation of costs and the timing of payment.

Extensive discussion of offshore removal has recently taken place among the North Sea States. The huge potential costs involved in removing deep water structures from the North Sea sparked off a "cost panic" in the international oil industry between 1984 and 1986. In this context the international law rules were re-examined to ascertain whether a flexible removal policy was compatible with coastal States' obligations or whether complete removal of structures and pipelines was necessary in all cases. The British Government drew up legislation to permit authorization of limited or partial removal on a case-by-case basis. Both oil companies and Governments paid new attention to the interests of other users of the sea.

In the event, the abandonment of North Sea structures could be less of an economic or technical problem than had been feared. A 1988 study by Wood Mackenzie forecast that new technology and expected lower contract rates for specialized vessels had brought the total cost of decommissioning and removing United Kingdom oil and gas platforms down from US\$ 12.60 billion (7 billion pounds sterling) to US\$ 9 billion² (5 billion pounds sterling). Most of this cost will be incurred in the deep water of the central and northern North Sea. The expected costs of removing 40 structures there amount to about 82 per cent of the total removal costs.

The very high costs of removing several dozen petroleum production structures in the North Sea should not detract from the fact that most of the world's offshore structures are in relatively shallow water, presenting costs of a much lesser order of magnitude. However, the general debate on abandonment or decommissioning, sparked off by these extreme cases, has involved an examination of many issues of concern to all coastal States with offshore production installations in place or likely to install them in the future. *Moreover, for the developing countries there is little consolation in knowing that the costs of abandonment which they face will be much less than those in the North Sea since the resources which they have available to deal with the problem will also be much less than those of the North Sea coastal States.*

For both Governments and oil companies the paramount issue is one of cost. How much will the Government of the coastal State expect to pay? If abandonment costs are tax deductible, a Government may find itself – like the United Kingdom – effectively

¹ "Brunei Shell Petroleum", Public Affairs Department brochure, 1986, p.30.

² Petroleum Economist, March 1988, p. 91.

paying 66 per cent of the removal costs through lost revenue. If the installations are government-owned, as in Indonesia, then that percentage share could be as much as 100 per cent.

Another issue concerns the potential for alternative use of installations which have reached the end of their production life. Instead of disposing of the structure, why not use it wholly or partly to create an artificial reef which would benefit the fishing industry? For developing countries seeking an easy and inexpensive solution to the problem, this mode of alternative use has its attractions.

If removal is decided upon, then what standards will govern it to protect the interests of other users of the sea? And what body will verify that the standards have been complied with? The petroleum industry's standards of "good industry practice" have a role here. Is it a viable option to leave a structure in place? If a structure is left *in situ*, who will pay for the maintenance costs? If a Government establishes a body to carry out maintenance and checking, what ongoing costs will it incur? Who will pay for the navigational lightings, for example?

These issues, and particularly their legal dimensions, are the subject of this report. Abandonment in Asia and the Pacific will not commence on a large scale until the mid-1990s. However, the number of removals is then likely to increase quickly, as will the costs to coastal States in the region. To be forewarned is an opportunity to be forearmed. For Governments in the region, this means finding a compromise between three distinct aims: the maximum extraction of petroleum, a proper observance of obligations in international law, and the lowest possible expenditure of public funds.

2. Technical solutions and interests involved

While this report is not intended as a technical paper, it seems appropriate to make some remarks on the techniques involved in removal and their consequences. Leaving economic considerations to one side, present technology and available equipment are capable of dealing with all the operations required to dismantle and remove topside structures and facilities. Examples of platform installations are given in figures 1, 2 and 3.

There are three basic options: leave the structure in place; total removal; and partial removal.

The first option is limited by deterioration caused by metal corrosion and fatigue cracking. Moreover, natural hazards such as ice flows in the Bohai Gulf can cause hazards. In South-East Asia such structures may attract refugees, although this is more likely to involve manned rather than unmanned platforms. None the less, with maintenance this option is quite feasible in some cases. The costs should not be underestimated, however, as they require the provision of annual inspections.

Leaving the structure in place allows for alternative uses, such as the creation of diving or training centres. Moreover, every installation is potentially an artificial reef. One of the curious facts about offshore installations is that they attract fish suitable for marketing. The structures attract barnacles, coral and similar kinds of sea-life, which in turn attract small fish which themselves attract larger fish. The use of platforms to enhance fishing opportunities is known as artificial reef planning.

The second option is total removal. The entire installation would be dismantled and brought onshore for disposal. It would have large-scale financial consequences for North Sea States like the United Kingdom and Norway. The bulk of the cost comes from the need to break the structure down into pieces: the need to reverse the process of installation removal is the root of the high cost. Current platform design does not permit easy or cheap removal. Not that total removal is beyond existing levels of technology; far from it. In the past 40 years, more than 350 installations have been removed from the shallow waters of the Gulf of Mexico belonging to the United States of America. By contrast, only two removals are recorded in the North Sea area: the first was a very small platform in British Petroleum's United Kingdom West Sole gas field (400 short tonnes); the second was a small platform in the Dutch sector owned by Pennzoil Wintershal (1,800 short tonnes).

The third option, partial removal, would leave part of the structure fixed on the seabed, while the rest would be toppled into the sea and removed. This would reduce costs substantially but would increase the risk to other users of the sea. This is not a problem if the platform is located far from shipping lanes, but that is not often the case. The cost savings arising from partial removal would increase with the water depth involved, both absolutely and as a percentage of the total removal cost. However, a study by the oil industry group, E and P Forum, concluded that smaller savings of about 27 per cent were available from the adoption of partial removal in shallow waters (40-75 metres), compared with 87 per cent in 250 metres water depth.

The interests involved

The costs of total removal and the savings from partial removal will not concern the owners alone but also the Government of the coastal State. In most countries, removal costs are allowable against tax and therefore a Government should expect reduced revenues. In addition, a Government will have the responsibility of making provision for the interests of other users of the sea. These fall into four main categories:

(a) *Merchant ships and warships*

Safety of navigation must be ensured for ships, and also for submarines. It is not hard to imagine a submarine becoming impaled on a structure which has been inadequately removed. Moreover, supertankers, the largest ships at sea, require a clear water depth of 40 metres.

(b) *Fishing interests*

The fishing industry will generally favour a clear seabed so that when nets are cast these are not caught on a structure beneath the surface, causing loss of life. However, it might be noted that there are already about 2,500 shipwrecks in the North Sea and around 10,000 in offshore waters.

(c) *Other States*

Other States may have rights of access to the coastal State's offshore waters. These must be respected. Their vessels may be vulnerable to submarine cables and pipelines as well as platforms. Defence interests are particularly important here.

(d) *Environmental groups*

These lobbies want legal safeguards for the marine environment. Their demands may be met by introducing standards for safe and clean removal of installations. Total removal is not necessarily required to meet their objections, which are far more influential in the North Sea context than in Asia.

It is understandable that oil companies and coastal States should seek to limit their removal costs. However, it is important that, in so doing, other users of the EEZ should not suffer as a consequence.

3. The legal framework

3.1 The international level

3.1.1 *The Convention on the Law of the Sea*

The relevant provision of the Convention on the Law of the Sea concerning removal is contained in article 60, The Law of the Sea (LOS) which states:

"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" (emphasis added)."

Although the above Convention is not yet ratified, it is generally taken to present the developing customary law in this area. Moreover, the active participation of Asian States in its development (unlike the previous United Nations Conferences on the Law of the Sea) gives it an authority in the region which the earlier rules lacked, concluded as they were when many of these States had colonial status. The extensive involvement of the developing countries in the negotiations over the Convention and their direct contribution to specific provisions such as the development of, for example, the archipelago concept, strongly suggest that its authority as a statement of international law prior to ratification is likely to arouse much less controversy than has occurred among the North Sea States.³

³ For example, see the discussion in two articles by Paul V. McDade, "The removal of offshore installations and conflicting treaty obligations as a result of the emergence of the new law of the sea: a case study, 24 San Diego Law Review (1987) 645-687, and "International law of abandonment of offshore installations: a reassessment" Oil and Gas Law and Taxation Review (1985/86) 291-296 Britain has not yet signed the Convention and is not likely to in the near future despite the fact that British negotiators were principally responsible for drafting article 60 paragraph 3, permitting departures from the total removal requirement in specified circumstances.

The debate about total versus partial removal is also likely to prove less controversial. Most platforms in Asian waters are likely to require total removal under international law, given the shallow water involved. However, the detailed specification of removal standards by "the competent international organization", the International Maritime Organization (IMO), is likely to arouse much interest since it will have a direct impact on national regulations in this area. If States which have signed the Convention and are also members of IMO are to follow these guidelines and standards (likely to be approved in late 1989), what measures should they take in their domestic law?

3.1.2 *The International Maritime Organization Draft Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone⁴*

The IMO Draft Guidelines and Standards are the first ever devised for the removal of offshore petroleum installations. Under them, abandoned or disused installations or structures standing in less than 75 metres of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure, should be entirely removed.

Similarly, installations placed on the seabed on or after 1 January 1998 standing in less than 100 metres of water and weighing less than 4,000 tonnes in air, excluding deck and superstructure should also be entirely removed. Indeed, no installation should be placed on the seabed after this date unless its design and construction are such that the entire removal upon abandonment or permanent use would be feasible. This is an important provision for a State such as the Republic of Korea, which does not yet have production structures in place but may face the task of installing them in the foreseeable future.

In addition, installations no longer serving their primary purpose and located in lanes used for international navigation – in deep draught sea lanes or routeng systems which have been adopted by IMO – should be entirely removed without exception. If a coastal State wishes to apply more stringent criteria, there is no obstacle to this in the draft Guidelines and Standards.

Governments are given discretion in the area of alternative use or leaving in place if no unjustifiable interference to other users of the sea is caused. The coastal State may determine whether the structure may

be left wholly or partly in place and decide on a case-by-case basis. However, and uninterrupted water column of not less than 55 metres should be provided to ensure safety of navigation. Legislators therefore have considerable freedom in drawing up rules suited to the particular setting.

The two principal concerns were that removal should not lead to pollution of the marine environment and that the area left unavailable to fishing interests (for bottom trawling) should be small. The IMO Draft Guidelines and Standards are set out in annex I. They are to be submitted to the IMO General Assembly at its sixteenth session in late 1989 with a view to adoption.

3.1.3 *The issue of disposal*

The disposal of removed platforms has been identified as a separate issue requiring a distinct set of guidelines⁵. These will be drawn up by the parties to the London Dumping Convention. Inevitably, their conclusions will have a bearing upon the acceptability of particular methods of disposal such as toppling. Indeed, this forum will consider all the legal and jurisdictional aspects relevant to controlling and preventing marine pollution from structures and installations abandoned at sea, toppled at site or placed at the sea bottom as artificial reefs.

3.2 **The national level**

A second – but not always subordinate – level at which the legal variable comes into play is the national one. This is the realm in which most of the rule-making will occur, but it is also the one in which legal regulation is least developed, particularly outside the North Sea countries and the United States of America. What legal instrument or combination of legal and fiscal instruments is most appropriate to deal with the removal problem? A general law? A set of regulations? A specific measure in a petroleum agreement? What options are available to a Government in making rules? How sensitive should a State be to potential impacts on foreign investment of new legal rules on this matter?

This is a key area in a host Government's relations to the petroleum companies engaged in offshore operations. It is also one on which a host Government will have to strike a compromise between the various

⁴ MSC/Circ. 490.

⁵ LDC 11/14, pp.48-51. Coincidentally, the Oslo Commission is to hold a workshop on the technical and environmental aspects of platform disposal in France on 6 February 1989. The outcome of the workshop will be discussed by the Scientific Advisory Committee of the Commission (SACSA) and also brought to the attention of the Scientific Group on Dumping of the London Dumping Convention.

interests involved at the national level and its commitments in international law.

3.3 The operating environment

A third legal variable has emerged in the North Sea context. Once a basic framework for removal has been provided by the host Government, participants in petroleum operations are prepared to conclude "abandonment agreements" to allocate their individual responsibilities in this matter. When several parties join together to develop a field, they establish a Joint Operating Agreement with a Joint Operating or Management Committee. Sometimes there is a provision included which deals with abandonment. Where it is not included a separate abandonment agreement may be concluded to deal with (*inter alia*) liability in cases of default. In Asia, such agreements appear to be unknown, but if introduced would have to include a national oil company as a participant in most cases.

The catalyst for legal development in this area is legislation by the host government. It has only begun to develop in the North Sea in the past two or three years. It is likely to be a major growth area in contract work in the next few years.

Of course, economic factors have also provided a stimulus. The context of volatile oil prices has raised the possibility that some oil companies may default on their removal costs. A defaulting company might therefore leave his co-venturers to pay his share of the costs.

From a government point of view, this area of activity is our important one to note. There is no reason why Governments should burden themselves with excessive regulation. If the companies, public or private, can be encouraged to carry out the work of abandonment preparation within a framework of general legal rules, there should be little need to require them to submit large quantities of documentation which could only be processed by using public funds.

4. Removal in Asia and the Pacific

This section provides an overview of the problems that coastal States in Asia could face in the future when their production platforms become redundant. It contains information obtained from the missions to selected countries undertaken for this report.⁶

⁶ In some cases the information is incomplete, since at the time of the meeting some data were not available.

There are several specific features of the Asian energy environment relevant to the question of removal.

1. The most obvious is that offshore platforms are almost entirely situated in shallow water, creating the possibility of relatively safe and inexpensive removal. Correspondingly, it will be harder to make a case for partial removal on technical grounds. Moreover, the total number of platforms which will eventually have to be removed is considerable. Three countries (Brunei Darussalam, Indonesia and Malaysia) each have more platforms than the United Kingdom sector of the North Sea. Even if the average removal costs of a single platform are likely to be much lower than in the North Sea, the total costs are large none the less, particularly for countries in which public resources are much less abundant (or more scarce) than in Europe or North America.
2. Many Governments in the region will face substantial indirect as well as direct costs from removal. Quite apart from tax allowances which oil companies may use to offset costs in some countries, the role of national oil companies in countries using production sharing contracts may place the burden of removal costs entirely onto the public sector.
3. A constraint on the scope of Governments to legislate for removal is the overall climate for petroleum investment in the region. Unlike the North Sea area, investment has on the whole declined following the oil price collapse in 1986. This climate seems unlikely to change in the 1990s. Measures taken to deal with abandonment costs are therefore likely to have an adverse impact on investment decisions if they appear to limit the costs wholly or partly to the private sector.

4.1 The impact of contract structure: the production sharing agreement

The production sharing contract (PSC) is a legal agreement between the national oil company, on behalf of the Government, and a contractor, usually a foreign oil company. It is used in Indonesia and Malaysia and has an influence on the system found in China.

The details of the PSC vary from one country to the next and from one agreement to another, but the essential features (in the context of this report) are the following:

1. All assets, including materials, equipment and installations, are purchased and installed by the contractor on behalf of the owner, the host Government, with the national oil company acting as its agent.
2. Management responsibility rests with the national oil company, but the contractor executes the work programme.
3. Exploration expenditure is only recoverable from commercial production. The contractor assumes all of the risk of exploration. If there is no commercial discovery, the contractor cannot recover exploration costs.
4. The contractor is reimbursed for all allowable current costs of production and amortized exploration and capital expenditures in crude oil, called cost oils. As figure 4 shows, the cost oil is a certain percentage of the barrel produced which the contractor may take for itself as payment for all the expenditures it has incurred in the exploration, development and production of crude oil. The percentage of cost oil varies from one PSC to another. The amount is generally determined by dividing allowable costs during the production period by the export price. The remaining profit oil is split so that, after taxes, specified percentages of the profits go to the Government and to the contractor. In Indonesia, this split is 85/15 for the first five years of field production. It can be extended by mutual agreement between the national oil company and the contractor.

In the context of removal, the PSC raises three specific problems. The first turns upon the accounting period for cost oil recovery. This occurs every quarter when, say 20 per cent (or perhaps as much as 50 per cent in more recent PSCs) of oil produced in the first quarter of production is recovered as cost oil. Such expenditure as is not recovered is carried forward to the next quarter when a further 20 per cent of the oil produced is allowed to be treated as cost oil. This process continues for every quarter. Ideally, all of the contractor's expenditure should be recovered by the end of the period of the PSC. This may not occur however. The situation can arise in which the contractor may have unabsorbed cost oil at the end of the PSC. In such cases, should the contractor then have to finance the cost of the removal of offshore petroleum structures, there is no mechanism to permit the contractor to recover its own expenditure or to pay for the cost of the removal.

A second problem arises from the operation of the profit oil recovery mechanism. The basic idea here is

that at specified periods the contractor is allowed to take a portion of the production of the oil produced as its profit or as a return on its investment. In any well the production will reach a plateau after which the volume produced will decline. The removal of offshore structures will inevitably occur when there is no more oil left to be produced. The question then arises of how the contractor is going to recover the cost of removing the structure when oil is no longer being produced: in other words, when there is no income from which the contractor can finance the removal cost. Currently, this problem is not addressed in the PSC regimes either in the PSC or in the basic law. If it is seen as a problem for the national oil company as the asset owner (as seems likely under present arrangements) and not a problem for the contractor at all, the company is therefore left with the task of making provisions to finance the cost of removal.

A third problem turns on the fact that the cost oil mechanism permits recovery of cost oil based upon contract areas. Each PSC has its own contract area and the contractor is not allowed to recover expenditure incurred in one PSC area from the income produced in a different area. Therefore, if a contractor has two PSCs in a single country, the oil in the first contract area cannot be utilized as cost oil in the second contract area. The recovery of cost oil from different contract areas is discouraged in some countries by a ring-fencing mechanism which treats each PSC as separate from the other even when the contracting company is the same in both cases. The first problem outlined above will be exacerbated by this feature of the PSC system.

A key element in the PSC system is the separation of the fiscal authority from the developing or operating authority. The latter is the national oil company. If the proposal is to recover removal costs by fiscal means then an authority other than the national oil company has to be willing to forgo revenue. One area which might be examined concerns the tendency to classify removal as a capital expenditure rather than as an expenditure incurred in producing the income, made on the ground that the structure is no longer utilized for producing income at the time when it is abandoned. Further problem areas are found in situations where the fiscal provisions do not allow for expenditure to be recovered from one PSC against another PSC, where a ring-fence operation is in place. These are matters which are not peculiar to the PSC systems, however.

Other non-institutional factors are likely to present complications: a reduction in taxes paid from the start of production is problematic since the costs of removal cannot be identified at that stage, although, as the Dutch system shows, it is possible to develop a

flexible formula applying from mid-way during the project's life; a phased contribution to an abandonment fund is not attractive (but not impossible) since there is no certainty that it will be sufficient or that the platform will ever be removed; despite the foregoing, a tax relief, if given, would have to apply to the period when the national oil company still had income from the field, since it would otherwise have little impact; finally, the cost recovery element in a PSC system may be affected by non-technical factors affecting provision for removal costs (for example, a cut in production imposed by the national oil company as a token gesture in support of OPEC production cuts).

The other principal type of petroleum agreement is the concession or licence, common in the North Sea and many other petroleum producing areas. Thailand has a form of concession regime. Under this system, the foreign company has responsibility for operating costs and management, subject to approval of its plans by the relevant ministry. The production phase in Thailand lasts 30 years, with a possible extension of 10 years. Brunei Darussalam also has a concession system, but the Government participates in the petroleum operations through a joint venture company.

In China, the regime has elements of both systems, but is largely a PSC one. The type of agreement, whether contract or concession, will have an impact upon cost allocation and liability for removal costs.

4.2 Country profiles

The following remarks on particular national regimes are intended as no more than a sketch of the features relevant to the abandonment problem. They are not comprehensive, and are based largely on interviews conducted in the countries concerned. Questions addressed to interviewees included the following:

1. How many platforms are located in offshore waters?
2. In what water depth?
3. Have there been any removals so far? If not, when is the first expected?
4. Is there a provision governing removal in current legislation or in petroleum agreements awarded?
5. If legal provision is to be made, what are the preferred options? Is total removal envisaged in every case?
6. Who is or is likely to be liable for removal costs?

7. Are tax incentives available or possible?

Brunei Darussalam

Brunei Darussalam is the third largest oil producing nation in South-East Asia (after Indonesia and Malaysia). Offshore production accounts for more than 80 per cent of total oil production. It began in 1964 from the S.W. Ampa field, making it an older oil province than any of the North Sea States. By early 1983, there were 182 light structures all operated by the Brunei Shell Petroleum Company (BSP), a joint venture owned by the Brunei Government and Shell. Most of the platforms are in water between 60 and 70 feet deep and the deepest (Gannet) is in water about 200-250 feet deep. Normally, between two to three jackets a year have to be abandoned. The structures are brought ashore, broken up and sold as scrap. The costs are met by BSP.

The Government's direct stake in BSP, coupled with the fact that only one foreign oil company is involved in production, has discouraged any formal approach to rule-making for abandonment.

The Petroleum Mining Act 1984 contains references to the abandonment and plugging of wells, but no mention is made of platforms. In the Model Petroleum Mining Agreement in Respect of Offshore State Lands (Third Schedule to the 1984 Act), the following provision is found (clause 31):

- "1. No borehole or well shall be abandoned and no cemented string or other permanent form of casing shall be withdrawn from any borehole or well which it is proposed to abandon without the prior consent of the Minister or in case of an exploration borehole or well without notification to the Minister as soon as practicable. Consent shall not be unreasonably withheld in respect of boreholes or wells which have become or are unproductive.
2. Every borehole or well which the Company intends to abandon shall be securely plugged by the Company in order to prevent entry and exit of water in and from any portion of the strata bored through unless the Minister determines.
3. The Minister may require on any occasion that no borehole or well shall be plugged except in the presence of an officer authorised by him".

This requirement applies to abandonment at all stages except at the end of the agreement when, according to clauses 63 and 64, all productive boreholes or wells have to be delivered up to the Government within two months in good repair and fit for further working.

Since plugging of wells is in fact only one stage in the abandonment process, this provision is quite unsatisfactory. Nor is there much comfort to be gained from the requirement in clause 32 that the concessionnaire shall carry out all operations "in a workmanlike manner and in accordance with generally accepted standards of good petroleum field operations and conservation practices. A failure to comply allows the Government to perform the concessionnaire's obligations and to recover the costs and expenses of doing so from it (clause 51)."

With respect to disposal, onshore scrapping presents no legal difficulties and deep-water dumping does not require a permit. The decision to abandon is taken by the company but the Petroleum Unit's suggestions are taken into account. Total removal is recommended in each case. Government authority is shared with the Marine Department, which had generally not been supportive of the idea of partial removal. The costs of removal are tax deductible.

BSP operates under a concession type of agreement, with a duration of 30 years (clause 1 of the Model Agreement, although particular agreements may contain a longer term). Under its terms, the production structures are the property of the Company until the agreement is terminated. At that time the concessionnaire is obliged to hand over to the Government at no cost all of the assets of a fixed or permanent nature (clause 61).

However, abandonment will not necessarily occur on the expiry of the production term. Three current agreements have extension clauses built into them. The initial production terms will expire in 2003, 2008 and 2021. In other cases, abandonment will not necessarily follow expiry of the production term. The terms of an agreement may on expiry be renegotiated to permit an extension of production. Despite the relatively frequent removals offshore, the general thinking behind the long term of the concession might be expected to discourage early abandonment. A long duration is thought to encourage optional production by promoting efficiency in recovery and stimulating use of techniques to extend the production life of the field. At present, removal usually follows a decline in safety (for example, when the walls of the well "water out").

Currently, the Government has no way of compelling BSP to adopt a particular mode of disposal. In contrast to approaches now developing in the North Sea, there has been no attempt to create a formal framework in which different options may be reviewed by the Government and are required by government officials. As the following note suggests, there is a potential conflict between a favoured policy (rigs to reefs) and an approach to removal based entirely on cost. So far this has not led to any dispute. However, what if the Government wished to build up the fishing industry by pursuing a mandatory rigs to reefs policy in every case, irrespective of cost? Reliance on a consensual approach would quickly break down and there would be no legal means to insist on one particular mode of disposal, without recourse to new legislation. It is hard to avoid the conclusion that there is much complacency in this informal, ad hoc approach to removal.

Rigs to reefs policy

On 28 August 1988, an experiment was conducted in using two platform jackets to create artificial reefs. With the consent of the Fisheries Department, they were dumped in the same area at the same time.

