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**IMO /FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP  
JOINT GROUP OF EXPERTS ON THE SCIENTIFIC ASPECTS  
OF MARINE POLLUTION  
- GESAMP -**

**REPORTS AND STUDIES**

No. 21

REPORT OF THE FOURTEENTH SESSION  
VIENNA, 26-30 MARCH 1984



INTERNATIONAL ATOMIC ENERGY AGENCY



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Definition of Marine Pollution by GESAMP

"POLLUTION MEANS THE INTRODUCTION BY MAN, DIRECTLY OR INDIRECTLY, OF SUBSTANCES OR ENERGY INTO THE MARINE ENVIRONMENT (INCLUDING ESTUARIES) RESULTING IN SUCH DELETERIOUS EFFECTS AS HARM TO LIVING RESOURCES, HAZARDS TO HUMAN HEALTH, HINDRANCE TO MARINE ACTIVITIES INCLUDING FISHING, IMPAIRMENT OF QUALITY FOR USE OF SEA WATER AND REDUCTION OF AMENITIES."

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Rep. & Stud. No.	Title	Date	Language
1.	Report of the Seventh Session	1975	E,F,R,S
2.	Review of Harmful Substances	1976	E
3.	Scientific Criteria for the Selection of Sites for Dumping of Wastes into the Sea	1975	E,F,R,S
4.	Report of the Eighth Session	1976	E,F,R
5.	Principles for Developing Coastal Water Quality Criteria	1976	E
6.	Impact of Oil on the Marine Environment	1977	E
7.	Scientific Aspects of Pollution Arising from the Exploration and Exploitation of the Sea-bed	1977	E
8.	Report of the Ninth Session	1977	E,F,R
9.	Report of the Tenth Session	1978	E,F,R,S
10.	Report of the Eleventh Session	1980	E,F,S
11.	Marine Pollution Implications of Coastal Area Development	1980	E
12.	Monitoring Biological Variables related to Marine Pollution	1980	E,R
13.	Interchange of Pollutants between the Atmosphere and the Oceans	1980	E
14.	Report of the Twelfth Session	1981	E,F,R
15.	The Review of the Health of the Oceans	1982	E
16.	Scientific Criteria for the Selection of Waste Disposal Sites at Sea	1982	E
17.	The Evaluation of Hazards of Harmful Substances Carried by Ships	1982	E
18.	Report of the Thirteenth Session	1983	E,F,S
19.	An Oceanographic Model for the Dispersion of Wastes Disposed of in the Deep Sea	1983	E
20.	Marine Pollution Implications of Ocean Energy Development (in print)		
21.	Report of the Fourteenth Session	1984	
22.	Review of Potentially Harmful Substances (in preparation)		
23.	Interchange of Pollutants Between the Atmosphere and Oceans (in preparation)		
24.	Thermal Discharges in the Marine Environment (in preparation)		

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1. OPENING OF THE MEETING

- 1.1 The Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) held its 14th session at IAEA Headquarters, Vienna, from 26 to 30 March 1984, under the Chairmanship of Mr. A.D. McIntyre. Mr. E.D. Gomez was Vice-Chairman.
- 1.2 At the opening of the session Mr. B. Semenov, the Deputy