On the initiative of the Petroleum Unit, BSP conducted a review of the alternative modes of disposal. It appeared that this use of rigs was slightly cheaper than onshore scrapping, the usual method, which in turn was slightly cheaper than deep-water dumping. The costs in each case are illustrated below:

Deep-water dumping :	B\$ 1.8m and B\$ 600,000
Rigs to reefs :	B\$ 1.6m and B\$ 400,000
Onshore scrapping :	B\$ 1.6m and B\$ 400,000

There was a small difference in cost between the rigs to reefs option and onshore scrapping. The former was slightly less expensive than the latter. Both were cheaper than deep-water dumping. Removal of the two jackets was equivalent to one day's operating costs. The fiscal arrangements have ensured that the lion's share of the costs will be borne by the Government.

An important consideration is the cost per day of the working barge, required to cut the platform legs, tow it away and properly arrange the structure using divers. Timing has significant financial implications.

A site was selected so as to avoid disturbance to shipping. Under the Ports Act, the Marine Department must be notified about seabed obstructions. Its standard procedures were adopted for alerting users of the sea to the existence of new objects such as wrecks. Once

removed, ownership of the structures was transferred to the Fisheries Department, preventing claims being made against BSP at a later date.

There was no need to legislate, since oil production is already carried out by a company which has a government shareholding of 50 per cent and also representatives on its Board. Although other oil companies are prospecting for hydrocarbons and may be involved in consortia later, BSP is the only company with production structures at the present time. If four or five companies were operating fields, or if the companies were not amenable to government control, it might not be possible to achieve policy objectives without legislation.

After the policy decision was taken, the approximate timing was left to BSP to arrange in accordance with its oil production schedule and the availability of structures for removal.

The policy aim behind rigs to reefs removal is to maximize community benefit by promoting the country's fishing industry. Dumping structures in appropriate even if not natural places for fish to gather (sedimentary rock, sand, loose bottom and so on) can attract fish for breeding. The policy was influenced by research done on this topic by the United States Cousteau Foundation.

China

There are currently 23 offshore production structures, 22 of these being located in the Gulf of Bohai and only one of them in the EEZ area. The water depth in the Bohai area is between 5 and 40 metres, while the waters of the South China Sea are significantly deeper. Several platforms have been removed from the Gulf of Bohai already: in each case, the legs were cut and the whole structure moved to another place for use. The cost amounted to one third and one half of the construction costs.

A major problem for China in the area of removal is the number of ministries which have overlapping jurisdictions. Several ministries have rights over removal procedures. Any abandonment will be a compromise between their diverse requirements.

Offshore operations are the responsibility of the China National Offshore Oil Corporation (CNOOC). Its main task is to join with foreign oil companies to explore for and exploit petroleum in offshore waters. To that end it has signed 42 contracts with 44 corporations from 12 countries. These contracts are mainly concerned with exploration activities. However, two oilfields are

currently in production and three are at the development stage.

Governing law

In all the model production sharing contracts awarded for offshore areas, there is a requirement that platforms should be removed at the end of their production life. If the contract is jointly held, removal costs are to be shared between CNOOC and the foreign contractor. So far, the implications of this standard requirement have not been felt but there is an awareness of the potentially large costs which could fall upon CNOOC when these platforms reach the removal stage. CNOOC must act in conjunction with other ministries in dealing with this situation, as the following rule illustrates:

The Maritime Traffic Safety Law 1983 states as follows, in article 26:

"The removal or dismantling of installations, the salvage or clear-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 about the name, shape, size, location and depth of water over the obstructions in question".

This does not state the removal is required; only that when it occurs, certain conditions have to be fulfilled. Since the official view is that the Bohai Gulf area is different from the EEZ, largely because of the very shallow water, it would seem that there is no law requiring removal of structures at the end of their production life. This is in contrast to the areas governed by the contracts awarded to foreign oil companies, jointly with CNOOC. However, there are institutional pressures which encourage removal of disused platforms. If there is no removal, objections will certainly come from the Fisheries Department, the navigation authorities and the Navy. The Port of Bohai Supervision Agent has already asked for the removal of structures if they are not being used or alternatively the installation of a signal device to ensure of safety navigation.

If explosive devices are to be used in removal, notification must be given to the competent authorities. The Fisheries Department has a role here under the Regulations of the People's Republic of China

Concerning Environmental Protection in Offshore Oil Exploration and Exploitation 1983, article 13 of which states:

"When offshore oil exploration and exploitation necessitates dynamite explosion or other operations harmful to fishery resources in important fishing grounds, effective measures shall be taken to keep away from the spawning, breeding and fishing seasons for those fishes and shrimps of major economic value. Such operations shall be reported in advance to the Competent Authority and distinct signs and signals shall be given while operations are carried out."

Upon receiving such a report, the Competent Authority shall "promptly inform the relevant units of the location and time of the operations."

Apparently, objections may be expected from the Fisheries Department to attempts to use explosive devices in the removal of platform structures. Other departments have regulatory requirements which would also have to be complied with in removal.

The task of removal is the responsibility of CNOOC, which shares responsibility for offshore petroleum exploration and development with the Ministry of Petroleum Industry. In practice, the removal work would be done by the regional companies under CNOOC's control. At present they carry out the work of installing platform structures. The Bohai Oil Corporation (BOC) is the largest of the four regional companies, each of which may subcontract work if it wishes. The other companies are the Nanhai West Oil Corporation, the Nanhai East Corporation and the South Huanghai Oil Corporation. BOC has the capacity to fabricate a jacket for a water depth of up to 120 metres, and has also established a shipyard to fabricate jackets for use in the South China Sea area.

Payment of removal costs

There appears to be no fiscal rule or rules providing for payment of the costs of abandoning platform structures. Are CNOOC and the contractor to be given tax relief or to provide for removal by establishing an abandonment fund or make provisions in some other way in their budgets? Without some choice of scheme adopted by the Government it is unclear how the costs will be met. It is also likely that, under present arrangements, companies will make no provision at all in their accounts for removal. Worse still, the extent to which different ministries can interfere in the removal

process makes it impossible to calculate how much the oil company might be expected to pay. The lack of any fiscal machinery is compounded by institutional confusion.

Production structures: profile

The two oilfields in production are:

1. *Wei 10-3 in the Beibu Gulf, South China Sea*

This is jointly held by CNOOC and Total, holding 51 and 49 per cent of the investment respectively. CNOOC is now the operator. It has one platform and one single point mooring (SPM) system connected to a floating production off-loading storage unit with a few miles of flow line;

2. *Chengbei in the Bohai Gulf*

Five of the 23 production structures are located here.

Each one is small: two for production, two for accommodation and one for storage. One commenced production in 1985 and the other in 1987. Initially, the operator was the Japan-China Oil Development Corporation. Now it is CNOOC (the contract permits a change of operator after a specified number of years).

The three oilfields under development are:

1. *BZ 28-1 in the Gulf of Bohai*

The structures include two platforms and an SPM. The operator is the Japan-China Oil Development Corporation, but one year after it has entered production (expected in 1989) the operatorship will be transferred to CNOOC.

2. *Huizhou 21-1*

This is located in the Po River mouth in the South China Sea. Its overall development plan has been approved by the Ministry of Petroleum Industry and production is scheduled to commence in 1990.

The structures will include one platform and one SPM.

3. *Wei 11-4 in the Beibu*

The production phase is expected in 1991; currently work is being constructed on the basic core design.

4. *BZ 34 in the Gulf of Bohai*

Two platforms will be used for production, one platform for water ejection and tanker for storage

Production is scheduled to commence at the end of 1989/beginning of 1990. The operator is the Japan-China Oil Development Corporation.

Indonesia

Offshore petroleum production began in 1970-1971.

By May 1988, there were 319 light structures in shallow water (maximum 300 feet). Most of these structures are located in waters offshore North Java and East Kalimantan, areas which are important for shipping. The Java Sea, for example, is one of the busiest shipping lanes in the region.

Under the PSC system, all structures and platforms are the property of PERTAMINA once they are brought into Indonesia. The foreign oil companies conduct operations under contract to PERTAMINA. While the Department of Mining and Energy will take any decision on removal, the task of preparing for removal costs appears to rest entirely with PERTAMINA. If each one of the structures should cost US\$ 1 to 2 million to remove, the total costs could be in excess of US\$ 0.5 billion. Although the production term is 30 years, some PSCs are scheduled to expire in the mid-1990s.

PERTAMINA began to give serious consideration to the funding of removal costs in mid-1988. This review appears to be restricted to PERTAMINA and does not yet involve the Department of Mining and Energy. The national oil company has limited scope in dealing with the removal problem. PERTAMINA is the manager of petroleum operations but is not the recipient of petroleum revenues: these are delivered to the Ministry of Finance. Moreover, it is obliged to give advice to the Government on petroleum operations, including the matter of removal. While the foreign contractors are obliged to report directly to PERTAMINA, they appear to have no responsibility for removal costs or for the actual removal.

Under the current PSCs, an extension of the production term may be applied for. Such applications for extensions will be treated positively. In this way, the need to abandon a structure may be postponed.

An alternative would be to shift the burden of removal costs onto the foreign contractor under the terms of new PSCs. In the current climate of volatile oil prices, shifting the burden of costs onto the contractor by unilateral action would almost certainly inhibit further the already declining investment in the petroleum sector.

Therefore the PSC terms are unlikely to be recommended as a means of dealing with removal costs. However, it is hard to see why there should not be a legal provision for the foreign contractor to be involved in carrying out a removal on PERTAMINA's behalf on a commercial basis.

In developing its position on removal, PERTAMINA will have to take into account the interests of other users such as:

1. The shipping sector (as a result of the archipelago concept whereby the State boundary follows the outermost island and all of the area is within the State, the total area is large: 13,760 islands spread out over more than 3,200 miles on top of two continental shelves);
2. Fishing interests.

At the present time, the review of abandonment issues has not progressed very far. No solution is possible until an arrangement has been developed jointly with the Department of Mining and Energy to cover removal costs. An initial problem seems to be commencing a dialogue between the national oil company and the other ministries involved. The specific issues arising from the PSC system might also be easier to resolve if there were discussion with other States using this system, principally Malaysia. It seems unreasonable to leave the burden of removal entirely with PERTAMINA, but until an interdepartmental discussion is conducted the extent of its responsibility will not be clear. By keeping the issue to itself, the national oil company is attracting the burden too in a way which is to an outsider both unreasonable and likely to stifle the discussion of practical solutions. Contractors should also be involved in discussions about how they can be re-engaged to deal with abandonment. Removal is frequently treated as part of the production process. It seems sensible, therefore, to involve the oil companies in dealing with this final phase of production.

Currently, there appears to be no provision on tax allowances for removal. Regulations on removal do not appear to be planned at government level but the internal review by PERTAMINA may lead to the submission of advice to the Government to legislate. This does not appear imminent.

Japan

Like many Asian countries, Japan is a net oil importer. The continental shelf on both sides of the Sea of Japan is narrow and water depths exceed 1,000 metres

within a short distance of the shore. The considerable water depths combined with present technology limit hydrocarbon exploration and production to a narrow strip along the coast. The narrow shelf area offshore West Hokkaido has been explored since the turn of the century but production has been insignificant. The petroleum-bearing structures are tightly folded and small, the reservoirs thin and field reserves small. The main area of offshore production is in the Tsushima Basin. The Aga-Oki field, for example, lies in 80 metres of water 11 kilometres from the shore. It began production in 1976. A related structure, Iwafume-Oki, began production in 1988 and was the fourth offshore field in the Sea of Japan. Substantial reserves of petroleum are most unlikely but several more small fields may be found. The entire shelf is under permit to Japanese companies.

From the information made available, it appears that there is no removal obligation in Japan's petroleum law. The issue is none the less important to Japan, given the large domestic fishing industry and the extensive participation of Japanese oil companies in the region as a whole, usually in joint venture projects (for example, in China). The fishing industry's influence has already encouraged substantial government investment in the creation of artificial fishing reefs. An estimate in the mid-1980's put the number of artificial reef sites at 2,500 with an output of 4.8 million tonnes of fishery products per year. There is no evidence available that petroleum installations have been used in this exercise.

Even though there are few offshore petroleum fields and unlikely ever to be many, Japan – as a signatory to the Convention on the Law of the Sea – will have to develop a removal regime which is in accordance with the IMO Draft Guidelines and Standards. In doing so, it will face strong pressure to provide compensation schemes for loss of access by fishermen if it chooses not to remove totally. Such schemes have been developed in the Joint Development Zone Agreement between Japan and the Republic of Korea. Compensation of US\$ 1 million was agreed by the Nippon Oil Exploration Company to be paid to the Japanese Fishery Union. A sum of US\$ 200,000 was paid to the Korean Fishery Union. Significantly, the initiative for compensation came from the Japanese industry. No such scheme operates in waters where Korean fishing interests alone are affected.

Malaysia

The first offshore oil production began in 1968 from the West Lutong field in Sarawak. There are now 33 fields and about 200 platforms offshore in water with

a maximum depth of 300 feet. There has been no experience of removal of a fixed offshore structure to date. However, a crude oil tanker in 15 feet water depth, used as a storage facility adjacent to the production area, was removed in 1985 by an international oil company at the request of PETRONAS, the national oil company. Since the PSC asset was a floating tank, the problem of removal was easily solved: it was towed to shore and dismantled as scrap. The cost of one million ringgit was fully recoverable.

There is no provision governing removal of disused structures in Malaysian petroleum legislation or in the existing PSCs. In PSCs awarded in the 1970s there are standard clauses dealing with the plugging of wells and for the observance of good oilfield practice. The Model Contract only makes reference to the abandonment of boreholes or wells, but not structures. In this situation one must assume that if a structure needs to be abandoned during the life of the PSC, it will only be done by the contractor if it can be regarded as necessary for "good oilfield practice". In a number of cases, subsequent PSCs included provisions for the contractor to contribute specified sums of money to PETRONAS by way of contribution to abandonment costs. The existence of such provisions implies a recognition that the ultimate responsibility and cost of removal is to be borne by PETRONAS. It may be noted that recent PSCs contain provisions which impose an obligation upon contractors to dispose of equipment and assets on behalf of the owner on terms to be mutually agreed with costs to be recovered from the cost oil. Since the wording does not refer specifically to the removal of offshore structures, it is not clear whether they are to be included. If they are – and it seems reasonable to assume so – they still leave unaddressed the question of whether the cost oil available at the end of the contract period will be sufficient to finance the operation.

Since petroleum operations are governed by a PSC system, PETRONAS has ownership of all assets, including materials, equipment and the petroleum structures, even though they are purchased and installed by the contractor on the owner's behalf. Once the contractor's rights under the PSC expire, the assets become the responsibility of the owner. It is not inevitable that abandonment will occur at the end of the contract period; wells may still be producing. Therefore, PETRONAS may find itself confronting the task of abandonment some time after the contract has expired when the oil company may have left the country.

Who then is responsible for abandoning the structure? It seems clearly to fall on the shoulders of

PETRONAS. Some PSCs concluded after 1976 contain provisions imposing an obligation upon contractors to dispose of equipment and assets on behalf of the owner on terms to be mutually agreed. In such cases the cost is to be recovered from the cost oil. However, the wording is not entirely clear as to whether it refers to the removal of offshore structures, since there are no clear words to that effect. If one assumes that it does, there is still the unresolved issue of whether there is sufficient available cost oil at the end of the contract period to finance the operation.

The duration of the production term in existing PSCs is short: 15 years, compared with Indonesia's 30 and, in some of Brunei Darussalam's concessions, 40 years. The total period from the start of production to the end of the contract period is approximately 20-24 years, at which point the rights of the contractor end. This does not necessarily mean that removal will quickly become a reality for Malaysia, since the production term in the PSC may well be shorter than the production life of the field. However, it emphasizes – if emphasis were needed – that on expiry of the PSC and transfer of the operatorship from the foreign contractor to PETRONAS, the task of removal of its assets as well as the costs of doing so will be left entirely to PETRONAS, even if this follows a further 10 years of production.

Nor is there much scope for flexibility offered by the use of extension clauses. The earlier PSCs gave PETRONAS sole discretion as to whether it wished the contractor to continue after the expiry of the PSC. However, such extensions have been short (5 years) and subject to conditions which are usually more onerous than those found in the original PSC (e.g. a reduced share to permit an interest for the exploration and production arm of PETRONAS). Further extensions may be negotiated for these earlier PSCs but recent PSCs do not even address the matter of extensions.

Currently, PETRONAS is exploring the issue of removal with a view to tendering advice to the Government about a draft regulation on this matter. Under the Petroleum Development Act 1974, the Company has ownership of and exclusive rights, powers, liberties and privileges in respect of all petroleum resources onshore and offshore. It is directly responsible to the Prime Minister.

In considering the matter of liability for abandonment costs, PETRONAS considered the option of recommending that a provision be introduced into new PSCs. This option was thought to have several disadvantages, including difficulty of specification to prevent uncertainty (What is meant by removal? Is it

total or partial? Who pays for it?). Such a provision might function as a disincentive to private companies, especially if they appeared to be an exercise in transferring costs to the contractor. However, companies in the North Sea are actively developing ways of reducing this uncertainty in accounting. It is hard to see how these doubts about investor confidence can be justified in the changing climate concerning the issue of removal.

It appears to PETRONAS that the costs of removal will have to be borne entirely by itself. Therefore, the question of total or partial removal is an important one. Given the shallow water, it appears beyond doubt that according to the IMO Draft Guidelines and Standards, removal will have to be total so now the real question is rather one of how the costs of removal are to be treated. While most countries permit the costs to be "carried back" (Australia and New Zealand, for example), or calculated over the life of the project at a large stage in its life, this seems impossible under the Malaysian PSC system, where the accounting period is divided into quarters. The PSC system makes it difficult to build up a provision for future removal costs.

PETRONAS' review of its abandonment options has been conducted largely in isolation from the debate on the issue among North Sea States, depending entirely upon its own contractors for information about North Sea developments. As a result, it has developed a rather limited view of its scope for action. It is certainly correct that the PSC system will require a specific kind of removal cost provision, but hard to see why one of the North Sea systems could not be adapted to suit it. The current system provides the Government with no guarantee that abandonment costs will actually be met. The current situation is one in which PETRONAS must either provide a solution to the problem of repayment or government action will have to be taken to remedy this omission from the country's petroleum regime. Determination of its international law obligations in the light of the IMO Draft Guidelines and Standards will in any case draw the Government into this matter in the foreseeable future.

Republic of Korea

The Republic of Korea is at an early stage in the development of its offshore petroleum sector and has yet to make a large-scale petroleum discovery. Not surprisingly, therefore, little effort has been made to examine the matter of removal of production structures. Attention has been limited to the exploration side of petroleum operations. Yet it is clear from the IMO Draft

Guidelines and Standards that they encourage coastal States to treat the issue in terms of the entire cycle of petroleum operations, giving thought to the problem and indeed making preparations at the stage of design and installation (see annex II, 3.13).

At present there is no detailed provision for removal in the petroleum legislation or model concession agreement. The sole concessionaire is currently the Korea Petroleum Exploration Development Corporation (KPEDCO), and it appears that responsibility for both installation and removal will be the operator's. Foreign companies explored offshore between 1969 and 1984 but were unsuccessful and have since relinquished the concessions (see figure 6). Because the geological structures are similar to those in China's productive areas, a number of companies are interested in applying for concessions. It is expected that in 1989 there will be some development in this respect.

The water depth varies from about 100 to 500 metres. Drilling began offshore in 1970. There appears to be no special provision concerning taxation of removal costs.

The main problem here is the complete lack of a legal framework. There is no incentive for a private company awarded a concession to make any provision for removal. The Government has no way of being sure that removal costs will be met. More importantly, it will have to act on this matter in the coming years to comply with the IMO Draft Guidelines and Standards if the current expectations of a commercial discovery are borne out.

Thailand

There are 42 fixed platform installations offshore, mostly producing gas, and all belonging to UNOCAL. The first removal is scheduled for 1993-94. UNOCAL has already commenced budgetary provisions for removal.

The only other company to have produced hydrocarbons from Thailand is Shell. The Petroleum Authority of Thailand (PTT) has expanded its operations into petroleum exploration, following a government review of Thai petroleum development in the mid-1980s. It is envisaged that eventually it too will become responsible for production structures.

Thailand uses a concession type of petroleum agreement. The basic legislation governing petroleum operations is currently being revised. Under prevailing arrangements, the duration of the production phase in

concessions is 30 years. Overall responsibility for concessions lies with the Ministry of Industry, and the Department of Mineral Resources has the specific responsibility. Many decisions are nevertheless made by the Petroleum Committee, an inter-ministerial committee established under the 1971 Petroleum Act, section 15.

Removal is explicitly referred to in the 1981 Petroleum Regulations, which require the Minister's consent to removal and the method of removal (article 39) (see following section). Article 40 requires the restoration of the operating environment. It seems to envisage total removal of the installation. However, a closer reading of the text suggests that the situation is not clear-cut. By adding the words "as much as possible" to article 40(1) and (3), restoration of the environment may be limited to measures designed to protect other users of the sea and avoid pollution but not amounting to total removal. The words "unless instructed otherwise by the Director-General" in article 40(3) to (5) give the Minister a measure of discretion to vary the removal requirement. Moreover, article 40(3) permits the concessionaire to reach agreement with the Minister on the variation of the removal requirement. These two articles cannot therefore be seen as necessarily stringent. The extent of removal is in fact a matter of the Minister's discretion.

Further provisions on the subject of abandonment are contained in clause 15 of the Model Concession. The Minister's consent has to be given before any property is disposed of, which presumably gives him some influence over the mode of disposal adopted by the concessionaire. Greater influence seems to be given him under article 15(4), where "properties which are not usable shall be removed by the Concessionaire in accordance with the Minister's instruction". Prior to that, installations have to be offered to the Minister on termination of production. Removal only follows if they are not usable.

Legal competence to vary the Regulations is contained in section 14 of the 1971 Petroleum Act. These permit regulations to be made covering the marking of installations involved in production operations: 14(2).

Section 76 ensures that the Minister is kept informed of relevant developments regarding petroleum operations. Section 80 requires the concessionaire to conduct petroleum operations in accordance with "good petroleum industry practice". At the well abandonment stage these standards will be crucial. Removal of the deck will involve a thorough inspection. Since techniques improve over time, these standards change.

Hence their relevance to the removal of production structures should not be underestimated.

There is considerable vagueness in the Thai legislation. While there is certainly a legal framework which provides for removal decisions to be made on a case-by-case basis, the rules are entirely indifferent to such crucial practical matters as how far removal should go: At what point should the platform legs be cut? Should the structure be cut level with the seabed so that there is no hazard to fishing, or cut 60 feet beneath the water so that there is no risk to navigation? There is no information about the mode of disposal which would be preferred. Pipelines would presumably be allowed to remain in place since they are already "flush" with the sea floor and are not a hazard to shipping. None the less, there might be some provision for their marking or covering with sand, as the Dutch Government insists upon.

Under the Thai fiscal rules, the sole burden of costs falls on the private company, but these costs are tax deductible. They can be written off until production ceases, so that it is in the interests of the company to make provision for abandonment costs while the field is still producing. In some cases, however, it will be cheaper for the concessionnaire to operate the field at low levels of production until an entire field can be abandoned. Since most platform structures are organized in clusters three to five kilometres apart, it will be more economic to remove a minimum of four at a time rather than one by one.

The disadvantage of current Thai laws is that they leave a very wide range of detailed decisions up to the private company. Since the Government will forgo tax revenue from the costs of removal, it has an interest in at least having access to information to removal plans at an early stage of their development. It is much harder to assess the merits of plans which have been worked out in detail over time and are presented for official approval. The Government has apparently made no provision for obtaining this information.

Thailand's legal requirements

Given the extensive treatment of the removal issue in the petroleum legislation (at least relative to all the other national regimes examined for this report), it seems worthwhile to quote extensively from the laws.

In the Ministerial Regulations No.12, B.E. 2524 (1981), issued under the Petroleum Act B.E. 2514 (1971), the following provision is found:

Article 39:

"Before abandoning a production pit, the concessionnaire shall notify the Director-General in writing of the reason therefore and the method thereof for his consideration, and when an approval has been granted he may proceed therewith".

Article 40:

"Upon completion of work at any place, or expiry or revocation of the concession, the concessionnaire or persons whose concessions have expired or been revoked shall:

- (1) Render the land or water area to resume its original condition as much as possible;
- (2) Erect walls or fences around the deposits, pits, trenches and wells excavated by the concessionnaire and still remaining useful to prevent any danger to humans or animals;
- (3) Fill up the holes, pits, trenches and wells excavated by the concessionnaire and which are no more used to resume their original condition as much as possible unless instructed otherwise by the Director-General, or an agreement has been made between the concessionnaire and the owner or processor of such land;
- (4) Demolish the concrete base, structure framework and living quarters; remove the machinery, equipment and other materials which are of no further use away from the survey or production pit, and burn all the petroleum waste in the area unless instructed otherwise by the Director-General;
- (5) Remove or destroy all impediments, barriers and objects hazardous to communication and fishing facilities, State or private property unless instructed otherwise by the Director-General.

The requirements in paragraph one shall be carried out and completed by the concessionnaire or those whose concession has expired or been revoked within three months as from the day the work is completed, or the concession expires or the revocation date, as the case may be."

In the Model Concession, clause 15 treats the termination of the concession and states:

- (2) "Upon termination of this concession all of the obligations between the Minister and the Concessionnaire shall thereupon cease to exist except those financial or special advantage obligations which have not been discharged and those obligations which are required in this concession to be performed after the termination thereof.
- (3) During the last five years of the petroleum production period or the renewed petroleum production period, the Concessionnaire shall not remove, sell, give away, dispose of or transfer any property mentioned in (4), except with a prior written consent of the Minister.
- (4) At the end of the petroleum production period or of the renewed petroleum production period in any production area, or at the earlier relinquishment of any whole production area or at the revocation of the concession prior to the termination of the said periods, the Concessionnaire shall deliver up to the Government of Thailand free of charge all lands, buildings, roads, railways, petroleum pipelines, pumps, machineries, platforms, storage tanks, stations, substations, terminals, plants, harbours, *installations and other facilities which are necessary for the conduct of exploration, production, storage or transport of petroleum* (emphasis added), or which are in the nature of public utilities such as electricity, gas, water, communication or telecommunication systems in connection with that production area; and the properties which are not usable shall be removed by the Concessionnaire in accordance with the Minister's instruction within three months from the date of the instruction."

Under the Petroleum Act 1971, as amended in 1973 and 1979, section 14, dealing with the role of the Ministry of Industry, states:

"The Minister of Industry shall have care and charge of this Act and shall have the power to appoint competent officers and to issue the Ministerial Regulations:

- (1) Prescribing rules and procedures in conducting petroleum exploration, production and conservation operations;

- (2) Presenting safety zones and marks in the vicinity of installations and devices which are employed in petroleum exploration and production operations;
- (3) Presenting measures in according care and protection to workers and safety to outsiders;
- (4) Presenting fees not exceeding the rates listed as an appendix to this Act."
- (5) Presenting other matters for the purpose of execution of this Act."

Section 76, dealing with the role of the Department of Mineral Resources, states:

"The Concessionnaire shall submit progress reports of his petroleum operations to the Department of Mineral Resources in accordance with rules and procedures described by the Department of Mineral Resources."

Section 80 contains the standard requirement to conform to good oilfield practice:

"In the conduct of petroleum operations, irrespective of whether the petroleum exploration or production rights under the concession have terminated or not, the Concessionnaire shall execute all operations in accordance with sound technical principles and good petroleum industry practice in respect of the petroleum operations and the conservation of petroleum resources."

5. The legislation of the North Sea States

General provisions on abandonment, implementing States' obligations under the 1958 Convention on the Continental Shelf, have been included in legislation or standardized concession agreements since the earliest days of North Sea operations. However, in recent years these have been developed further. The United Kingdom has enacted a statute designed to encourage licensee companies to provide for removal of offshore petroleum production structures. Norway has been debating new legal provisions to cope with removal costs, favouring a direct subsidy to the oil industry to cover costs incurred. The Netherlands has not drafted new regulations but is keeping the matter under review and is likely to legislate in the foreseeable future. Denmark has also conducted a detailed review of removal costs and how to meet them.

The incentive to act derives from several sources: firstly, major structures are likely to require removal in the mid-1990s and planning for meeting these costs should begin as soon as possible; secondly, there is an awareness that the international law of the sea standards which are now emerging will permit coastal States greater flexibility in removal than had been expected; thirdly, some criteria for balancing the interests involved are required, as are guidelines about what is required of concessionnaires; finally, there is an awareness that unless concessionnaires are legally obliged to make some provision to meet costs well in advance of the cessation of production, many will not do so voluntarily.

United Kingdom of Great Britain and Northern Ireland

Faced with the probability that very large costs will be incurred in the near future when abandoning petroleum structures in the northern part of its sector of the continental shelf, the British Government investigated the adequacy of its existing rules on abandonment and concluded that they were unsatisfactory.

Under the Coast Protection Act 1949, which applies onshore and offshore, ministerial consents are required for works carried out upon the United Kingdom continental shelf. Section 34(3) permits the Minister to make his consent subject to "such conditions as he may think fit" if he considers that the operations will cause or are likely to cause obstruction to navigation. Consents issued under the Act therefore have conditions attached requiring the Minister to be notified in the event of abandonment or disuse and that possible removal is to be effected to his satisfaction. These consents are given to the operators of licence groups and so it is the operator who has the full liability to the Government in fulfilling its requirements for disuse or abandonment. This may include the removal of unentrenched pipelines. The problem with this legislation was that it did not give the Minister the power to require the submission of abandonment programmes or the power of approval of those programmes. Moreover, it did not include any provision to discourage default by the licensee companies which have abandonment obligations. In the event of difficulty, the Minister could carry out the abandonment himself and then attempt to collect the cost from those who should have done it in the first place. With the approach of the inevitably large-scale abandonments, this situation appeared to be in need of improvement.

The Petroleum Act 1987 included provisions designed to change this situation (although the Coast

Protection Act provisions remain in force). The complex arguments involved in the British assessment of their scope to legislate under international law need not detain us here; suffice it to say that they correctly perceived that, whatever the strict legal position, the trend was to permit Governments greater flexibility in dealing with the problem. The new legal framework reflects a determination to exploit that new flexibility in providing a framework for the abandonment of offshore installations and submarine pipelines.

Was there not a risk that in introducing such a comprehensive new law, even if it was a framework to be filled out in detail at a later date, there might be adverse impacts upon foreign investment? The answer to this is simple. The official view is that "all we were doing was consolidating a position which had been in existence for some time". Moreover, the only reason why the Act refrains from setting out detailed standards, for example on platform removal, is that these are to be prescribed in regulations to be promulgated at a later date when the IMO Draft Guidelines and Standards have been introduced. Extensive consultations with interested parties no doubt facilitated acceptance of the legislation.

The main provisions of the Act dealing with abandonment are the following:

Abandonment programmes

The Secretary of State (Minister) is empowered to require by written notice that abandonment programmes be submitted for all offshore installations and submarine pipelines. These programmes must include a detailed breakdown of the costs involved in removal. Revisions can be required in the programmes, which can also be rejected by the Minister.

Performance

Where an abandonment programme is approved, the Minister can make it the duty of the persons who submitted it to ensure that it is carried out.

Requirement of proof

The Act provides means whereby the Minister may satisfy himself that any person who has a duty to ensure that an approved abandonment programme is carried out is in fact capable of discharging that duty and, where he is not so satisfied, require by notice that such a person take such action as may be specified.

Cost recovery

In the event of failure by those given notice to submit a programme, or to ensure that it is carried out, to

enable the Minister to do the work and recover the cost from those given notice.

Penalties

Failure to comply with notices can result in both civil and criminal penalties, involving the imposition of fines and/or a term of imprisonment not exceeding two years. A person found guilty can mean both a company and its officers.

Cost allowance

In specific cases, abandonment costs may be set off against royalty previously paid.

Regulations

The Minister may make regulations over a wide range of issues, including the following:

- (i) The prescription of standards and safety requirements in respect of dismantling, removal and disposal;
- (ii) The prescription of standards and safety requirements in respect of anything left in the water where an installation or pipeline is not entirely removed;
- (iii) Provision of measures for pollution prevention;
- (iv) Provision of inspection;
- (v) Provision for the determination of the amount of any fees payable to the Minister.

Casting the net widely

An area of considerable importance concerns the persons on whom the notices may be served. The number is, in fact, quite large. Apart from the licensees themselves, anyone owning an interest in an installation, or who controls or is controlled by such an interest holder, may be served with a notice – where control is equivalent to ownership of half of the issued share capital. The thrust of this provision is simple: the parents, subsidiaries and associates of licensees (e.g. banks) can be served with notices. The net is therefore cast very wide.

Since the abandonment obligation is joint, the Minister may therefore require the well-financed parent of a single licensee to shoulder the entire obligation. Why was such a power included at all? Essentially, a parent company could otherwise choose to bankrupt its North Sea subsidiary to escape its abandonment obligations.

A special problem arose here in relation to pipelines. Would the owner of a spur with a tariff access arrangement to the main pipeline risk being served with a notice for the whole pipeline? An amendment to the Bill removed this risk.

One might well ask whether this emphasis upon comprehensiveness is sensible since it seems likely to lead to a deluge of paper swamping the offices of the Department of Energy. In practice, there is no intention of serving notices as widely as possible. To begin with, notices have been served upon the persons who are in relation to each offshore installation the parties to the relevant Joint Operating Agreement or Unit Operating Agreement – or the holders of the relevant licence where there is no such agreement. The legal power to serve notices more widely is intended to serve as a fall-back in case one or more parties to the Joint Operating Agreement default on their obligations or appear likely to do so.

Currently, the same process is being carried out for pipelines but first they have to be designated by Orders made under Section 33(3) of the Petroleum and Submarine Pipelines Act 1975: agreement has to be reached as to who owns each piece of a pipeline.

Uncertainty

It can be readily objected that the breadth of the British provision will lead to uncertainty as to where the abandonment obligation will fall: so much so that it may put in jeopardy future petroleum development. The Act therefore permits the parties to a Joint Operating Agreement to take early action to protect both themselves and the Government against default. If, by 1 July 1988, the parties to the Agreement had entered into abandonment arrangements, including financial arrangements, which the Minister is satisfied will ensure that a satisfactory abandonment programme will be carried out, he will not serve notices more widely unless the parties to the Agreement default, or appear likely to do so. The submission of such arrangements is entirely voluntary and allows companies to protect their associates, and especially their parents, against the risk of being served notices requiring the submission of an abandonment programme. Some such arrangements have already been made, but none have as yet been submitted to the Department of Energy. Large companies are keen to make such arrangements, but small ones apparently prefer to establish some kind of fund for abandonment costs for which tax relief would be required.

Identifying the parties responsible

It may be worth emphasizing that the serving of a notice is not tantamount to a demand by the Minister that the licensee company or companies should deliver up a full abandonment programme. Serving a notice fixes the obligation upon the party to the Joint Operating Agreement and also permits that person to make representations. Why does this matter? It is bound up with the matter of responsibility for abandonment. The first task in implementing the Act was to establish unequivocally who was responsible for the eventual submission and execution of abandonment programmes. The first group of such persons was the parties to the Agreement in respect of installations and the designated owners in respect of pipelines. Initially, the Department had no comprehensive list of the parties to the Agreement for each installation and indeed the earliest Agreements did not require departmental approval.

This matter was cleared up by sending first a survey letter to all of the operators of oil or gas fields on the United Kingdom continental shelf asking him:

1. To confirm to the Department the identities of co-venturers in the field;
2. To confirm to the Department of Energy the identity of all installations in the field;
3. To inform the Department whether he or his co-venturers intend to submit an abandonment arrangement under Section 3 of the Act before 1 July 1988;
4. To estimate the date of the first abandonment in the field and on the basis of that estimate to state when he would wish to open preliminary discussions with the Department about his abandonment plan. It should be noted that the date is to be provided to assist the Department in planning its own workload and is not designed to bind the operator to a particular time for abandonment.

The second step was to send a "warning letter" to each party to the Agreement. This informs him that, in the Department's view, he is, together with the names of those appended to the letter, a party to the Agreement appertaining to installation 'x'. He is then informed that the Minister has it in mind to serve a notice upon him under Section 1(1) of the Act and he is invited to make written representations if he considers that there are reasons why he should not be served or if there are others who in his view should also be served (within 30 days). In this way a complete and up-to-date list of the parties to the Agreement is obtained in respect of every United Kingdom installation.

Finally, notices were then served under Section 1(1) of the Act on these parties, advising each one of his obligation to submit and execute an abandonment programme at such date as the Minister may subsequently specify. Abandonment notices have therefore been served in a sweeping fashion, *not* on a case-by-case basis. It is quite wrong to conclude from this that recipients of notices will be required to prepare abandonment programmes within a specified period. The bulk of them will be required to do so when the Minister subsequently directs: perhaps between five and seven years before abandonment.

Security agreements

The British Government has also tried to encourage the conclusion of security agreements among parties to a licence – a third tier of legal activity, after the international and national ones. This was the result of a suggestion by the industry itself, which pointed out that since a number of the earlier licences were silent on the matter of abandonment obligations, there was no mechanism whereby the prudent and solvent members of a licence group could protect themselves against a potential defaulting member. To meet this point and deal with the uncertainty issue discussed above, the Government amended its legislation to limit itself in serving notices from doing so on the parents, subsidiaries and associates if it is satisfied that the parties to the Agreement have made adequate arrangements to ensure that a satisfactory abandonment programme will be carried out. From the Government's point of view, there is little need to serve notices upon associates of the parties so long as it can satisfy itself that there is at least one company of substance in a Joint Operating Agreement group who is capable of meeting the bill for abandonment if other members default. The members of the consortium are jointly liable for the removal obligation. From the industry's point of view, the matter is rather different, of course. Each company will be concerned to protect itself from the possibility of default by a fellow member of a consortium. Nor are there general guidelines about the content of a security agreement by the parties to the Agreement since what may be suitable for one group, field or installation may not be appropriate for another.

While nothing in the Act compels parties to enter into a security agreement, the threat of serving notices more widely might encourage companies to conclude such an agreement. Once again, it may be emphasized that the main aim of the Government is to ensure that a satisfactory abandonment programme is carried out. It is therefore an easy matter to be flexible on the means parties choose to adopt to meet this objective.

So far very few of these agreements have been carried out. The main reason seems to be the absence of internationally accepted removal standards against which to plan and uncertainty as to whether toppling of platforms will be permitted. Guidelines from the London Dumping Convention to apply to toppling are, however, not likely to emerge for at least a couple of years.

A procedural point may be worth nothing. There is no right to obtain arbitration on the merits of an abandonment programme. In a few instances, the validity of an act may be challenged in court within 42 days. Challenge is permitted only on the grounds that an act was *ultra vires* or procedurally incorrect.

It should also be noted that beneath the comprehensive structure of legal rules is a bedrock of assurances which have credibility due to the Government's track record of good relations with the oil industry. The process of dealing with programmes is to be dealt with in a similar way to the submission and development of field plans, an interactive and step-by-step process in which problems are ironed out before the programme is submitted for final approval.

An interesting aspect of the process is that parties affected by the abandonment, such as fishermen, are required to be consulted by owners of structures when preparing their abandonment programme. They are required to report on these consultations to the Secretary for Energy. These parties may make representations to the Department of Energy at any time regarding their particular interests. Incidentally, the arguments of the fishing industry for compensation had a negligible impact upon the 1987 Act.

Compared with anything found in Asia, the scope of the United Kingdom law is sweeping. That it could legislate in this manner without damaging investor confidence may be due in part to the continued profitability of the United Kingdom sector and the track record of British Governments in their dealings with the oil industry. However, extensive consultation with the parties involved also played an important role, as did the willingness to take many of their views into account. Moreover, at no point did the Government challenge the basic principle that abandonment costs could be set against taxable income and therefore that the Government itself would face a significant loss of income at the removal stage. Nevertheless, the fact remains that this "consolidation" law imposes significant costs on licensee companies.

For several Asian countries it will be interesting to note that prior to the Act no less than four government departments had the legal power to require removal of disused petroleum structures, although the potential exercise of these powers was unclear. This led to uncertainty about the removal obligation. An important task in designing such legislation would appear to be to channel authority into one, or at most two, bodies.

With respect to taxation, the Act does nothing to change the situation which has prevailed for many years. Changes are in fact being proposed to the Inland Revenue by the industry through the United Kingdom Offshore Operators' Association.

Currently, the British fiscal regime contains three principal taxes:

1. *Royalty*

This is levied at 12.5 per cent of gross revenue but abandonment costs are allowed against royalties in about the same proportion as other capital expenditure. This allowance may be carried back and set against royalties paid during earlier years.

2. *Petroleum Revenue Tax (PRT)*

This tax is levied at 75 per cent on the profits of each individual field after payment of royalty and deduction of capital and operating expenditure. For PRT purposes, it is always possible to carry back abandonment costs against assessable profits where they are incurred for the purposes of safety or the prevention of pollution; refunds which result are repayable with interest.

3. *Corporation tax*

This operates on a company rather than a field basis: the rate is only 35 per cent. Abandonment costs may only be carried back for one year, with the remainder being carried forward indefinitely unless the company ceases to be in business.

Among the proposals for reform of the fiscal system is the idea that the British Government introduce some form of tax-deductible abandonment bond. These could be purchased directly from the Government in advance of abandonment and would be redeemed in order to meet the costs of abandonment. This has the advantage of providing the companies involved with a measure of security, while letting the Government have the use of the funds in the meantime. None the less, it would also reduce company cash flow and its allowance against tax would mark a radical departure from the current fiscal regime.

A similar idea would be to establish an abandonment trust. Contributions would be eligible for immediate relief against all three taxes and it would be invested in a wide range of financial instruments.

The Netherlands

Apart from the United Kingdom, the Netherlands is the only North Sea State with experience of platform removal. It is unique, however, in having developed a system for repayment of removal costs involving a guarantee agreement. This has been in operation for a number of years.

There are currently about 70 petroleum structures in Dutch waters, but the deepest are located in no more than 50 metres of water. This fact, coupled with the heavy use of these waters for shipping, makes total removal seem necessary in all cases. There has, therefore, been much less debate in the Netherlands about the scope for flexibility under international law than in Norway and the United Kingdom.

Legal framework

The Netherlands is a party to the 1958 Geneva Convention on the Continental Shelf, article 5(5) of which requires total removal of offshore structures. The 1967 Mining Regulations (Continental Shelf) have adopted this wording almost literally, with the additional requirement that debris and other material in the vicinity of the platform and connected with its installation, use or removal also have to be removed in so far as they create danger to navigation or fishing. Article 68 of the Regulations states that "a mining installation which is no longer in use must be removed *in toto*" and "the Minister can fix a term within which this has to be done".

The 1967 Regulations also contain notification provisions with regard to the timing of the removal and the obligation to ensure the safety of persons employed in abandonment operations, and of navigation and fishing and of prevention of pollution of the sea. No specific removal requirements have been made with respect to the different types of structures found offshore. The Regulations also give the Minister of Economic Affairs the right to execute unfulfilled obligations of the licensee himself, and the right to take action against the licensee to secure repayment for these costs. This right has recently been introduced into the British system, but has been in article 30 of the Dutch Continental Shelf Mining Act since 1967.

Under the current legal rules, it is not clear whether "total removal" implies a legal obligation to

remove parts of platforms below the seabed. The definition of mining installations in the 1967 Regulations which describe a platform on or above the continental shelf imply that such removal is not required. Pipelines are not currently treated as mining installations within the terms of the Regulations, highlighting a largely unexplored area of potential disagreement over whether pipelines should be subject to a removal requirement similar to petroleum installations⁷. Currently, a draft Ministerial Order is taken into account in these matters⁸. Section 2 of this draft states that pipelines which form an integral part of the mining installation have to be removed. Section 7 states that pipelines connected to mining installations should be cut off, with sufficient clearance, if the pipeline is not to be removed completely. The residue pipeline has to be cleared from oil and gas as far as the pipeline is abandoned and may be left in position when not causing any hindrance to fisheries or the environment.

Security arrangements

The costs of removal are specifically covered by the requirements to provide a financial guarantee or security. Through article 10.3 (c) of the Act, the Minister has the power to include in a licence provisions which oblige the licensee to put up a guarantee for payment of whatever he may eventually owe to the State in his capacity as a licensee. The guarantee works like this.

When announcing a decision in principle to grant a production licence, the Ministry will ask the prospective licensee company or companies to enter into a guarantee arrangement with respect to the cost of removing mining installations. The company or consortia has to put up a bank guarantee (or another equivalent kind of guarantee) covering the costs of removal. This guarantee has to be obtained when at least one half of the reserves have been produced.

For illustrative purposes, a typical agreement is included in annex II.

Fiscal rules

Fiscal arrangements to meet abandonment costs have been in place for some time. Until the mid-1980s two methods of treating abandonment costs for tax purposes were permitted. Firstly, a tax provision was allowed to be built in to meet abandonment costs using

⁷ This is despite the fact that matters concerning pipelaying and maintenance are the responsibility of the Minister of Economic Affairs under the Mining Act Continental Shelf.

⁸ Draft Ministerial Order 20-10-87.

the unit of production depletion method. At the end of each year the provision is calculated by applying the following formula.

a/b x c, under which:

- a = total accumulated hydrocarbon production over the production period through the end of the subject year
- b = the total proven reserves at the end of the year
- c = estimated abandonment expenditures nominated in year-end costs

An increase in the estimated future abandonment costs (e.g. due to inflation) or a decrease in such costs (as a result of improved removal techniques, for example) is automatically reflected in the amount of the provision as stated in the balance sheet at the end of the year.

The difference between the tax provision at the beginning and the end of the year is deducted from taxable income

Alternatively a substantial provision was allowed to be formed at the start of production on the basis of the present value of the estimated future removal costs (with an annual addition to the provision of that years discount only).

Since a decision of the Supreme Court on taxation only the first method mentioned above is allowed, with an important amendment thereto: the annual provision increase is no longer tax deductible in total, but only its interest-discounted value to following years the annual provision increase is increased by the deemed interest to be earned over the provision at the beginning of the year. Through this method the timing of tax deductibility of abandonment costs is substantially deferred to the end of production.

One of the unusual features of the Dutch system is that abandonment costs are fully tax deductible.

Application

The Dutch system is the only comprehensive system for removal in the North Sea which has been tried in practice. By contrast, the single United Kingdom experience occurred in 1978 with the very small West Sole platform weighing about 400 short tonnes, under the rather general arrangements found under the Coast Protection Act 1949. The current system is still at an early stage of development,

resembling a framework set out in an enabling Act to be fleshed out in forthcoming regulations⁹.

By contrast, practical experience of abandonment in the Netherlands is very recent. In February 1988, Pennzoil/Wintershall, the operator of the Noordwinning Group, began the first platform removal on the Dutch continental shelf. This followed consultations with the Ministry of Economic Affairs and other relevant authorities. Within four weeks, the four-pile satellite platform K-13D, in 26 metres of water and weighing about 1,800 short tonnes, was dismantled, lifted and towed away by the Dutch company Heerema Marine Contractors. The platform had been in use for 11 years. This is the first major abandonment in the North Sea and is part of a larger removal project which also includes the K-13C platform¹⁰. Currently, the platform is being used for research purposes.

Norway

There have not yet been any abandonments of petroleum structures in the Norwegian sector of the North Sea. There are only 42 structures in all, compared with 45 in the Netherlands and 159 in the United Kingdom (see table 1). Numbers are deceptive, however, since 8 of these are concrete structures, making removal expensive. Generally, the water depth is far greater than that of the Netherlands and, not surprisingly, the Norwegians share the British concern to establish arrangements which permit flexibility in abandonment regimes, permitting a case-by-case approach to the problem.

There are three significant features of the Norwegian system for removal:

1. Takeover of installations

Under Section 30 of the Act of 22 March 1985 pertaining to petroleum activities, an oilfield installation becomes the property of the State without compensation on expiry of the licence, surrender of all or part of the licence, revocation of the licence or when an installation is no longer to be used; alternatively, the authorities can require the owner to remove it at his own expense or take action to prevent damage or inconvenience being caused. If the State takes over an

⁹ The unforeseen necessity of removing the Piper Alpha platform will provide an early experience of large-scale removal however.

¹⁰ "The removal of Pennzoil/Wintershall K-13D Wellhead Platform", by W. Schoonmade, Heerema Engineering Service B. (unpublished).

installation, this removal obligation no longer applies.

This right to take over an installation is rather surprising; yet it is the first option which the State may take up, with priority over the removal option. Why should the Government wish to take it up at all? Firstly, the State will bear the lion's share of the costs anyway because of the subsidy system (see below) and through State participation. On new fields the total percentage which the State will have to bear will be up to 96 per cent on the new and 80 per cent on the older fields. The extra costs might not appear to be so very high.

Moreover, where installations would be difficult to remove, one would assume that the State would only be interested in taking over when a long-life field is involved, such as the Gullfaks field, where a long production life is expected. The profit accruing after the licence has expired can then go entirely to the State and may outweigh the costs of removal.

2. *Tax deductibility*

Removal costs are deductible for tax purposes when the removal takes place. Allocations to cover future removal of offshore petroleum installations are nevertheless not deductible for tax purpose, according to the Act of 22 December 1978. This raised the problem of the licensee not having sufficient income in Norway to cover removal costs when it takes place. In discussions over a draft new tax law, it has been proposed that licensee companies, including the NOC Statoil, should be given a direct subsidy to compensate for the extra tax burden following on the non-tax-deductibility of removal costs. This subsidy will not be subject to taxation. As in the United Kingdom, it is the State (in this case, Parliament), which has the authority to decide on removal as well as to grant the amount necessary to cover the refund of the removal costs.

3. *Provision of security*

As in the United Kingdom and the Netherlands, Norway has addressed the issue of security for payment of removal costs. Under Section 55 of the above Act, all licensee companies are obliged to provide the Government with guarantees against all their obligations, including removal obligations. For subsidiary companies, the guarantees must be provided by the parent, either directly or through an intermediate holding

company. This may take effect when the licence is granted or at a later date.

Section 30 of the Act also applies to pipelines since it refers to Section 24 of the Act, providing a licence requirement for pipelines used in connection with exploration and production from the Norwegian continental shelf.

The model production licence does not make specific provision regarding the obligation to remove facilities on abandonment.

Discussion of new abandonment measures in Norway has continued for several years and new legislation has recently been drafted. The urgency which was present in the context of the United Kingdom has not been apparent in Norway, at least not among the legislators. The influential fishery interests, arguing for total removal in all cases, have also played a more vocal role in discussion of the issue.

The removal provision

"When a licence expires, is wholly or partly surrendered or the use of the installations as mentioned in Sections 23 and 24 has terminated for good, the State has the right to take over, free of charge, such permanent installations with accessories, as well as all material pertaining to them. The same applies to revocation pursuant to Section 62; however, the King will decide to what extent compensation shall be paid for investments made, and this decision will be binding.

The demand for takeover shall be presented not later than concurrently with the expiry of a licence and otherwise no later than six months after the licence has lapsed in other ways or the use of the installations has been terminated for good.

At the takeover, the installations with equipment shall be in such a condition as prudent maintenance indicates. Disputes regarding this, and, if applicable regarding the compensation to be paid to the State for lack of maintenance, shall be determined by a court of appraisal.

Instead of taking over the installations in accordance with the first paragraph, the Ministry may enter into an agreement with the owner for temporary use of the installations.

If the State does not wish to take over installations with accessories, the Ministry may require, within two years after the use of the installations has been terminated for good, and in any case within two years

after the licence has ceased to apply, that the installations shall be wholly or partly removed within a time-limit stipulated by the Ministry, or that measures shall be taken to prevent them from causing any damage or inconvenience. The obligation to remove installations etc. rests with the owner of the installations at any time. Ownership of the installations may not be transferred without the Ministry's consent. If demands as mentioned above are not complied with, the Ministry may undertake the necessary measures for the owner's account and risk. The cost of such measures may be collected by distraint.

In the event that the State, after the expiry of the recovery licence or after the use of the installations has been terminated for good, requires that the installations shall cease to be removed, the security for debts thereon will cease to be effective. The same applies if the State takes over the installations in such case, though rights of use established with the Ministry's consent will remain.

The "state of play"

In developing standards of removal, the North Sea countries are clearly inhibited by the absence of officially recognized international standards. Nevertheless, their actions so far indicate that a wide range of mechanisms are available to tackle the various problems arising from platform removal. Hopefully, the foregoing review will have shown that the removal of offshore petroleum structures is much more than a challenge to engineering skills. It also presents a challenge to those responsible for ensuring that a nation's petroleum regime is designed to cope with all the problems of exploration, development and production.

The most recent issue concerning abandonment emerging from the North Sea context is one likely to tax the skills of these officials to their limits. This is the issue of residual liability or the many possible problems of continuing liability after the due completion of an abandonment programme. For private companies and the national oil companies, this is likely to become a major concern. It takes two forms: firstly, there is the continuing liability to mark and maintain any residues of platforms which remain (How are the costs of maintenance and inspections to be treated in a tax-effective manner?); secondly, there is the unknown factor of continuing civil liability for any damage caused by or alleged to have been caused by part of an installation being allowed to remain after abandonment (a nuclear submarine caught on a platform stump?). Whether or not this will turn out to be the major problem

area which some people fear, it is certainly attracting much scrutiny in the North Sea at the present time.¹¹

Conclusion: relevance of the North Sea experience to Asia and the Pacific

1. Offshore petroleum structures in the ESCAP region are located in relatively shallow waters and will therefore be subject to the "total removal" requirement in international law. While the average cost of removing individual structures will be considerably less than in the North Sea, the resources available to meet the government contribution are also much less.
2. Only one of the Asian countries examined in this report has made detailed legislative provisions to deal with the removal of offshore petroleum structures. The favoured approach is to incorporate a clause in the petroleum contract or concession which puts the operator under a general obligation to abandon at the end of a field's production life. Such provisions ignore the complex issues concerning the method of cost repayment and enforcement in the event of default on obligations which have figured largely in the North Sea debate on removal. At a time of volatile oil prices, the faith which Asian countries are placing in these broad requirements appears naive. It is not shared by the coastal States of the North Sea, where admittedly the costs are higher and the risks of default correspondingly greater.
3. The single exception is Thailand, which has a legal framework for removal of offshore petroleum structures. Although detailed, it appears on examination to be open-ended in its requirements. Ultimately the extent of removal which will in fact be required will be determined by discussions between the Government and the petroleum industry. There is no provision requiring information submission which would permit officials to critically assess a removal programme put to it.
4. The ability of oil companies to treat abandonment costs as tax deductible in many countries means that the lack of government control over the

¹¹ It should be noted that the IMO Draft Guidelines and Standards do in fact address this issue: "The coastal State shall ensure that legal title to installations and structures which have not been totally removed from the seabed is unambiguous and that responsibility for the maintenance and the financial ability to assume liability for future damages are clearly established".

removal process could lead to a significant loss of revenue. For this reason alone some measures ought to be taken to develop a legal regime for abandonment; at the very least a guarantee of payment should be sought from the concessionaire, perhaps along the lines of the one used in the Netherlands.

5. The imminent conclusion of internationally agreed guidelines and standards on removal gives coastal States an excellent opportunity to act to remedy these gaps. They will be the most significant developments at the international level for some years to come. Asian States should act to adapt and incorporate these standards to suit their domestic requirements. The legislative programme might benefit from technical assistance from organizations in the United Nations system, including IMO and ESCAP. This could ensure that the development of particular sets of national regulations took account not only of the published guidelines and standards but also of the various approaches to removal problems which have been adopted or which have been considered in countries outside the Asian region. Given the diverse circumstances and needs of the countries examined in this report, it will be useful to conduct comparative studies not only of removal regimes in various countries in one region but also of the role given to one particular group of users in a variety of regimes: for example, the fisheries industry. Brunei Darussalam might wish to draft a set of regulations which are particularly suitable to the policy aim of developing an indigenous fishing industry. Indonesia will seek to give particular weight to the role of shipping and the need for safety of navigation in its waters. Japan will have little choice but to give the maximum protection to its well established fishing interests. On these issues the IMO Draft Guidelines and Standards represent a compromise between different users of the sea which may not be satisfactory to one or more countries of the ESCAP region. However, the Guidelines and Standards permit sufficient flexibility in their implementation to allow coastal States to shape regulations to give proper weight to their individual policy priorities.

6. Abandonment of offshore petroleum structures touches on a wide range of issues. It therefore requires a diverse combination of skills and expertise to produce regulations applying to it. A measure of the overlapping types of expertise can be seen in the problem of overlapping jurisdiction faced by the United Kingdom and, in the Asian

region, by China. The development of a new set of regulations by a coastal State will require a specific type of technical assistance, including advice on navigational, fishing, petroleum and defence matters as well as access to comparative studies of the treatment of particular issues in national regimes. Fishing is an example of the latter. As renewable resources, fish have longer-term advantages than petroleum resources, being finite. In the debates within IMO, some countries and organizations have made it clear that greater weight should be given to the protection of these renewable resources than that which follows from the Draft Guidelines and Standards. Some countries in the ESCAP region will want to develop regulations which give greater weight to the long-term use of these renewable resources than is implied from the Draft Guidelines and Standards.

Finally, it should be noted that the IMO document is just what it says: a set of guidelines is no more than a beginning and standards have to be incorporated in a set of national regulations to have the force of law in a coastal State.

7. The reluctance of government officials in some countries to consider new legislation is distinctly odd in the light of North Sea experience. For several years a draft law on payment of removal costs has been in force in Norway, while in the United Kingdom a law was enacted in 1987 specifically designed to extend government control over oil operations concerning removal. The British legislation is both sweeping in scope, requiring licensee companies to submit abandonment programmes when the Department of Energy notifies them that they must do so, and draconian in the penalties which it attaches to non-compliance (both civil and criminal law penalties apply). Companies and officers may be found guilty and there is no right to arbitrate on the merits of an abandonment programme. Appeal to the courts may only be made on the grounds that an act was procedurally incorrect or *ultra vires*. In the near future regulations will be promulgated in the United Kingdom treating removal matters in great detail and creating the most regulated environment in the North Sea, and probably in the world. Ironically, one of the reasons for introducing this framework was to remove uncertainty about the consequences of removal in the United Kingdom sector. In the Netherlands too, new legislation has been considered and may follow the adoption of the IMO Draft Guidelines and Standards.

Asian countries should not hesitate to use legislation in the form of new regulations. Such measures alter the framework in which concessions and contracts are effected but do not necessarily alter the terms of agreements themselves. The principle of *pacta sunt servanda* should certainly be respected, particularly in an investment climate which is not very favourable to the development of the petroleum sector. However, it is not necessary to alter the agreements directly if there is some general clause relating to removal already in the agreements. This is frequently the case. It is therefore quite compatible with a host Government's sovereignty to enact legislation on this issue. Consultations with the affected parties in the normal manner would surely help to ease any anxiety among present or potential investors.

Put more strongly, the legislative experience of North Sea States so far and the likelihood that more legislation will soon follow, coupled with the imminent settlement of doubts at the international level about the law of the sea on this matter, shift the responsibility to take action onto host Governments.

8. There is every reason to believe that action by host Governments will assist both private and public sector oil companies, plus their bankers, to focus their minds more positively on this issue. For several years a problem in the United Kingdom North Sea was the reluctance of oil companies to act with respect to removal obligations. As soon as legislation was announced, this situation altered and companies addressed themselves to matters of detail such as liability for default by parties to a joint venture.
9. It is very clear from the North Sea experience that security agreements are required to give affect to guarantee schemes. These should require all members of the concession to provide in a particular form and from a particular source a guarantee from a third party that the guaranteed company will contribute its share of the cost of abandoning the group's installations. In the event of failure, the guarantor will himself become liable to the other members of the group for such a share.

It is also very clear that such guarantees can only come from either parent companies of concession companies or from banks. The provision of such guarantees by companies may become standard in the international oil industry and draw in many

international banks. This is already happening in the North Sea. Each of the three States treated in the report has taken legal measures to deal with the need for security. The Netherlands has the most developed approach. Arbitration is the method chosen for settlement of difference of opinion, it is also favoured in Norway but not in the United Kingdom. Legal recourse to parties not directly involved in the concession has been taken in the British Act of 1987, albeit controversially. Asian countries should study the various schemes with a view to ascertaining the measures that are required to provide them with the security they currently lack.

10. Provision for removal costs is a crucial issue which has been largely ignored in the Asian context. The North Sea countries have faced up to the two major accounting problems squarely here:
 - (1) How to build up a provision fairly over the life of a field which will cover the eventual costs;
 - (2) How to ensure that the amount of that provision is actually available at the time it is required.

One way of resolving the issues is to adopt the Dutch approach, which is based on the idea that the amount of estimated abandonment costs can be required by the Minister in the form of a parent company or bank guarantee. The oil industry is apparently satisfied with this system, which is both straightforward and not excessively onerous.

The Norwegian approach is quite different but, like the Dutch approach, is based on an unwillingness to provide companies with any tax relief in the lifetime of the field. A direct subsidy is to be given retroactively, fixed at the time of actual removal, summing up all tax savings which would be made during the field's lifetime if a yearly tax deduction on a unit of production basis would have been allowed. Arbitration is envisaged in cases of disagreement.

The system has at least four advantages:

- (1) Accuracy. The subsidy will be defined afterwards and fixed on the basis of the annual yearly income, production and reserves. The removal costs themselves will be estimable very precisely.
- (2) The extent of a removal obligation is not relevant. The State merely guarantees that a subsidy will be given, if removal is required.

- (3) The system does not require any moves towards the rather advantageous tax system used by the Dutch; it leaves current petroleum fiscal arrangements alone.
- (4) The principle that removal costs ought to be tax deductible is not challenged by this system. This is a sensitive area which it may be best to avoid in legislation.
11. Both Norway and the United Kingdom have made it clear that they regard the decision on whether a platform should be removed or not as a sovereign prerogative. Like the decision to develop a petroleum field, the decision on removal is very important. Even if it is the outcome of extensive negotiations with the oil company or companies concerned, in which their advice has played a major role, it should in form at least be a decision taken by the host Government. This is a right which Asian Governments should ensure they possess.
12. The removal decision should not rest with the national oil company, which may have a vested interest in the outcome of such a decision.
13. Legal provisions should be drafted in such a way as to permit a company to volunteer an abandonment programme for government approval at an early stage if it wishes. The United Kingdom has shown itself willing to entertain such proposals informally, while leaving untouched the official right to initiate a programme.
14. An issue deserving special attention in the Asian region is the impact of PSCs upon the issue of removal. This puts responsibility squarely on the shoulders of the National Oil Company and creates special difficulties in making provision for removal costs. North Sea experience is not helpful in dealing with this matter since the basic petroleum regimes are quite different (although one might look at the role of Statoil in the emerging Norwegian system to ascertain whether Norway is different from the other North Sea States despite having the same basic concession regime). There is a case for holding a special workshop on the ways of dealing with the legal, fiscal and accounting problems raised by this system. The regulations on removal required will in some respects take a quite different form.

ANNEXES

Annex I

IMO DRAFT GUIDELINES AND STANDARDS FOR THE REMOVAL OF OFFSHORE INSTALLATIONS AND STRUCTURES ON THE CONTINENTAL SHELF AND IN THE EXCLUSIVE ECONOMIC ZONE

1. General removal requirement

- 1.1 Abandoned or disused offshore installations or structures on any continental shelf or in any exclusive economic zone are required to be removed, except where non-removal or partial removal is consistent with the following guidelines and standards.
- 1.2 The coastal State having jurisdiction over the installation or structure should ensure that it is removed in whole or in part in conformity with these guidelines and standards once it is no longer serving the primary purpose for which it was originally designed and installed or a subsequent new use or no other reasonable justification cited in these guidelines and standards exists for allowing the installation or structure or parts thereof to remain on the seabed. Such removal should be performed as soon as reasonably practicable after abandonment or permanent disuse of such installation or structure.
- 1.3 Notification of such non-removal or partial removal should be forwarded to the Organization.
- 1.4 Nothing in these guidelines and standards is intended to preclude a coastal State from imposing more stringent removal requirements for existing or future installations or structures on its continental shelf or in its exclusive economic zone.

2. Guidelines

- 2.1 The decision to allow an offshore installation, structure, or parts thereof to remain on the seabed should include a case-by-case evaluation by the coastal State with jurisdiction over the installation or structure of the following matters:
 1. Any potential effect on the safety or surface or subsurface navigation, or of other uses of the sea;
 2. The rate of deterioration of the material and its present and possible future effect on the marine environment;

3. The potential effect on the marine environment, including living resources;
 4. The risk that the material will shift from its position at some future time;
 5. The costs, technical feasibility, and risks of injury to personnel associated with removal of the installation or structure; and
 6. The determination of a new use or other reasonable justification for allowing the installation or structure or parts thereof to remain on the seabed.
- 2.2 The determination of any potential effect on safety of surface or subsurface navigation or of other uses of the sea should be based on the number, type and draught of vessels expected to transit the area in the foreseeable future; the cargoes being carried in the area; the tide, current, general hydrographic conditions and potentially extreme climatic conditions; the proximity of designated or customary sea lanes and port access routes; the aids to navigation in the vicinity; the location of commercial fishing areas; the width of the available navigable fairway; and whether the area is an approach to or in straits used for international navigation routes used for international navigation through archipelagic waters.
 - 2.3 The determination of any potential effect on the marine environment should be based upon scientific evidence taking into account the effect on water quality; geologic and hydrographic characteristics; the presence of endangered or threatened species; existing habitat types; local fishery resources; and the potential for pollution or contamination of the site by residual products from or deterioration of the offshore installation or structure.
 - 2.4 The process for allowing an offshore installation or structure or parts thereof to remain on the seabed should also include the following actions by the coastal State with jurisdiction over the installation or structures: specific official

authorization identifying the conditions under which an installation or structure or parts thereof will be allowed to remain on the seabed; a specific plan, adopted by the coastal State, to monitor the accumulation and deterioration of material left on the seabed to ensure there is no subsequent adverse impact on navigation, other uses of the sea or the marine environment; advance notice to mariners as to specific position, dimensions, surveyed depth and markings of any installations or structures not entirely removed from the seabed; and advance notice to appropriate hydrographic services to allow for timely revision of nautical charts.

3. Standards

The following standards should be taken into account when a decision is made regarding the removal of an offshore installation or structure.

- 3.1 All abandoned or disused installations or structures standing in less than 75 metres of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure, should be entirely removed.
- 3.2 All abandoned or disused installations or structures emplaced on the seabed on or after 1 January 1998, standing in less than 100 metres of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure, should be entirely removed.
- 3.3 Removal should be performed in such a way as to cause no significant adverse effects upon navigation or the marine environment. Installations should continue to be marked in accordance with IALA recommendations prior to the completion of any partial or complete removal that may be required. Details of the position and dimensions of any installations remaining after the removal operations should be promptly passed to the relevant national authorities and to one of the World Charting Hydrographic Authorities. The means of removal or partial removal should not cause a significant adverse effect on living resources of the marine environment, especially threatened and endangered species.
- 3.4 Where:
 1. an existing installation or structure, including one referred to in paragraphs 3.1 or 3.2, or a part thereof, will serve a new use if permitted to remain wholly or partially in place on the seabed (such as

enhancement of a living resource); or

2. an existing installation or structure, other than one referred to in paragraphs 3.1 and 3.2, or part thereof, can be left there without causing unjustifiable interference with other uses of the sea;

the coastal State may determine that the installation or structure may be left wholly or partially in place.

- 3.5 Notwithstanding the requirements of paragraphs 3.1 and 3.2, where entire removal is not technically feasible or would involve extreme cost, or an unacceptable risk to personnel or the marine environment, the coastal State may determine that it need not be entirely removed.
- 3.6 Any abandoned or disused installation or part thereof which projects above the surface of the sea should be adequately maintained to prevent structural failure. In cases of partial removal referred to in paragraphs 3.4.2 or 3.5, an unobstructed water column sufficient to ensure safety of navigation, but not less than 55 metres, should be provided above any partially removed installation or structure which does not project above the surface of the sea.
- 3.7 Installations or structure which no longer serve the primary purpose for which they were originally designed or installed and are located in approaches to or in straits used for international navigation or routes used for international navigation through archipelagic waters, in customary deep-draught sea lanes, or in or immediately adjacent to routing systems which have been adopted by the Organization should be entirely removed and should not be subject to any exceptions.
- 3.8 The coastal State should ensure that the position, surveyed depth and dimensions of material from any installation or structure which has not been entirely removed from the seabed are indicated on nautical charts and that any remains are, when necessary, properly marked with aids to navigation. The coastal State should also ensure that advance notice of at least 120 days is issued to advise mariners and appropriate hydrographic services of the change in the status of the installation or structure.
- 3.9 Prior to giving consent to the partial removal of any installation or structure, the coastal State should satisfy itself that any remaining materials will remain on location on the seabed and not move under the influence of waves, tides,

currents, storms or other foreseeable natural causes so as to cause a hazard to navigation.

- 3.10 The coastal State should identify the party responsible* for maintaining the aids to navigation, if deemed necessary to mark the position of any obstruction to navigation, and for monitoring the condition of remaining material. The coastal State should also ensure that the responsible party* conducts periodic monitoring, as necessary, to ensure continued compliance with these guidelines and standards.
- 3.11 The coastal State should ensure that legal title to installations and structures which have not been entirely removed from the seabed is unambiguous and that responsibility for maintenance and the

* The phrase "party responsible" refers to any juridical or physical person identified by the coastal State for a purpose mentioned in the paragraph.

financial ability to assume liability for future damages are clearly established.

- 3.12 Where living resources can be enhanced by the placement on the seabed of material from removed installations or structures (e.g. to create an artificial reef), such material should be located well away from customary traffic lanes, taking into account these guidelines and standards and other relevant standards for the maintenance of maritime safety.
- 3.13 On or after 1 January 1989, no installation or structure should be placed on any continental shelf or in any exclusive economic zone unless the design and construction of the installation or structure is such that entire removal upon abandonment or permanent disuse would be feasible.
- 3.14 Unless otherwise stated, these standards should be applied to existing as well as future installations or structures.

Annex II

NETHERLANDS: MODEL GUARANTEE AGREEMENT FOR REMOVAL COSTS

Agreement between the State of the Netherlands, for these presents represented by the Minister of Economic Affairs, and the holders of a production licence covering sections of the continental shelf acreage designated as a block.

The State of the Netherlands, for these presents represented by the Ministry of Economic Affairs, acting in his capacity of Minister in charge of the implementation of the Continental Shelf Mining Act, 1955 (Official Journal 428), (hereinbelow called "the Minister"),

and

as holders of the gas and/or oil production licence granted by the Minister of Economic Affairs on .., No..., for (parts of) block ... as marked on the map appended as an attachment to the Royal Decree of 6th February 1976 (Official Journal 102) in implementation of Section 12 of the said Act (hereinbelow called "the licensees")

whereas

each of the licensees recognizes that it is under the obligation mentioned in section 68 of the Continental Shelf Mining Regulations (Decree of 14th March 1967, Official Journal 158) – all the foregoing to the extent that such an obligation remains in force – to remove from the continental shelf such mining installations (not including pipelines) as have been erected by or on behalf of the licensees but are no longer in use, except in the event that this obligation is taken over by another (licensee) with the approval of the Minister of Economic Affairs;

each licensee recognizes moreover that in the event of non-compliance with this obligation, the Minister of Economic Affairs may cause the prescribed measure to be carried out at its expense;

to make certain that such costs shall be recoverable, it is desirable for an arrangement to be made under which the licensees shall provide security at such time as the Minister may desire;

do hereby declare that they have agreed as follows:

Article 1

The licensee(s) shall be liable for payment of the security demanded by the Minister for the cost of removing the mining installations, as provided for by article 6, paragraph 1, article 7, paragraph 4 and article 9, paragraph 1, respectively, except for the DSM-Aardgas BV share thereof on account of a State interest.

Article 2

The Minister shall not demand such security until at least half of the economically producible reserves of the acreage covered by the aforesaid licence and for the production of which the mining installations have been erected, has been extracted.

Article 3

1. To enable the Minister to judge whether it is desirable to demand provision of a security at the time mentioned in article 2 or a later date, the licensee(s) shall be obliged to notify the Minister of Economic Affairs at least six months prior to the date by which half of the reserves mentioned in article 2 can be assumed on a reasonable estimate to have been extracted;
2. The Minister shall be entitled at all times to require the licensee(s) to furnish additional information for the purpose of verifying the time mentioned in article 2;
- 2.4 The process for allowing an offshore installation or structure or parts thereof to remain on the seabed should also include the following actions by the coastal State with jurisdiction over the installation or structure: specific official authorization identifying the conditions under which an installation or structure or parts thereof will be allowed to remain on the seabed; a specific plan, adopted by the coastal State, to monitor the accumulation and deterioration of material left on the seabed to ensure there is no subsequent adverse impact on navigation, other uses of the

sea or the marine environment; advance notice to mariners as to the specific position, dimensions, surveyed depth and markings of any installations or structures not entirely removed from the seabed; and advance notice to appropriate hydrographic services to allow for timely revision of nautical charts.

3. Standards

The following standards should be taken into account when a decision is made regarding the removal of an offshore installation or structure.

- 3.1 All abandoned or disused installations or structures standing in less than 75 metres of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure, should be entirely removed.
- 3.2 All abandoned or disused installations or structures emplaced on the seabed on or after 1 January 1998, standing in less than 100 metres of water and weighing less than 4,000 tonnes in air, excluding the deck and superstructure, should be entirely removed.
- 3.3 Removal should be performed in such a way as to cause no significant adverse effects upon navigation or the marine environment. Installations should continue to be marked in accordance with IALA recommendations prior to the completion of and partial or complete removal that may be required. Details of the position and dimensions.
- 3.4 Within three months after receipt of a notification as mentioned in article 3, paragraph 1, or a statement as mentioned in paragraph 1, or a statement as mentioned in paragraph 3 of that article, the Minister shall decide the term and amount of security for the removal cost which shall be provided.

Article 6

1. Without prejudice to the provisions of article 1, the amount of the security shall never exceed the amount of the removal cost as estimated by the licensee(s) pursuant to article 4, under c, or agreed on pursuant to article 7, paragraph 1, or fixed with binding effect pursuant to article 7, paragraph 2, and accepted by the Minister of Economic Affairs.
2. The licensee(s) shall be obliged to provide the security at the time fixed by the Minister pursuant to article 5, paragraph 2, and at the total amount fixed pursuant to that article in conjunction with

article 6, paragraph 1, in the form of a bank guarantee or a company guarantee or in another form as proposed by the licensee(s), and which in the judgement of the Minister may be equated therewith.

3. The Minister shall not on unreasonable grounds withhold his consent to a guarantee in a form other than a bank guarantee as proposed by the licensee(s) in accordance with the preceding paragraph.
4. Irrespective of the form of guarantee chosen or accepted by the Minister, the following provisions shall apply in this respect:
 - a. In the event that there is a group of licensees, each licensee shall provide its share of the security – in proportion to its share of the licence – at the time fixed by the Minister;
 - b. Should one or more licensees fail to provide the security as mentioned under a. at such time, following a written demand from the Minister, the other licensees shall, within 60 days after the date of the Minister's demand, pay the missing share in a form accepted or to be accepted by the Minister;
 - c. In the event that the total security has not been provided at the time mentioned under b., the Minister may claim payment of the missing share in such form as the Minister shall fix, by one licensee at the Minister's discretion within 14 days after a written demand for payment. Such licensee shall be obliged to comply.
5. The licensee(s) shall maintain the security provided for as long as and to the extent that removal of the mining installations in respect of which it has been provided has not been completed, save in the event that the whole or partial removal obligation plus the security provided in that respect has been transferred to another (licensee) with the approval of the Minister of Economic Affairs.

Article 7

1. Contrary to the provisions of article 5, paragraph 2, the Minister shall invite the licensee(s) within the time-limit fixed in that paragraph for further consultation in the event that he does not agree with the statement made as to the amount of the removal cost. Failing agreement in such consultation within three months after its

commencement, the amount of the said cost shall be fixed by an independent expert (organization) to be appointed by the licensee(s) and the Minister of Economic Affairs in joint consultation.

2. Fixation by such expert (organization) shall be binding on the parties.
3. The cost of such a binding award shall be borne jointly by the licensee(s) and the Minister of Economic Affairs.
4. The Minister shall be entitled to demand from the licensee(s) a provisional security amounting to the removal cost as estimated by the licensee(s) in good faith, for the term until the further consultation on, or the binding fixation of the amount of, the removal cost as mentioned in the first paragraph of this article, has been completed.
5. The licensee(s) shall be obliged to provide such security within the time-limit to be fixed by the Minister and to maintain it so provided until the dispute over the amount of the removal cost has been finally settled.

The provisions of article 6, paragraph 4, under 1. to c. inclusive, shall apply accordingly.

Article 8

Should one or more licensee(s) give up its (their) stake(s) in the production of the ... field, the remaining licensee(s) shall be obliged to continue the total security provided for the removal cost.

Article 9

1. Every other year, by 1st April at the latest, the licensees shall send the Minister of Economic Affairs a statement of the then estimated amount

of the removal cost, accompanied by a list of possible changes in the statement mentioned in article 4, on the basis of which the Minister will – if necessary – fix an adequate adjustment of the amount of the security provided.

2. Articles 5 sqq. shall apply accordingly to the fixation by the Minister of Economic Affairs and the provision of security.

Article 10

The arrangement on the provision of security for the cost of removing mining installations erected in the licence acreage for the production of a field with a boundary-straddling structure shall be made in the manner as laid down in the preceding articles. The licensee responsible for operations in the field in question shall as far as possible also present in that respect the holder(s) of the licence covering the acreage into which the said structure continues.

Article 11

Without prejudice to the provisions of Section 68 of the Continental Shelf Mining Regulations, the mining installations shall be removed to such an extent as the Minister of Economic Affairs shall determine, which shall be reasonably commensurate with the safety of shipping and fisheries that requires to be guaranteed.

Article 12

The licensee responsible for operating the ... field shall represent the other licensees *vis-à-vis* the Minister of Economic Affairs in respect of the arrangement made under this agreement.

TABLES

Table 1. North Sea: Number and types of platforms

	<i>Floating</i>	<i>Fixed steel</i>	<i>Fixed concrete</i>	<i>Other</i>	<i>Total</i>
Denmark	3	24			27
Germany		1		1*	2
Netherlands		45			45
Norway	1	33	8		42
United Kingdom	5	144	10		159
Total	9	247	18	1	275

* An artificial island consisting of a caisson filled with sand and topped with concrete

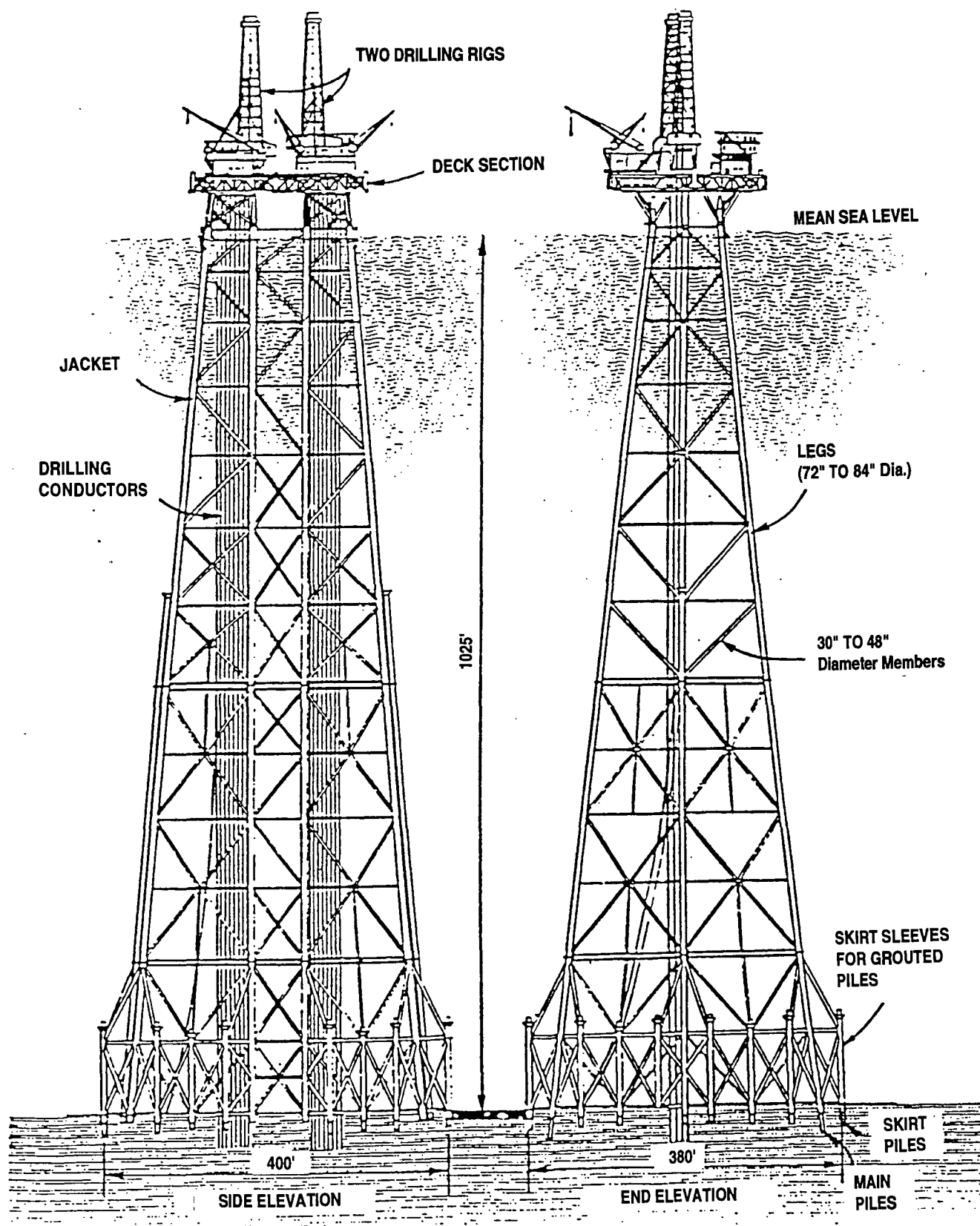
Table 2. North Sea: Tabulation of water depths

<i>Depth (metres)</i>	<i>Floating</i>	<i>Fixed steel</i>	<i>Concrete</i>	<i>Total</i>
0 - 50	3	170		173
51 - 70		4		4
71 - 100	1	34	3	38
101 - 130	1	13	4	18
131 - 160	3	11	11	25
> 160		4		4

These figures do not include all the Norwegian platforms recorded in table 1.

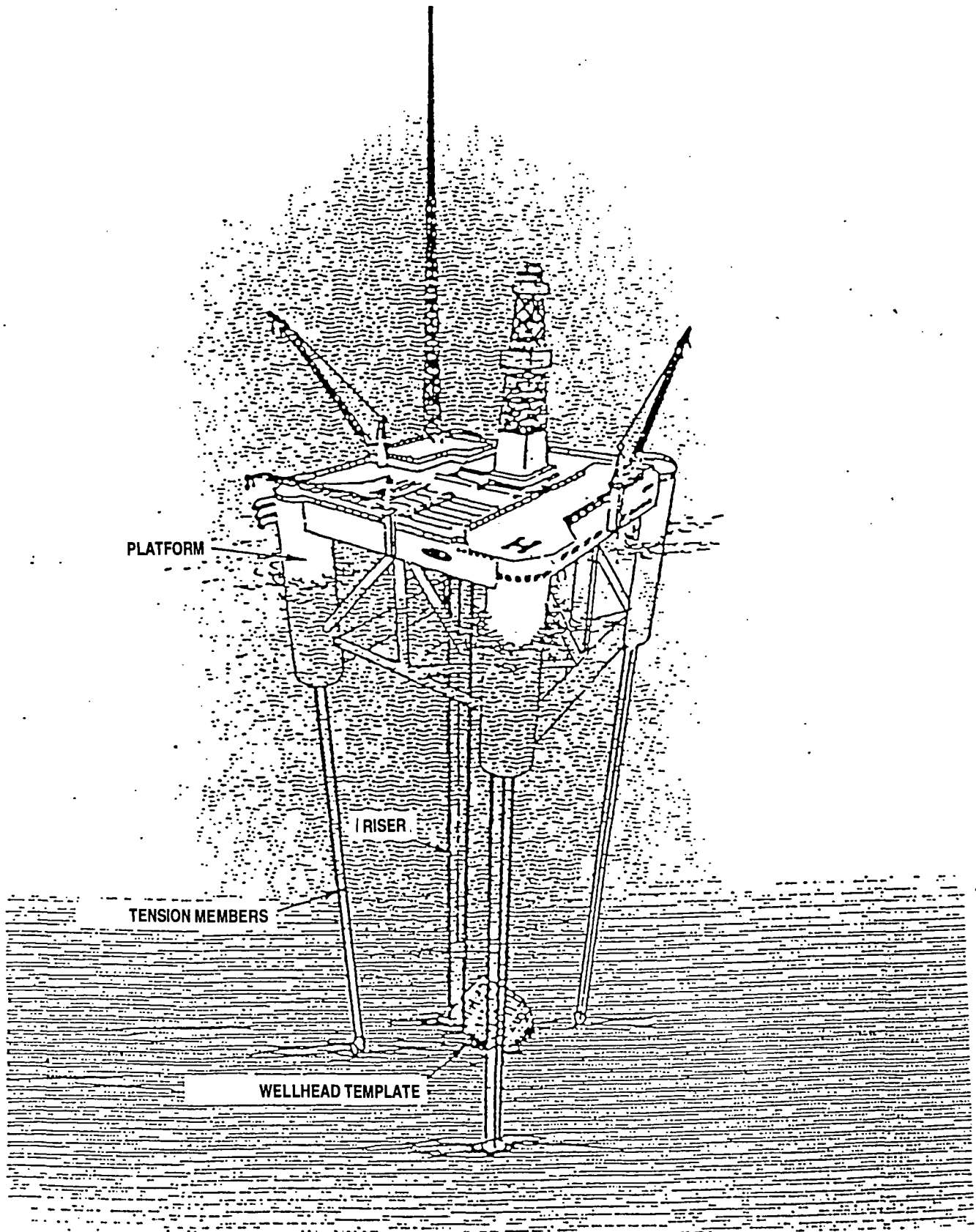
Table 3. North Sea: Platform removal strategies, likely timetable and estimated costs

<i>Country</i>	<i>Number of platforms</i>	<i>Removal strategy</i>	<i>Likely timetable</i>	<i>Disposal options</i>	<i>Estimated costs of removal</i>
Denmark	27	?	From the late 1990s	?	No information
Germany	2	Platforms to be removed down to seabed	?	Shore disposal being considered for steel platform. Caisson may remain as artificial island. No dumping.	No information
Netherlands	45	All platforms to be removed entirely	From early 1990s (Expected average: 1 per year) (one removed in 1988)	Shore disposal	No information
Norway	42	To lay down provisions for removal in Norwegian law compatible with international law and practice	From 1997-2000	Not yet considered	Estimated at 40-60 billion Nkr for total removal of all platforms
United Kingdom	159	Each platform to be considered on its merits but taking account of the following principles: a. Floating platforms to be removed entirely; b. Fixed steel platforms in depths up to 55 m to be removed entirely; c. Fixed steel platforms in depths greater than 55 m to be entirely or partially removed in accordance with international standards; d. Concrete platforms: not yet determined.	From early 1990s (one small, shallow-water fixed steel platform already removed).	Not yet decided but options being considered include: a. Dumping in a deep water site; b. Dumping <i>in situ</i> ; c. Disposal on land. Dumping at sea will only be permitted if studies show that such disposal will not have an unacceptable impact on the marine environment or other legitimate users of the sea.	Estimated at 6 billion pounds (1984 prices) for total removal; 4-5 billion pounds for partial removal.



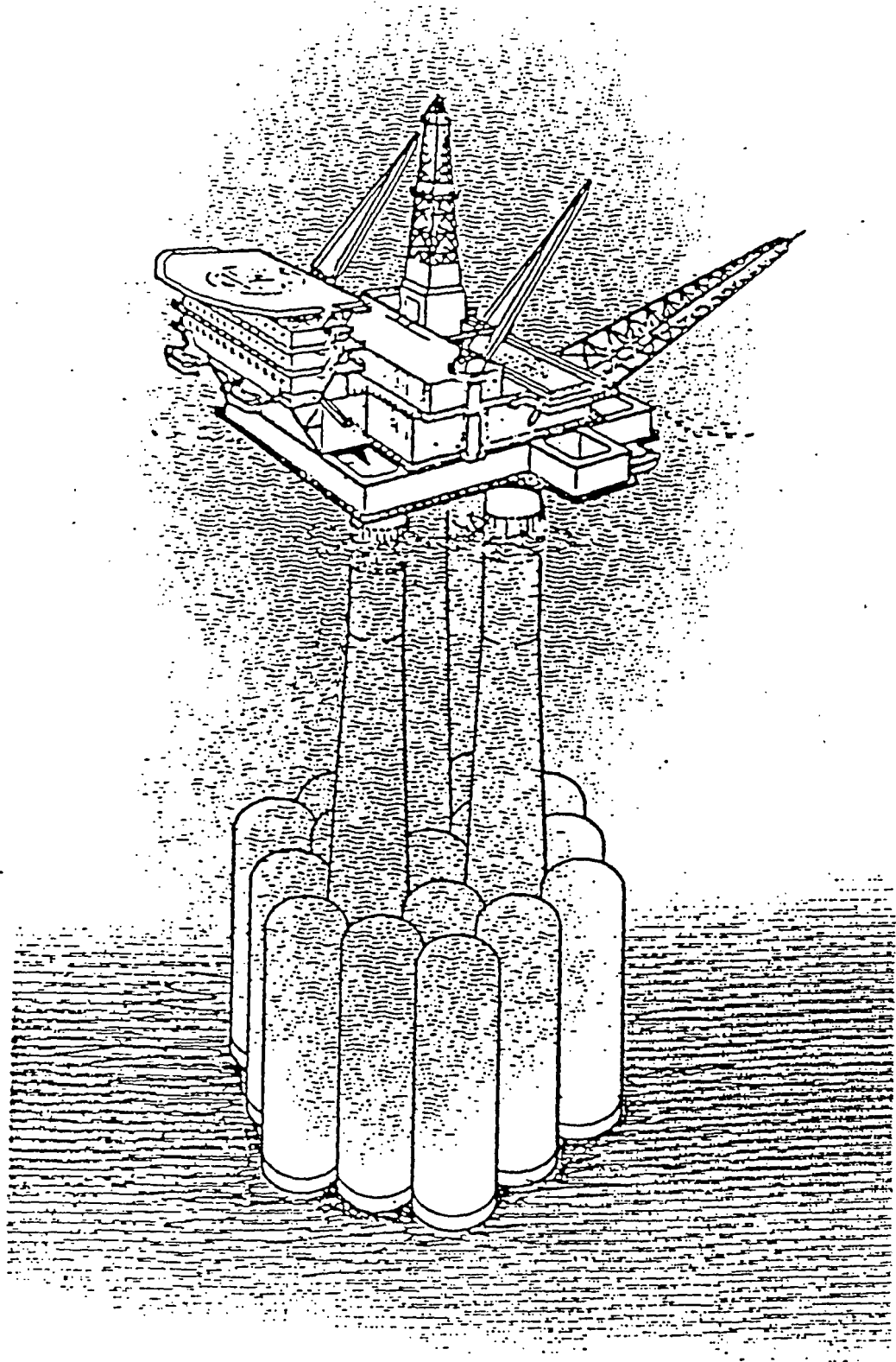
Source: Shell Oil Company.

Figure 1. Deep-water platform.



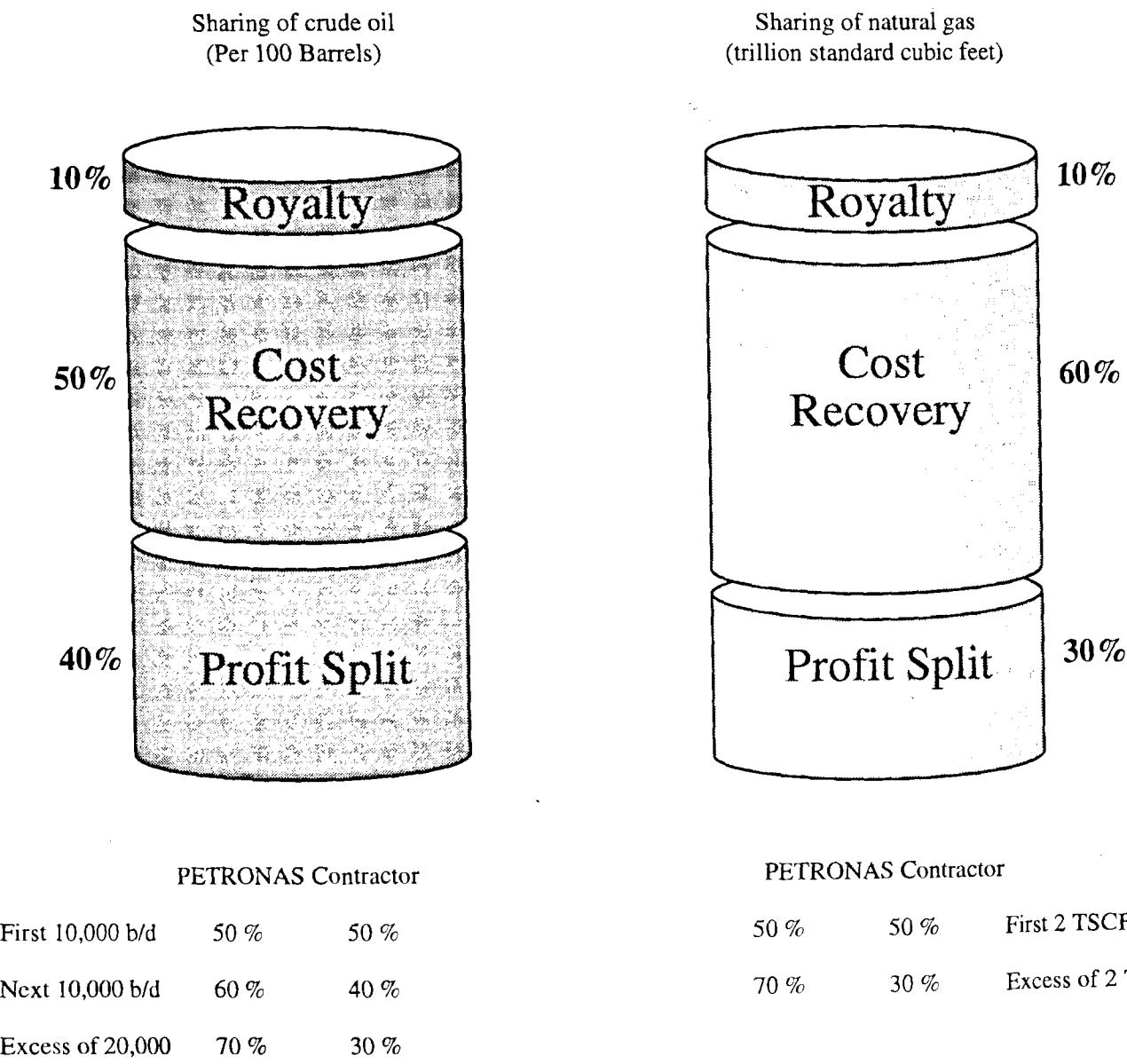
Source: United States National Research Council.

Figure 2. Tension leg platform (water depth 485 feet).



Source: E and P Forum.

Figure 3. Concrete gravity-base platform: North Sea (water depth 520 feet).



Source: Petroleum Nasional Berhad, Malaysia.

Figure 4. Production - sharing formula

IDEAS FOR NEW BUSINESS USES OF OBSOLETE OFFSHORE INSTALLATIONS *

I. Introduction

Article 5(5) of the 1958 Geneva Convention on the Continental shelf states that installations on the continental shelf "which are abandoned or disused must be entirely removed". However, Convention on the Law of the Sea of 1982 envisages in article 60, paragraph 3, the possibility of installations being "not entirely removed". It stipulates that in the process of abandonment, account should be taken of "any generally accepted international standards established in this regard by the competent international organization". The following quotation is from the Journal of Energy and Natural Resources Law:¹

"The International Maritime Organization (IMO) is regarded as the 'competent' body in this context, and in January 1987, the Maritime Safety Sub-Committee of the IMO began a detailed consideration of the whole question of abandonment, notwithstanding that the 1982 Convention is not yet in force.

At the meeting in 1987 there was much discussion of two figures in respect of the possibility of partial removal of installations: namely, a safe depth for surface navigation – figures ranged from 40 to 55 metres clear water above any remaining obstructions – and the percentage of installations which might be left in place on the continental shelf of any State. The United States was then advocating a small percentage, and tabled the figure of 2 per cent. Both those numbers were, in effect, held over pending further discussions in IMO.

The Safety Sub-Committee met again in February 1988, and had before it a paper submitted jointly by Norway, the United Kingdom and the United States. That paper is based on the concept that abandoned offshore installations should be removed, except where non-removal or partial removal is consistent with the guidelines set out in the paper itself. In very brief summary, and it is a detailed document, the guidelines provide that the decision by a coastal State to allow an offshore installation, or parts of it, to remain on the seabed should be based upon a case-by-case evaluation. This should include: the safety of surface and subsurface navigation, the rate of deterioration of

the material, the effect upon the marine environment, the possibility of material shifting, the cost, feasibility and risk of removal and the possibility of a "genuine new use or other justification" for leaving the installation wholly, or in part, on the seabed.

The nature and position of the area concerned, the types of vessels using the area, potential effects on fisheries and the potential for pollution should be closely studied. Conditions should be imposed by the State, a specific plan for monitoring drawn up and advance notice given to mariners and hydrographic services of any installations left wholly, or partially, in place. An unobstructed water column of 55 metres depth should be provided above any partially removed installation.

Detailed guidelines are also included as to entire removal of existing (relatively) light structures in, e.g. less than 75 metres of water, while as far as future installations to be erected in the 1990s are concerned, their original design should take into account the practicability of eventual removal".

How did the implementation of these – admittedly still evolving – guidelines take place in practice?

Quoting from the same issue the Journal, we can refer to the case of the Netherlands:

"On February 4, 1988, Pennzoil, acting as operator for the Noordwinning Group, started the first platform abandonment operation on the Dutch continental shelf. This followed consultations with the Ministry of Economic Affairs, States Supervision of Mines and all other relevant authorities.

Within a period of two weeks the four-pile satellite platform K13-D, situated in block K13 in 26 metres of water and weighing approximately 1,800 short tonnes (sh.t.) was dismantled, lifted and towed away by the Dutch offshore contractors Heerema Marine Contractors S.A. The production platform had been installed in 1978 to drain the gas-bearing Rotliegend formation but in autumn 1987 the five producing wells were abandoned.

Pennzoil carried out the abandonment programme in three stages. First the top deck, including the living quarters and the helicopter deck (850 sh.t.), was lifted, followed by the sub-cellar deck (140

* Presented at the 1989 Seminar by the ESCAP secretariat.

¹ Vol. 6, No. 3, 1988.

sh.t.), and finally the jacket (810 sh.t.). The piles were cut six metres below the seabed, prior to removing the jacket.

The legal framework in which this platform removal was conducted has been in existence for some time. There is no official indication that it may be altered in the foreseeable future. The Netherlands is a party to the 1958 Geneva Convention on the Continental Shelf, article 5.5 of which states that installations which are abandoned or disused must be "entirely removed". The 1967 Mining Regulations (Continental Shelf) have adopted this wording almost literally, with the additional requirement that debris and other material in the vicinity of the platform and connected with its installation, use or removal also have to be removed insofar as they create a danger to navigation or fishing. Article 68 of the Regulations states that "the Minister can fix a term within which this has to be done".

The 1967 Regulations also contain notification provisions with regard to the timing of the removal and the obligation to ensure the safety of persons employed in abandonment operations, and of navigation and fishing, and of prevention of pollution of the sea.

It is not entirely clear whether there is a legal obligation to remove parts of platforms situated below the seabed. The definition of mining installations in the 1967 Regulations which describes a platform as a structure on or above the continental shelf implies, however, that such removal is not required. Pipelines, incidentally, are not treated as mining installations within the terms of the Regulations.

With regard to taxation aspects, mention should be made of the fiscal regime's allowance for relief on the future estimated abandonment costs. This allows companies to build up a provision to meet future abandonment costs. An increase or decrease in these costs is automatically reflected in the amount of the provisions shown up in the balance sheet at the end of the year.

There are about 70 mining installations in Dutch waters but the deepest structure is located in no more than 50 metres of water. This fact, coupled with the heavy use of these waters for shipping, makes total removal seem necessary in all cases, in contrast to the situation in other sectors of the North Sea".

What are the implications of the evolving legal framework and practices described above for Asian and Pacific waters? An attempt is made to answer this

question below through surveying some possible alternatives. The general thesis of this paper is that rather than regarding such offshore structures as environmental eye-sores and a costly burden, the structures, considered as fully depreciated capital assets, would have at least salvage value (scrap iron and steel?). In addition, in some cases, possible other business uses could present valuable assets to possible new owners.

I.

How does one envisage offshore structure salvage operations in a mature oil producing area? A certain competence of offshore construction has been in existence for a number of years, with a, say, 10-20,000 tonnes per year fabricated steel throughput, involving a number of construction barges, onshore fabricating and electric-arc-steelmaking facilities etc. As the province matures, the rate of new installations is reduced and the offshore contractor would face a business slump, unless, of course, other neighbouring provinces were to come on stream in the meantime. Fortunately, in the Malaysian and Brunei waters of the South China sea, new provinces did come on stream and a continuous fairly even pace of development has made contractors fairly prosperous.

For the next 10 years or so, the possibly 15-16 years' productive life of quite a few of these structures (first installed around 1972) will have come to an end.

It is the first objective of this paper to assess whether a planned phased removal (over the next 10 years or so) could represent an attractive enough business proposition for offshore contractors (in Singapore, Brunei Darussalam, Malaysia or elsewhere) or whether they would be forced to move to possibly other (new?) offshore oil and gas provinces.

In what follows, notional costs are assumed for scrap steel and for installed platforms, for purely illustrative purposes.

During the build-up phase, at possibly 10-15 thousand tonnes of steel per year, it is assumed that 10-12 platforms are installed under contract, with a total gross annual turnover of around 30 million US dollars and (contractually regulated) accounting profits of around 3 million US dollars per annum.

Could facilities of a similar scale be kept active by salvage operations alone?

Suppose, now, that the oil-field operator sells in the wind-down phase an annual 15,000 tonnes of obsolete structures to the contractor at \$ 100 per tonne. This would represent a 1.5 million "cost" to the contractor, before the actual dismantling and

transportation costs (that could easily more than double it) for a total of, say, a 3 million US dollars outlay. Note that the delivered price of the "scrap" would have to be at least \$200/tonne for breakeven only, while for normal profits it would have to be \$220-\$240. Moreover, the scale of operations has been reduced from 30 million US dollars per year to 3 million US dollars per year, while "removing" the same number of platforms as were installed previously annually. Clearly, the proposition is not very attractive to offshore contractors unless either they obtained the structures "free", or scrap iron prices rose higher.

In any case, clearly the answer to the question of whether the facilities of the offshore contractor could be kept alive by salvage operations alone must be answered in the negative.

Reducing the scale to "shoestring operations" may also increase risks to human life and property.

Is there a better way? How can the industry meet legal requirements while remaining solvent? Clearly, some better, more imaginative business uses need to be devised.

First, if a "new" platform cost US\$ 3 million and would have been constructed modularly for partial reuse (allowing that metal fatigue, corrosion etc. can be controlled so as to double the useful life from 15 to 30 years) then the salvage operation could re-sell platforms not at scrap price but, say, at a "used" price of \$ 2 million or so, with perhaps an increase in "up-front" costs of new platforms to \$ 4 million each. Such an undertaking would not only be environmentally sound but would help to keep the offshore construction industry in business for a longer time period without the drastic reduction of scale shown above.

Are there any other possible solutions? What use could be made of offshore structures after their useful life in oil/gas production has ended, at the place where these have been installed? How long are these structures expected to last under their new uses?

First, the legal provision of the Geneva Convention is clear: "which are abandoned or disused must be entirely removed". Thus, to leave it in place the structure either (a) must not be abandoned or (b) must not be disused. This means either:

- (a) Continued stationing of personnel on the structure; or
- (b) Continued use of the structure (albeit for different purposes).

The first case could only be envisaged if some sort of rotational "guard duty" were established, with regular provisions not only of food but also entertainment and psychological support for personnel confined to these structures. It would be hard to justify, unless national defence considerations dictated it. In any case the managing of offshore production facilities (with skeleton personnel) could continue, at some (quite considerable) cost to the oilfield operator.

Continued use of the structure, on the other hand, does not necessarily involve manned use. Navigation beacons, lighthouses, radio and direction-finding beacons (for aviation and shipping) could be sited on some of these structures, thus ensuring continued use and enhancing air and sea navigational safety. Since some of the larger structures may already have such communication facilities for regular helicopter and boat service during the productive life of the field, the question would be whether to maintain (or enhance) such services beyond the economic life of the oilfield. Decisions would have to be taken very much on a case-by-case basis. Meteorological, satellite-tracking, radar or other equipment could also be installed depending on air/sea navigational (and possibly defence) needs. These installations could conceivably function unmanned; however, in some cases the advantages of continued manned services might justify the costs. Energy sources for such applications would also be needed.

The above applications would basically represent continuation of the status quo, with costs, perhaps, assumed by air/sea navigation or defence agencies. At the end of the physical life of the structures these would still have to be removed, or reinforced at suitable intervals as part of a standard "preventive maintenance" programme. Could one consider some more permanent, income-generating uses rather than just accumulation of continued costs? Some such uses could be envisaged, the more so since it is believed that the oceans are humanity's last frontier, potentially more important to humanity than outer space. These structures are its first steps in utilizing the resources of this waste new frontier.

What are these resources? On the one hand, food/protein from fisheries, and on the other, energy from various possible sources associated with the ocean. One could argue that the energy applications could represent a natural outgrowth of the energy orientation of current activities on these structures. Costs, however, still mitigate against this and therefore the farming of the oceans option first will be considered, looking for benefits justifying costs.

There have been a number of studies by the Food and Agriculture Organization of the United Nations

(FAO) showing that the enhancement of local nutrient chains by offshore structures could lead to "fish aggregation", a form of "farming the sea". Earlier references are given below, and these may be used to estimate the costs of such projects, mainly from the United States [1]. In particular, costs are cited from the article "Artificial reefs as a resource management option for siting coastal power stations in southern California", by Robert S. Grove, describing a practical environmental management monitoring and control effort of the California Coastal Commission through the Marine Review Committee (MRC) in the vicinity of the San Onofre power plant: "To date (1980), California Coastal Commission funding for these studies has exceeded \$ 17 million. The MRC is continuing its plankton, kelp, fish, and oceanographic studies with a 1981 budget of \$ 3.29 million". The objective of the effort was to offset any degradation in the marine environment through artificial reefs, resulting in compensating marine resources aggregation effects.

Benefits in this field are hard to estimate. The total fisheries income of Solomon Islands, for instance (based mainly on tuna), is about US\$ 30 million per year (private sources). Could such projects, for instance, double such income? It is far from clear at this stage: more research is needed.

It is, finally, of interest to look at the energy supply-related uses of these structures. Since already in their present uses the structures are used for energy supply purposes, the same companies/contractors may continue to use them, if economically viable alternative energy supply developments can be found.

A number of technologies have been studied, but very few are commercially proven at present. Some of these are described below:

(a) Ocean thermal conversion technology (OTEC) could superficially be considered as being of some use to offshore platforms. The water depth requirement (1,000 m depth for cool water) would, however, rule out most of the continental shelf, where offshore platforms are located. In addition, the technology is only in the design and testing stage, with commercialization in the distant future. One aspect of an "open" system might render it of interest for some offshore locations near marine "trenches": fresh water is produced through an evaporation process, concurrently with energy, and some "nutrient recycling" may also enhance the use of the surrounding marine resources. Although the technology may not be economically viable for one objective (energy) alone, as a multi-objective, self-sustaining marine resources management station (with its own power and fresh-water requirements

supplied as a by-product) it may become viable in some (very few and selected) locations. The following is a quotation from a recent review of OTEC and other marine-based renewable energy technologies [2] concerning specifically the relevant legal institution and financial factors:

OTEC technology is confronted with complex institutional problems typical of renewable energy technologies. It must be resolved who can be the owner/operator of OTEC plants and plant-ships, how OTEC capital formation will occur, and how to establish a stable and predictable legal regime for at-sea operations. Investment in, and operation of, OTEC power plants in territorial seas, economic zones of coastal States, and in international waters, will require bilateral and multilateral agreements among nations. Some of the relevant legal, institutional and financial aspects have already been examined. One of the key considerations is whether OTEC platforms can be regarded as 'vessels' from a legal standpoint. This classification may differ according to whether the platform is moored or operating as an unmoored plant-ship, manufacturing energy-intensive products. On the other hand, in neither case would the platform be a vessel in the sense of plying between ports. The safety, minimal negative environmental impact, insurance coverage and physical protection of OTEC platforms will need to be ensured.

It is essential to resolve the above-mentioned questions in a fashion conducive to the attractiveness of OTEC as a commercial investment. However, the fact that the offshore and nuclear industries have made progress in solving comparable problems is somewhat encouraging.

Prospects for OTEC technology thus depend both on economic factors and on institutional factors. Both sets of factors will need to be satisfactorily resolved before OTEC can become commercial. If and when this is achievable, the ocean-thermal resource could provide the world with a new source of renewable energy that has a substantial potential to help meet growing worldwide demand for additional energy supplies. OTEC-derived electricity and products, by increasing the world energy supply, could help reduce the foreseeable polarization between nations over energy resources.

(b) Solar and wind energy represents, perhaps, a more immediate solution to powering offshore structures for limited (not very energy-intensive) uses.

For telecommunications applications in isolated locations, solar photovoltaic systems are already well

established. Similarly, small wind-powered generators are also well established for the local generation of (limited) electric power in locations where the wind regimes are favourable. Such systems could thus be installed "off-the-shelf" for some low-energy intensity use of these platforms.

For higher energy intensity applications (e.g. "factory-ship" substitute applications for fisheries, including refrigeration and conservation applications in conjunction with possible "fish-farming" of the area), one could think of continued use of natural gas from nearby platforms in the oilfield that may be still producing.

(c) There are other, more far-fetched, applications of processes that rely on semi-permeable membranes, to extract chemical energy by a reverse electrodialysis process (annex I, figure 1).

This, however, requires/fresh water input, difficult to obtain at these offshore locations unless, of course, a reverse-osmosis process (perhaps powered by wind energy) is used to produce/fresh water. There are, again, off-the-shelf units available for producing 200-300 litres of fresh water per day. These units are, however, still expensive, and even more so for the pressure-retarded osmosis energy conversion devices described below that might be interesting for some offshore platforms located near river deltas (e.g. Baram, Belait, Tutong rivers in Sarawak/Brunei Darussalam) (annex I, figures 2 and 3).

All these applications are far-fetched in terms of commerciality. However, offshore research stations could be conceived for studying such processes, as well as possible wave-energy devices [3] (annex II, figure).

Why does one go on describing such esoteric technologies? Clearly, these could not form part of a viable business use of obsolete offshore platforms. As production facilities, maybe not. However, as research, demonstration and testing facilities – together with research development and testing of some fisheries-related projects – these platforms may represent a valuable asset to some R and D-oriented companies and perhaps could be auctioned off to the highest bidder for such uses by the oilfield operator. Alternatively, as part of a planned diversification strategy, the oilfield operators themselves might engage in such activities.

What would be the economics of such an R and D operation? Clearly, some of the equipment to be tested in a realistic marine environment would itself be expensive, costing millions of dollars. In addition, research support staff for "integrated marine sciences", located perhaps at a nearby national university, might

represent an operational budget of, say, US\$ 10 million a year for about 100 professional and support staff and operating facilities.

The pay-off of R and D institutions is of a long-term nature; however, locating such an institution in Asia and Pacific waters (for instance, Labuan or Brunei Darussalam?) would make a long-term beneficial contribution to marine resources development in the region and to the energy regime of declining oil provinces. In addition, the oilfield support personnel would represent a pool of technically skilled support staff, who could thus continue to be employed. One could suggest an ASEAN project, possibly hosted and financially supported by the ASEAN member countries.

II. Summary

A suggested framework for an environmentally sound and self-sustaining offshore structure management programme for marine resources development

To recapitulate the argument of this paper, it can be asserted as follows:

- (a) Offshore structures need to be managed with long-term objectives in mind;
- (b) The environmental management of these structures may involve complementary beneficiation of ocean resources through research and development, while at the same time reducing adverse environmental effects through conscientious and judicious limitations upon environmentally harmful practices;
- (c) The proposed continued business uses for these structures would represent employment opportunities, and would limit otherwise adverse economic impacts of declining oil provinces.

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2. *New and Renewable Sources of Energy*, No. 148, 1988, *Impact of Science and Technology* (UNESCO/Taylor and Francis).
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ANNEXES

Annex I

Semi-permeable membrane devices

Reverse electrodialysis is a process requiring membranes. Instead of being permeable to water, every second membrane passes anions, every alternate one passes cations. Figure 1 shows the elements of the reverse electrodialysis process. From the saline feed, anions pass one membrane towards the cathode, cations one membrane towards the anode, creating an electrochemical potential of 80 mV per cell. Mixed brine is discharged from both sets of cells. Any number of cells is possible; a stack of 1,000 would yield 80 volts. Stack arrangements are preferable to single cells because they minimize electrode problems. Electrodes erode in use and must be replaced periodically; there is also a voltage loss at their surface. A turbine generator, however, is unnecessary.

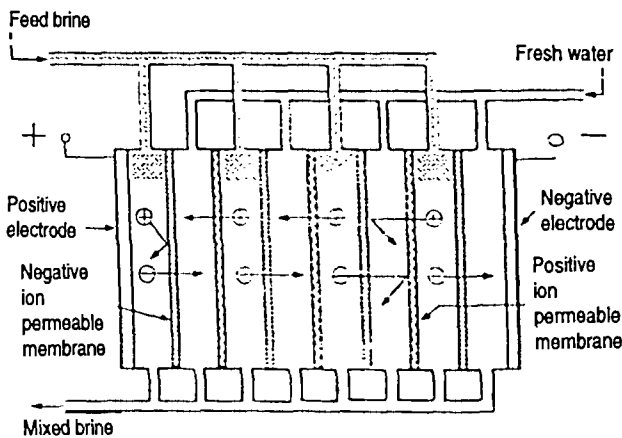


Figure 1. Principle of salinity energy conversion using reverse electrodialysis.

Inverse vapour compression, the second process, requires no membranes. It employs the difference in vapour pressure as a function of salinity. At any given temperature the vapour pressure is lower over sea water than over fresh water; it is still lower over brine. By lowering the pressure in a partially filled chamber, fresh water can be brought to a boil at ambient temperature, say 20°C. Sea water in an adjacent chamber will not yet boil (at the same temperature and pressure) and can absorb water vapour by condensation, causing a small drop in pressure. Thus, low-pressure steam could drive a turbine located between the chambers.

Pressure-retarded osmosis is another process requiring membranes. Figure 2 shows its elements. A pump pressurizes sea water or brine to a pressure P below the osmotic pressure difference π . Water molecules from fresh water (or sea water) can permeate into the pressure vessel against the pressure head as long as $P > \pi$. The volume of sea water (or brine) is proportionately increased and drives a turbine generator. Only part of the turbine output is needed for pressurization. A variation of this process places the osmotic device in the ocean to exploit the pressure existing at depths (figure 3). The best depth has been judged to be approximately 100 m, about half the osmotic pressure of sea water. In this arrangement, river water powers a hydroelectric generator and then permeates into the sea through membranes. Since river water will not be pure, a small flushing pump would remove impurities from the membranes.

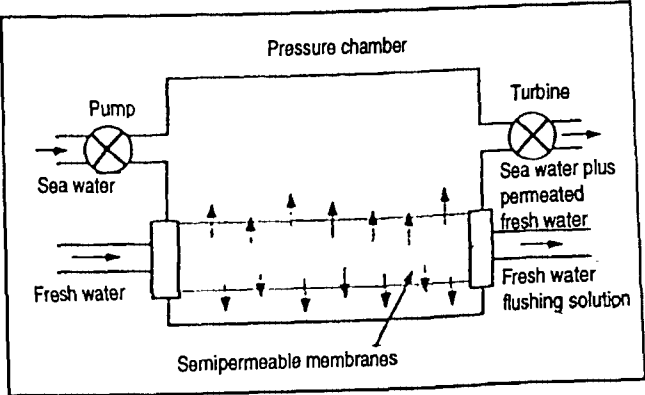


Figure 2. Schematic diagram of a pressure-retarded osmosis energy-conversion device.

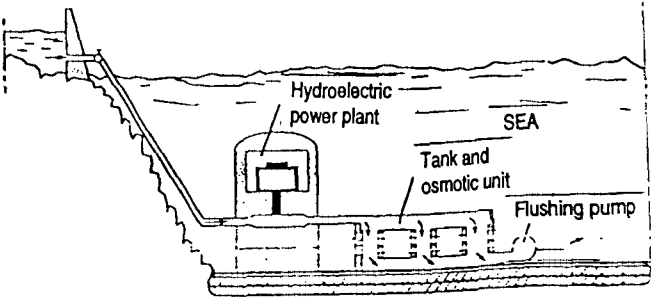


Figure 3. Submarine pressure-retarded osmotic power plant.

Annex II

The lockheed (USA) wave energy converter

This device, called the Dam-Atoll (fig.4), was invented by Leslie S. Wirt of the Lockheed Corporation. It works on a different principle from many of the other devices by making use of the fact that waves approaching a shelving beach progressively steepen and finally break. It also makes use of the fact that the velocity of surface waves varies inversely with local depth, and as a result surface waves refract, i.e. their direction of propagation always bends strongly towards shallower water. These two effects mean that an appropriate shell contour can completely capture an approaching wave front and convert it into a breaking wave extending all round the shell. Waves enter an opening at the top of the unit. A set of radial guides inside the device imparts a swirl to the breaking waves which then pass down the central pipe in a vortex and comprise a fluid flywheel which imparts a degree of smoothing to the wave pulses.

An axial flow turbine situated at the base of the standpipe is driven by the water flow and is so designed that not all of the energy of swirl is removed. The remaining swirl energy is taken out in a diffuser section and induces a radial outflow, creating reduced pressure at the bottom of the standpipe.

In the Lockheed visualization of the device, a 78-m diameter hemispherical dome would be used and would extract 1 MW of power from 2-m waves of 7-second period. It is intended to anchor the Dam-Atolls off the windy beaches of the world, where there is about 40 MW of power available per kilometre of beach. In particularly good wave areas, such as the Pacific north-west, the developers believe it would be possible to anchor 500 to 1,000 of these units, providing a power station comparable to that of the Hoover Dam. The device, 250 ft. in diameter and made of concrete, has many potential uses other than the generation of electricity, such as cleaning up and recovering oil spills, protecting beaches from wave erosion, forming calm harbours in the open sea, and desalinating sea water through the process of reverse osmosis.

Some experimental work on a small scale has been done by Lockheed. Although no firm costings have been presented, the size and power output of the system is comparable with that of the first-generation United Kingdom devices and thus the costings would probably be of the same order. The device has some potential for further improvement, principally because it lends itself to quantity production methods owing to its axially symmetrical structure; it may also be possible to mount the device on the seabed and thus avoid the cost of mooring.

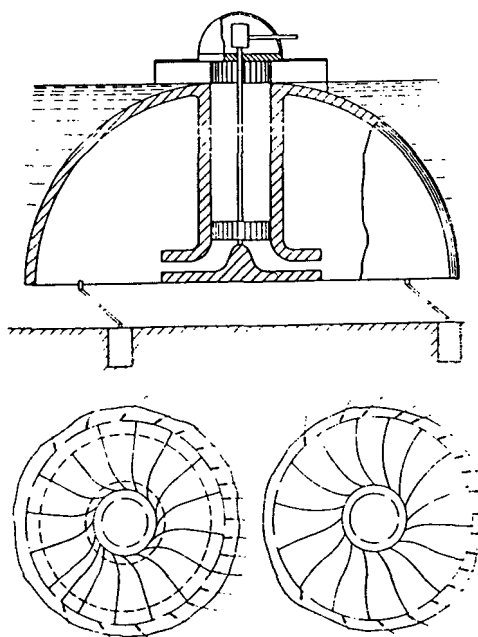


Figure. Lockheed wave energy converter.

ALTERNATIVE USES FOR OBSOLETE OFFSHORE PRODUCTION PLATFORMS : RIGS TO REEFS*

The following data are presented to illustrate the growth of the technology associated with the offshore petroleum industry in the past 42 years.

On 9 September 1947, Kerr-McGee Corp. spudded in a well in Ship Shoal, Block 32, about 12 miles off Point Au Fer, Terrebonne Parish, Louisiana. The platform was located in 18 feet of water. Oil began to flow from the well in November 1947.

In November 1988, divers using conventional oxy-arc methods removed the four-pile well protector. The salvage was performed without the use of explosives in order to protect marine life.

This salvage task was accomplished about the same time as Placid Oil Co. started gas/condensate production from the first floating production system in the Gulf of Mexico in 1,522 feet of water on Green Canyon Block 29.

Shell Oil Co. has encountered pay sands in a well in 7,520 feet of water, about 130 miles off the Mississippi River Delta on Mississippi Canyon Block 657.

Information abstracted from the *Oil and Gas Journal*, 30 December 1988.

Introduction

At present, there are more than 6,000 offshore installations located in producing areas worldwide. Two thirds of these are in United States waters.

The estimated cost of removing obsolete structures varies significantly, but ranges up to \$30 billion, with costs per structure largely dependent upon water depth.

Various scenarios have been proposed, with total removal of outer continental shelf (OCS) installations being one extreme, and the other extreme being total retention. Partial removal has also been suggested as a means of reducing decommissioning costs. This concept embodies removing portions of an underwater structure to a water depth sufficient to ensure safety of navigation, based on the draft of all existing or currently envisioned

surface vessels. One aspect of such salvage which renders it more viable than previously considered is the utilization of the heavy lift capabilities of today's crane barges.

Another option often mentioned is disposal *in situ*, which involves toppling. This approach depends heavily on being able to predict the mode of failure and the trajectory of toppled sections.

However, the topic to be discussed here involves an alternate use to which the decommissioned structures might be put, regardless of the method of decommissioning. Simply stated, this alternative is their utilization as artificial reefs to enhance fishing. This alternative, which has been dubbed "rigs to reefs", is a concept under which the owners of offshore structures are requested to participate voluntarily on a case-by-case basis to enhance the fisheries best suited for the specific locations.

Several companies in the United States have intentionally placed platforms in locales over the past decade. The best-known case was in 1987, when Tenneco, Inc. sank portions of three unused platforms from the Louisiana OCS in Florida waters. The resultant "reef" has since become very popular with the fishing and boating communities of south Florida, which are among the world's largest.

There is absolutely no doubt that offshore platforms represent *de facto* reefs of superior quality.

The success of fishing is directly related to the quality and extent of marine habitats that attract the fish.

Studies have been conducted offshore California in which 20,000 to 30,000 fish have been quantified representing over 45 species in and adjacent to underwater platforms. It has been estimated (by the Gulf of Mexico Fishery Management Council) that oil and gas structures account for 23 per cent of hard bottom habitat in that area. Previous to the emplacement of the petroleum-related structures, suitable habitats in which new species could expand their range did not exist. This is especially true of the Gulf of Mexico OCS off Alabama, Mississippi, Louisiana and Texas.

Concern has been expressed that the total removal of platforms will aggravate fishery management problems by decreasing the habitat and thereby

* Presented at the 1989 Seminar by James L. Harding, Consultant to CCOP.

increasing the potential for over-exploitation as well as competition between the sport and commercial fisherman.

It should be mentioned at this point that the overwhelming majority of artificial reefs, whether they be sunken vessels or petroleum platforms, are utilized for recreational fishing. As an example, offshore my own home State (Georgia), 10 artificial reefs have been installed over the past decade. None are petroleum-related structures (as there is no production within economically towable distances). These 10 reefs consist of a motley assortment of Liberty ships, one obsolete suction dredge donated by the Corps of Engineers, and various small naval vessels sunk by military aircraft for target practice purposes. All are outside of shipping lanes, submarine approach paths, etc., and are marked by surface buoys and lights, as well as appearing on applicable charts. The State of Georgia investigated the feasibility of using platform structures, but with the nearest offshore petroleum production being in the Gulf of Mexico, the expense was prohibitive.

"Rigs to reefs" is a highly workable concept. However, it should be emphasized that since the primary user group on the receiving end of such a scheme is the recreational fisherman, unless there is a concentration of these potential users already existing in the area near which such an artificial reef is to be placed, the reef will not be adequately exploited, even though the habitat will have been created. Therefore, this alternate use of obsolete platforms should only be considered on a highly site-specific basis.

In summary, the three decommissioning options: (1) leave *in situ*; (2) partial removal; and (3) complete removal, can each lead to their use as artificial reefs. In the case of leaving the platform *in situ*, it could be merely abandoned with suitable navigational markings. In the case of partial removal, the substructure could be abandoned, again with suitable markings, it could be toppled to clearance depths, or it could be removed and dumped elsewhere. If complete removal is dictated, the topside could be scrapped onshore, or dumped at sea and the substructure also disposed of at sea.

Technical and engineering problems, verification of removal

There are three principal variations of decommissioning obsolete petroleum structures:

1. *Leave in situ*
 - (a) Convert to alternate use

- (b) Abandon with navigational markings
- (c) Topple

2. *Partial removal*

- (a) Topside structure
 1. Scrap onshore
 2. Dump (*in situ* or at sea)
- (b) Substructure
 1. Abandon with suitable markings
 2. Topple to clearance depths
 3. Remove to clearance depth

Removed portion dumped
(*in situ* or at sea)

3. *Complete removal*

- (a) Topsides
 1. Dump at sea
 2. Scrap onshore
- (b) Substructure
 1. Dump at sea
 2. Scrap onshore

In each of these operations, the degree of removal (total, partial, toppling, etc.) must be verified on site.

Techniques for verification include:

1. Visual
 - use of divers and associated underwater photography closed circuit television, (CCTV), etc.
 - use of remotely operated vehicles (ROVs) for photo records
 - use of submersibles for photo records
2. Remote sensing
 - side-scanning sonar
 - magnetometers
 - high-resolution seismic profilers

Of these tools and techniques, the ROVs, side-scan sonar and magnetometers are probably the most cost-effective, as all three can be deployed simultaneously from a single surface vessel.

Side-scan sonar units permit the detection of bathymetric irregularities and objects on the sea floor, and represent the only high-resolution tool that provides coverage to both sides of a survey vessels track. It is an extremely practical and valuable tool for obtaining an acoustic picture of the sea floor (and objects on and above the sea floor). Interpretations of the sonographs permit detailed mapping of geologic outcrops, variations of surface lithology, sunken wrecks and the construction of structures. The resolution obtained by side-scan sonar systems is a function of electronic variables. However, resolution is approximately equal to 1/1000 of the operating range. For instance, at a frequency of 100 KHz , the computed resolution is on the order of 15 cm at a range of 300 m. Factors, other than electronic, can also effect the resolution, such as ship speed, pulse rate, etc.

On the basis of operational range and frequency, side-scan sonar systems can be placed in one of three categories:

1. Short-range systems – provide coverage of sea floor between 50 and 300 m to either side of the vessel track.
operate between 100 and 500 KHz

2. Mid-range systems – range of a few km, operational between 10 and 80 KHz
3. Long-range units – 20 km + range to either side - 10 KHz , example: GLORIA (Geological Long Range Inclined ASDIC)

There is also a sector-scanning sonar, usually utilized for obstacle avoidance or for fisheries applications.

Magnetometers

The detection of ferromagnetic objects, on or near the sea floor along a survey vessel's track, is possible through the measurements of anomalies to the earth's magnetic field caused by the object.

Typical features detected may include sunken ships, pipelines, cables, anchors and chains and metallic debris. When used in conjunction with a side-scan sonar, a magnetometer could be employed to measure the "cleanliness" of an area from which a rig has been removed either in part or as a whole.

**RESOURCES RECYCLING AND ITS ECONOMICS: THE CASE OF OBSOLETE
OFFSHORE OIL AND GAS PRODUCTION FACILITIES***

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* Presented at the 1992 Seminar by the ESCAP secretariat.

Introduction

In February 1989, ESCAP organized the first Seminar on Issues Associated with Offshore Installations and Structures in the Exclusive Economic Zone at Bangkok. The ESCAP secretariat prepared a paper [1] for that meeting, the gist of the argument being that rather than regarding these structures as an economic burden, one should attempt to find new uses for them. In the paper such new business uses were studied and the question "what would be the effect of various courses of action to the offshore oil-field service industry of declining oil and gas provinces" was asked and answered. The conclusions and recommendations are cited below:

- (a) Offshore structures need to be managed with long-term objectives in mind;
- (b) Environmental management of these structure may involve complementary beneficiation of ocean resources through research and development, while at the same time reducing adverse environmental effects through conscientious and judicious limitations upon environmentally harmful practices;
- (c) The proposed continued business uses for these structures would represent employment opportunities, and would limit otherwise adverse economic impacts of declining oil provinces.

An attempt is made below to generalize the arguments of the paper to find conditions under which similar recycling of fully depreciated economic assets may be desirable and possible. What are the relevant parameters that could be adjusted by government policy, so that such the recycling business becomes viable? What would be the effect of such national/regional/global policies on the evolution of coastal zones and ocean resources? What practical steps could be taken to generate a self-sustaining process of using "the vital seas" in a more benign manner, as discussed in a 1984 UNEP publication [2].

I. Implementation prospects

A. General principles of resource recycling and its economics

First, the paper will review, in the light of figures 1-4, the relation between resources development and resources recycling. Following this in the light of figures 5-8, a framework will be discussed for dealing

with such problems in both "upward unstable" and "downward unstable" economies shown in figures 6 and 7. It will be seen that while the former is characterized by "pleasant surprises", the latter is plagued by "frustration of expectations" that renders both stagnating least developed and stagnating post-industrial societies sociologically unstable. The application of these general principles to stagnating and declining offshore oil provinces will close the discussion, anticipating a practical application of these principles to environmental management problems of offshore oil provinces to be presented in the next section.

First, it may be recalled that in the paper, "Simple environmental economics of Asian coal and gas" [7] (where the above figures 1-6 were presented previously), it was claimed that "there were no automatic restoration processes for energy depletion and environmental damage shown by the two side arrows in figure 1. In the present paper the ESCAP secretariat picks up the discussions where they left off in that paper: the question now is how do we design such restoration processes.

As a general introduction, it might help to quote the description of such systems for energy resources development from ESCAP (1989) Committee on Natural Resources and Energy documentation [4]:

"Why is it important to review energy resources? In the previous (demand-related) discussions it has been established that large flows of appropriate forms of energy will be required to meet the development and welfare-related needs of the Asian and Pacific countries. It is natural to ask, then: are stocks of energy commodities available to sustain the required energy flows? Is the mobilization of these energy flows sustainable, in terms of both the known and expected level of stocks of energy commodities, and the environmental degradation (and increase of entropy) resulting from the conversion of "stock" into "flows" at the substantial intensity levels envisaged in the demand-related discussions?

Energy flows, like income flows, are an indicator of "welfare". Welfare is a "flow" rather than a "stock" concept. For the energy or welfare situation not to worsen, by definition it should at least be sustainable.

As in the case of wealth, sustainability for energy systems would mean that eventually "stocks" would have to be restored. This points toward the need for renewable resources, reforestation,

recycling, and other measures – even if it is hard to imagine for stocks of "wealth" such as oil reserves, coal reserves and uranium reserves. In case of hydropower and solar energy "flows" are converted only to "flows" (for example, electricity); sustainability there means replacement of the conversion technology (dams, photovoltaic cells, and others). The case of hydropower is similar, to a certain extent, to that of nuclear energy. For nuclear energy, however, the additional complication arises of securing stocks of fuel and disposing of stocks of waste although, perhaps, not at a scale as large as for some other non-renewable sources of energy such as coal and oil. Still, depending on where the system's boundaries are drawn, energy production and use could be characterized as an "open steady state system".

In figure IV, the "open steady state system" theory is described. Note that these systems involve certain "sources" on the upper left and certain "sinks" at the lower right, the technology producing both an entropy increase at the bottom (disappearing in a "sink" as long as the system is open) and an entropy decrease represented by the more highly organized "finished products" of the production process (for example, solar photovoltaic cells, power plants and others).

Note that the normal environmental argument would go against such technological processes, arguing that the only way to avoid (in closed systems) the excessive costs associated with "refuse and waste heat" is to do without the finished products. This could be characterized as a passive reaction.

An active reaction, on the other hand, would try to minimize the costs related to refuse and waste heat by attempting to open up the closed system: finding appropriate "sinks" for entropy increases in the universe at large, outside our closed systems.

Is such a process possible? What is argued below is that such processes must be sought, through active involvement in an environmentally sustainable energy planning and management effort. These concepts are illustrated by a quotation from an article by Professor Nakamura Tatsuya of Chiba University:¹

"The theory of open steady systems explains how society can survive without suffering from constipation as a grand drama staged on the

singular planet of the earth. Any system that sustains itself repetitively, such as man's body, society, or the environment, is a "steady system". The availability of resources and energies, and the expansion of entropies, are essential to the continued sustenance of a steady system. We human beings live by eating, drinking water, generating heat, sweating, and excreting. Economic activities yield finished products by consuming resources and energy and discharging refuse and waste heat. A system that has an exit for the discharge of entropies to an external world is an open steady system. An open steady system exists only within a larger open steady system. If the environmental system outside the human body should be entirely closed without an exit, refuse and waste heat generated as a result of our life activities would accumulate in it, ultimately endangering the sustenance of the human body, an open steady system, by eliminating its exit for contamination.

Each of the cells of our body can continue to exist because our body as a whole is also an open steady system, and our body can continue to exist because our environment is also an open steady system. Wastes generated as a consequence of productive and consuming activities are transformed into organic matter and heat by micro-organisms in the soil, and their thermal entropies are absorbed through water circulation. Soil is an aggregate of various species of micro-organisms, which decompose the wastes generated by production, consumption, and human life activities into inorganic matter and waste heat. The organic matter is placed in organic circulation as nutrients for plants, and water upon evaporation leaves thermal entropies in the air. Water circulation and organic circulation take place within the soil, thereby allowing our environment to be sustained as an open steady system. This has been made possible by the fact that the earth, a larger system that encompasses the environment, offers an exit because it is itself an open steady system.

As the vapour that has absorbed thermal entropies reaches the upper atmosphere, it adiabatically expands, discharging the heat absorbed on the earth's surface as long-wavelength radiations. After having discharged its thermal entropies, the vapour returns to the ground as rain, or water. In this way, the theory of open steady systems points out that the earth, as well as every cell in our bodies, lives as an open steady system in an eternal flow of life, leading us to view human

¹ *Saijokino Keizaigaku* (Tokyo, Iwanami Shoten, 1985).

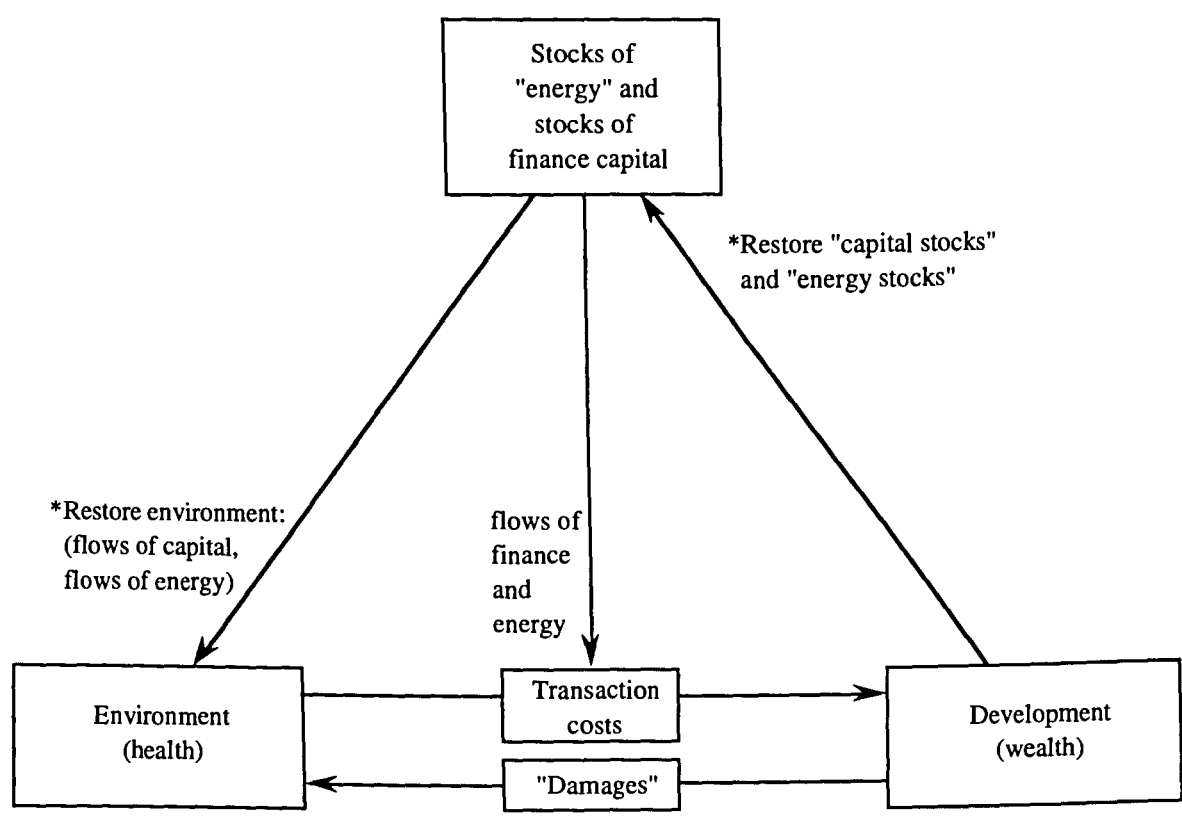
economic activities as transient events in this flow.

What is essential to observe from the above is that the entropic "sink" for life on earth is, in fact, outer space. Feasible ways and means of utilizing it in a controlled fashion must be sought."

In figures 2 and 3, energy resources development is related to the financial criteria for exploration, and the "energy costs of energy" respectively. What is apparent from figure 4, however, is that there is always a

dichotomy between final products and waste, and unless new processes can be found that work on the waste stream as viable business propositions (or unless we can dump such waste into the "sink" of outer space) the processes of resources development will end in an environmental (entropic) death.

Is the above analysis correct? Can no way out be found? In the next section, possible solutions to the above dilemma are discussed via "value changes" that may render the design of "entropic sinks" and new final products economic in a "rejuvenated" business society (figure 8).



* These are reverse flows that have to be designed and implemented by society: not automatic!

Figure 1. Energy stocks and flows.

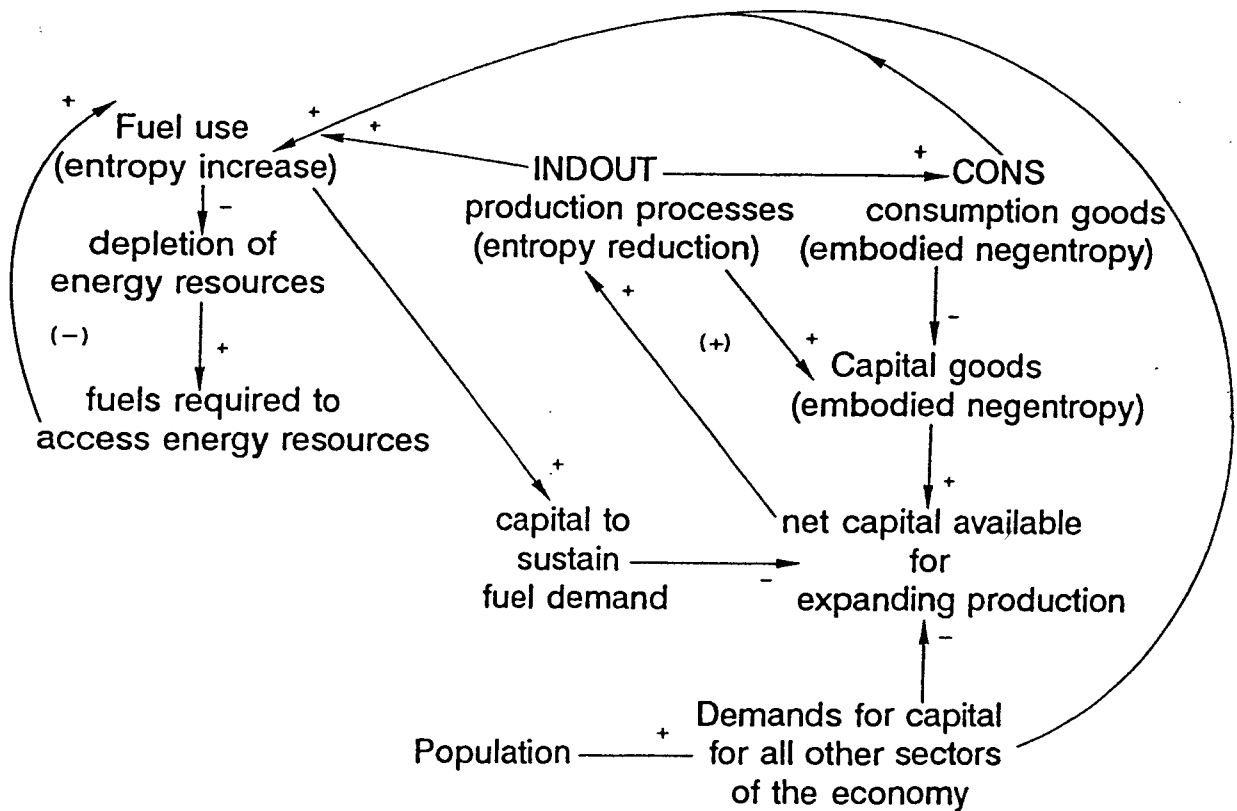


Figure 2. The energy/development interaction: influence diagram.

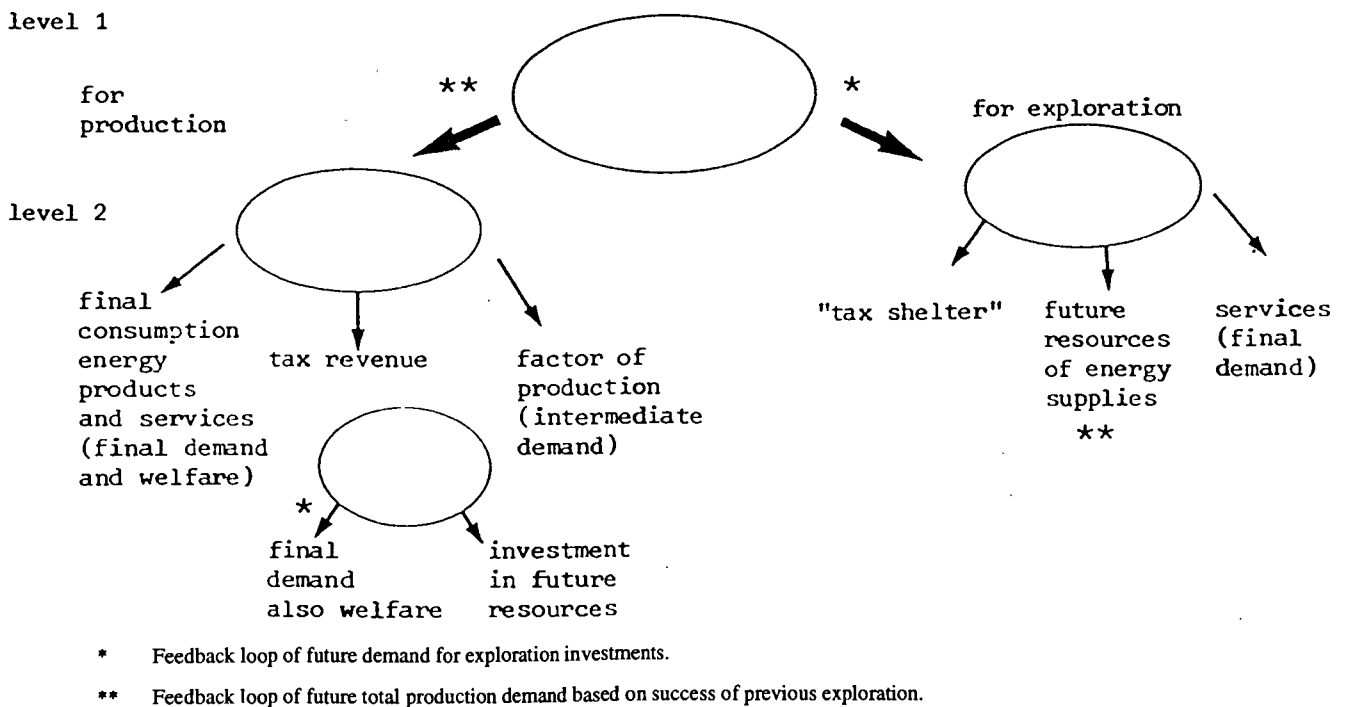


Figure 3. Current energy investments – determinants of demand levels.

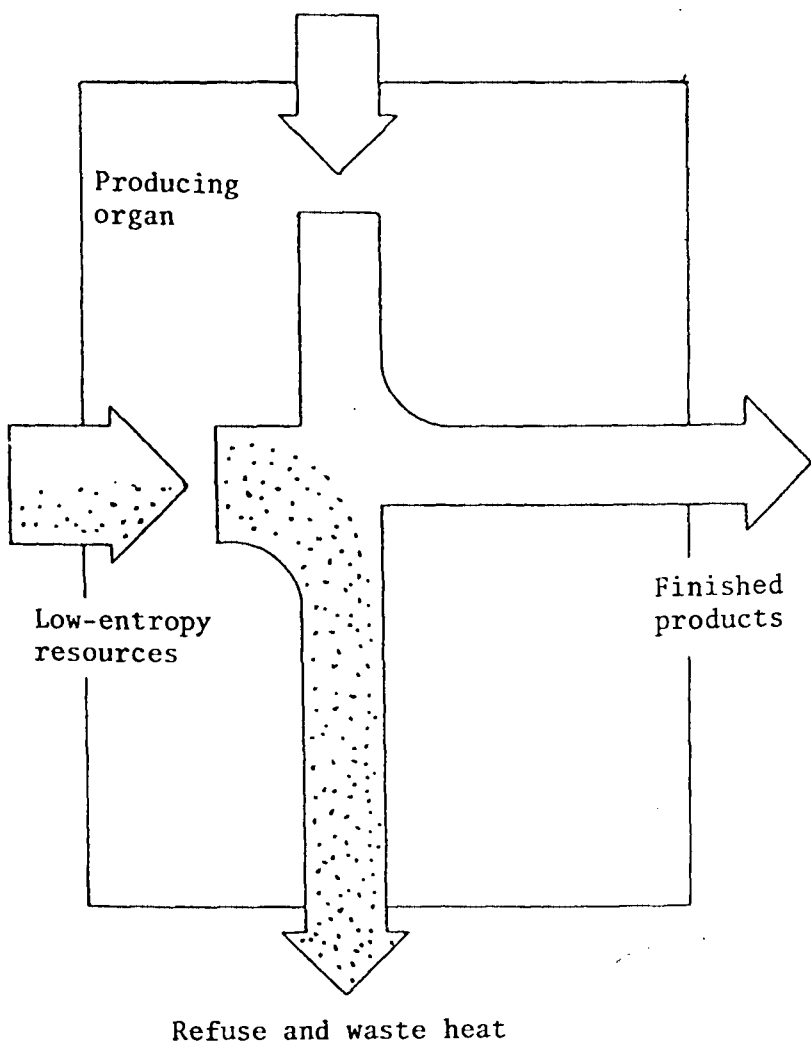
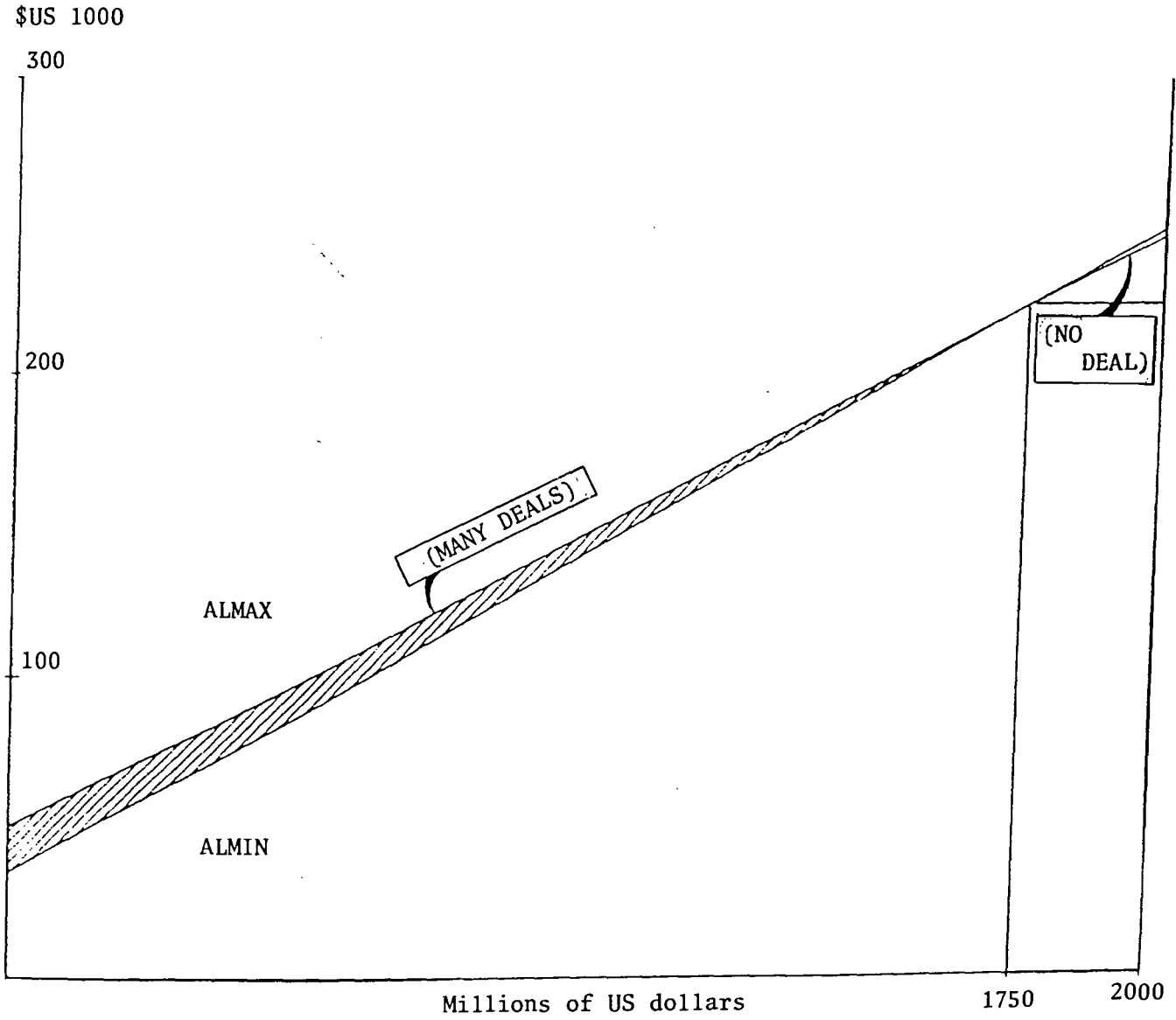


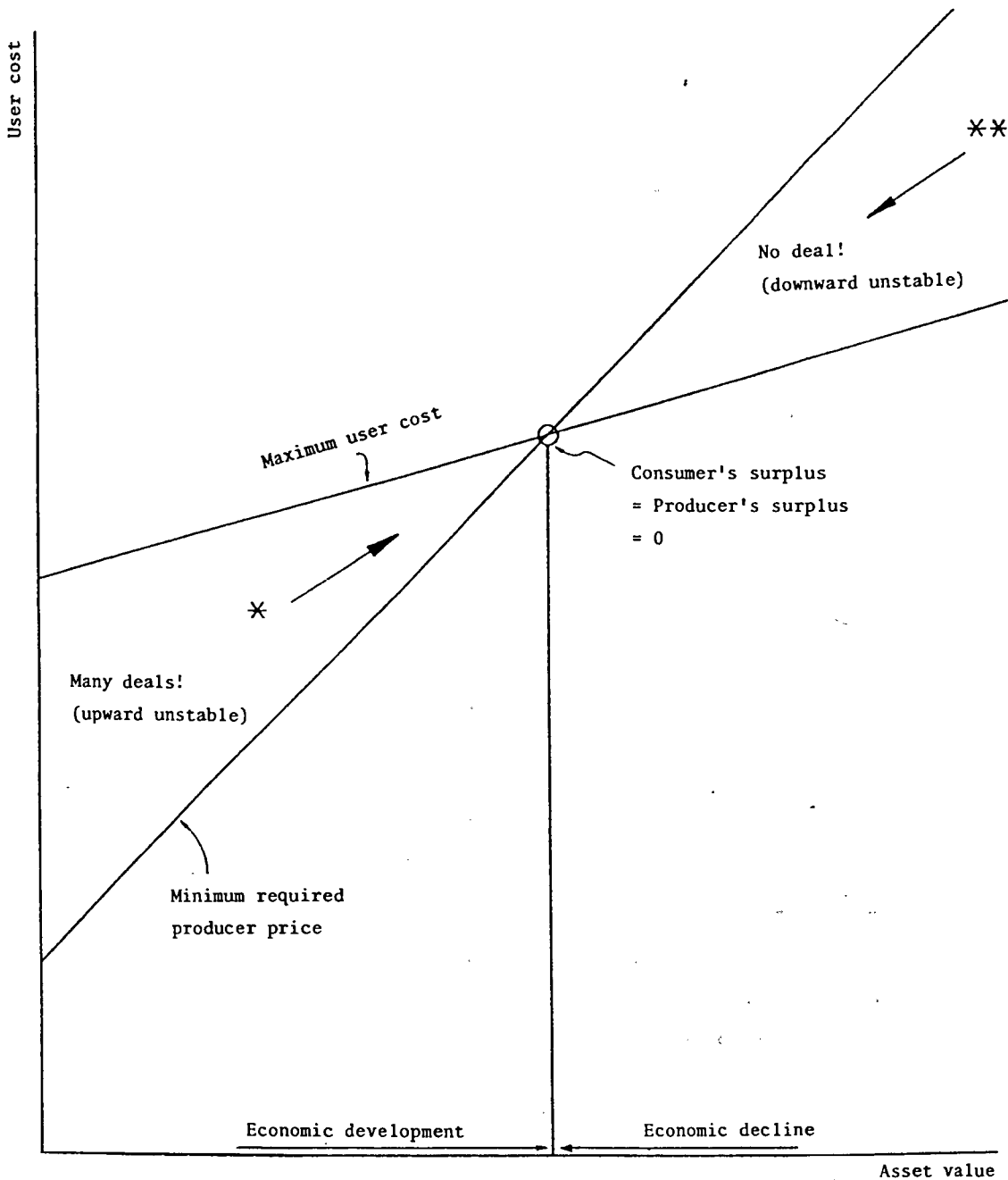
Figure 4. Process of producing positive and negative output.



Notes: A1 = 1,000, A2 = 2,000, N = 10, ACQCOS = 800,
TAXB = 25%, TAXS = 10%, C = 50, CS = 40,
REV = 100, AIB = 9.25%, AIS = 7.25%

- A1 - Minimum asset values
- A2 - The computer programme required as input maximum
- N - Number of years (life of the asset)
- AIS - Cost of capital for the lessor
- AIB - Cost of capital for the lessee
- REV - Annual revenue from the asset
- ACQCOS - Acquisition cost of the asset for the lessor
- TAXB - Tax rate faced by the lessee
- TAXS - Tax rate faced by the lessor
- C - Running cost of the asset if owned by lessee
- CS - Running cost of the asset if owned by lessor

Figure 5. Lease/buy decisions.



(Note that economic development, rises of standards of living, will push acceptable user costs upward, and thus allow continued development)

Figure 6. Simple environmental economics.

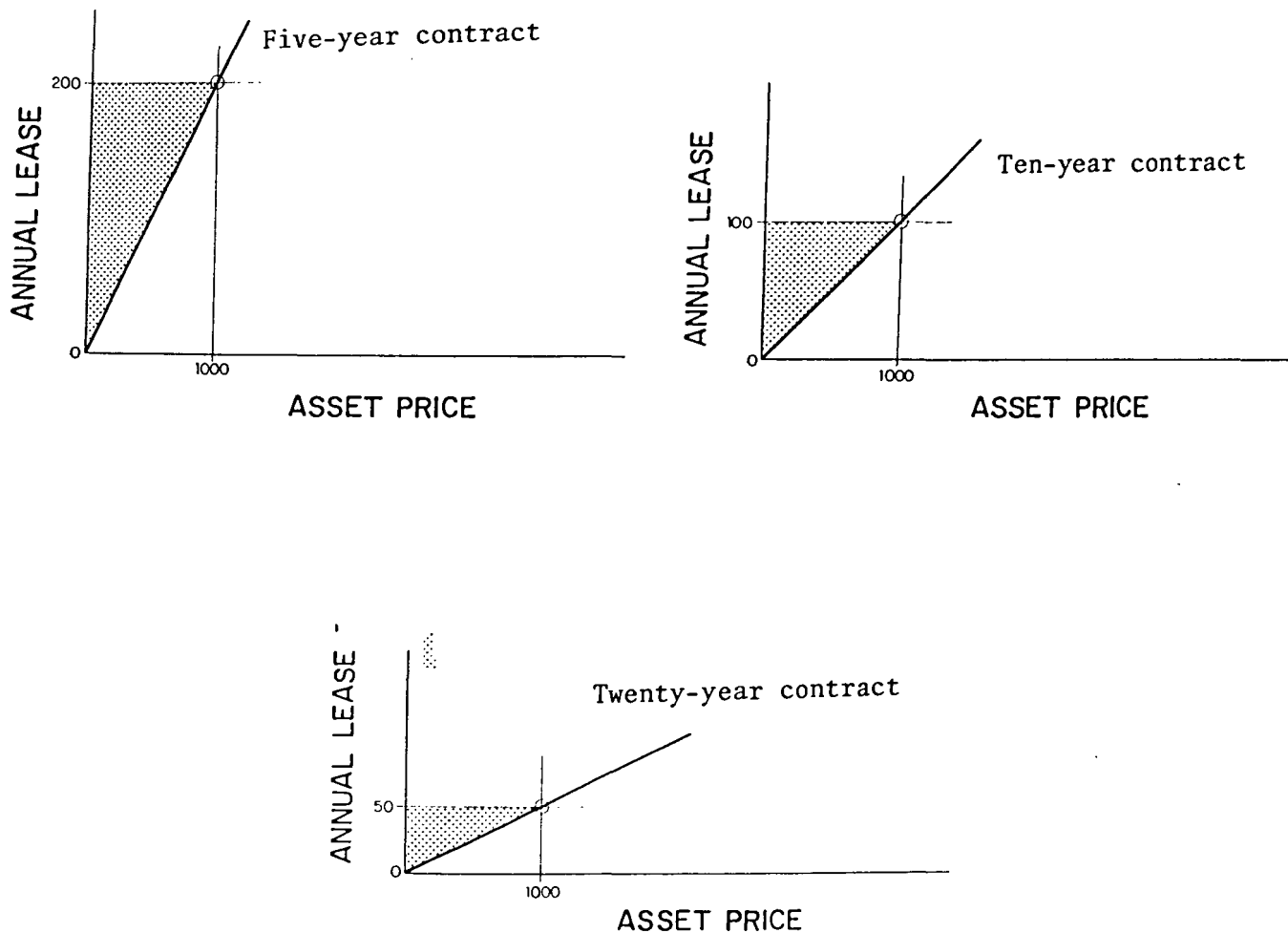


Figure 7. Asset conversion (0% interest).

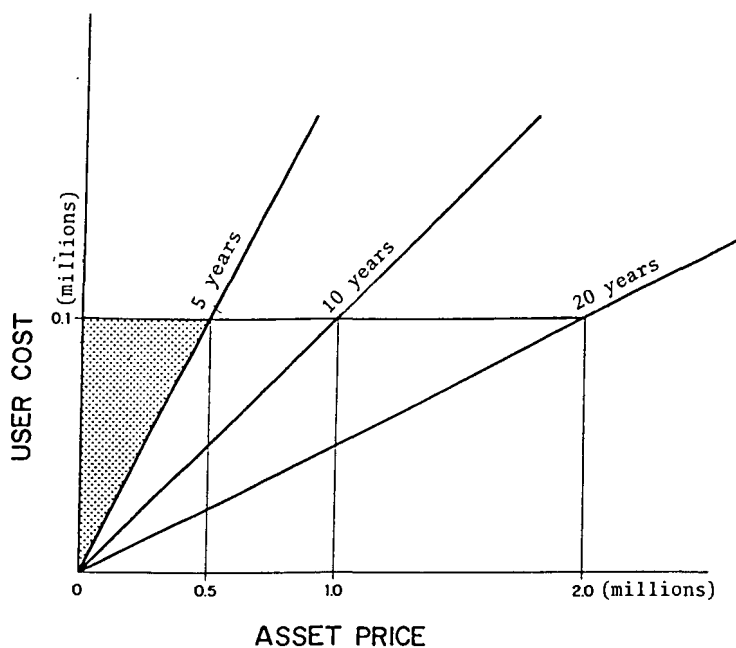


Figure 8. "Durability" and successful search: value-change dynamics of assets (0% interest).

B. Prognosis for the future – increasing profitability through "resources rent" of recycling know-how

In two previous papers [6, 7], the economics of search processes (figure 3) and the economics of resources conversion (figures 5 and 6), respectively, were discussed. The latter was, essentially, a financial management problem analogous to lease-buy decisions. What is attempted below is a grand synthesis of valuation of outputs in interlinked "open, steady state systems" [4] (figure 4). The key to such links is the search processes mentioned above, and the reason offshore production facilities are used as an illustration is that the previous paper [1] was an example of such a search process.

First, in figures 7 and 8 the aim is to illustrate what is involved (thus rendering, the meaning of the previous figures 5 and 6 more transparent).

When assets are converted into revenue streams for the owners of these assets, one commonly used criterion is the payback period. Going from top to bottom (figure 7), it is seen that depending on longer and longer payback periods (physical life of the asset?) lower and lower annual leases or user costs are possible. (To render these graphs simple, a zero interest rate or constant time value of money is assumed here.) For the buyer (lessee), on the other hand, a budget constraint operates that determines the limit he/she is willing to pay for the use of the asset. The higher the income level of the lessee (or the more desirable the item) the more the lessee is willing to pay, allowing for a "profit" for the lessor over and above what the payback of any asset conversion to revenues would give him/her. The shaded area in the top graph is the largest, showing in graphic terms that shorter paybacks mean higher profitability for the lessor, *ceteris paribus*. For the lessee, if a lease anywhere below the budget constraint could be concluded the same shaded area would measure the consumer's surplus, as long as the lessee could pay at a lower rate than what the budget constraint allows, freeing funds for other final consumption uses. If the lifetime and asset value were both guessed correctly, the break-even point is where "profit = consumer surplus = 0": everything works out as planned.

What actually happens, however, is shown in figure 8: the "asset" may be more "durable" than expected: a five-year contract can be extended to 10, 20 years in some cases (e.g. some ships, some cars, some houses, some offshore facilities, etc.).

In such a case the user would be satisfied (his payment represented what he could offer under the

budget constraint), while the owner of the asset would increase profitability beyond the payback. He might thus feel generous in giving a discount to the user, introducing a consumer surplus for the benefit of the user. Longer lease at lower rates should thus ensure sustainability in the sense that both lessors and lessees (or "hire purchase" buyers and sellers) are likely to be satisfied (provided, still, each has a zero discount rate or constant value of money, as an assumption).

What if "time value of money" is introduced for the lessor (seller)? It can be seen that he/she would want a five-year payback as at the top of figure 7, increasing the short-term cash available for gambling on the future or investing, possibly, in research and development, exploration, etc.

What if "time value of money" is introduced for the lessee (buyer)? Clearly, he would wish to maximize his "consumer's surplus" by being as far below the budget constraint as possible (asking, in effect, for longer-term contracts). Time preferences of seller and buyer thus drive contract periods in opposite directions.

Linking this now to gaming and search processes: it is seen that as long as the sellers win (and they are interested in gambling on the future), search processes, exploration, research and development, etc. can be paid for. As long as such gambling does pay off, the future is assured. What if the buyers (lessees) win, and they, in turn, are not interested in gambling on the future (education, research and development, exploration funds as part of the "investment" portfolio, etc.)? Immediate gratification, instant consumption (drugs, alcohol, etc.) could result, and thus an instant economic boom (but imminent bust). New knowledge, new research and new exploration would dwindle, and the society would decline in an orgy of conspicuous final consumption. Here we go beyond Quiggin [9], arguing that intergenerational equity may best be served by gambling on the future, by risk-taking producers. This is made possible by charging separately for exploration know-how, as was argued in the paper "Trade-offs between government revenue and future resource acquisition objectives" [6].

Some simple two-sector "capital's share/labour's share" models have been discussed; here this formalism is applied to the offshore oil and gas production facilities management problem. This represents an example of environmental management as an open, steady state system.

The argument in the idea paper [1] was to link such management to search processes, research and

development, so as to ensure the future of economic and environmentally sound utilization of the "vital seas" [2] The following is quoted from paper [1] as an illustration.:

"As research, demonstration and testing facilities – together with research development and testing of some fisheries related projects – these platforms may represent a valuable asset to some R and D-oriented companies and perhaps could be auctioned off to the highest bidder for such uses by the oilfield operator. Or, alternatively, as part of a planned diversification strategy, the oilfield operators themselves may engage in such activities;

What would be the economics of such an R and D operation? Clearly, some of the equipment to be tested in a realistic marine environment would itself be expensive, costing millions of dollars. In addition, a research support staff for "integrated marine sciences", located, perhaps, at a nearby national university, may represent an operational budget of, say, US\$ 10 million a year for about 100 professional and support staff, and operating facilities. The payoff of R and D institutions is of a long-term nature; however, locating such an institution in Asia and Pacific waters (in, for instance, Labuan or Brunei Darussalam) would make a long-term beneficial contribution to marine resources development in the region and to the economic regime of declining oil provinces. In addition, the oilfield support personnel would represent a pool of technically skilled support staff, who could thus continue to be employed. One could suggest an ASEAN project, possibly hosted and financially supported by the ASEAN member countries."

How could such an enterprise become profitable?

Long-term leases of obsolete facilities to the R and D company would allow for low "user costs" of these facilities. Overhead investments in research facilities would also have to have long-term payback objectives (say, 50 or 100 years?)

The processes chosen (OTEC, fisheries, etc.) should have a "high risk and high pay-off" profile, similarly to oil/gas exploration investments in the past. Thus, recommendations such as in the previous paper on such investments [6] should characterize the business planning of these projects. A brief outline of a proposed procedure along these lines appears, as the concluding section of this paper, with intersectoral and intergenerational efficiency and equity issues being

discussed at the same time.

II. Summary and recommendations

"The complex web of life in the sea continuously recycles the chemicals essential for living organisms to survive. The marine plants transform inorganic nutrients into organic matter. Animals convert organic matter back into carbon dioxide when they breathe. The plants serve as food for vegetarian forms of life. These in turn are eaten by the carnivores. At the bottom of the sea, scavenging forms of marine life and bacteria which decompose organic debris help regenerate the nutrients which are gradually carried back to the surface. This takes place particularly in the so-called upwelling regions near coasts, where over 90 per cent of fish production occurs." This quotation from Kullenberg [2] allows us to see the natural symbiosis of living systems in the sea. Industrial metabolism, applied to recycling, would attempt to emulate this for human-created systems, linking a number of open, steady state systems as depicted in figure 4. The refuse and waste-heat output stream of one system forms the low entropy resources input of the next one. Such links would not only would have to be sanitary, but would need to make economic sense. Unless the finished products represent economic value higher than the costs of inputs and processing, the chain would be broken, the process would stop, and one would be left with unprocessed refuse and waste heat. Finding economically viable processes, however, necessitates a search process (exploration, research and development) that, in turn, must remain economically viable. Figure 3 depicts such processes, exhibiting a recursive structure: exploration success at time t (depicted by the double asterisk on the right) determines economically viable production processes at time $t + 1$. Within this, the final consumption allocated for search processes at that time (denoted by a single asterisk on the left) determining (through the success of exploration) economically viable production processes of the next time period.

Intersectoral equity is related to the fact that while the earlier oil/gas development may have been economic, the follow-up processes may instead be located in the fisheries or high-technology research and development sectors, for viable business propositions of the future.

Intergenerational equity depends in a complicated way on the proportion of forgone current consumption

and welfare, for financing research and development and search processes. As long as search processes are successful, new assets will be abundant and cheap (in a comparative sense). Thus one would be operating on the left hand side of figure 6. Unsuccessful search processes, on the other hand, may result in overvalued assets and a "vicious society", where no one is satisfied, and where people are unable, and unwilling, to finance additional search processes out of current income.

Since the oceans represent a new frontier, it is likely that the long-term search processes based on research and development uses of offshore platforms could pay off, and thus result in a revitalized post-industrial society, based on the symbiotic utilization of the vital seas.

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CONCLUSIONS

Having treated the offshore platform disposal problem as a particular case of the more general problem of waste recycling for sustainable development, what kind of general conclusions emerge?

First, the absolute size of an economy is indeterminate from general equilibrium analysis: there are several possible equilibrium levels, depending on capital structures, financing etc. and the valuations implied in the economic "ends" chosen by society including, at present, values placed on the environment, on search processes, and on the welfare of future generations.

While the problem has been discussed before, the solutions proposed were often ideology-inspired, and thus counter-productive. This is the case also with the present great faith in the market mechanism to solve all intractable interface problems.

What is offered here, instead, is the view that large projects create their own markets – as long as there is a social consensus on these projects.

The emerging environmental consensus may result in large projects, creating their own markets. Large space programmes (perhaps inspired by worries about the greenhouse effect) might represent a worldwide economic stimulus. Paradoxically, even the mammoth task of trying to feed an estimated 10 billion or more of the world's population by the middle of the next century might turn out to be such an economic stimulus.

The hopeful note end on is that as long as such questions are treated in an ideologically bias-free manner, some search processes might be successful and acceptable equilibria in several communicating subcultures could be achieved.

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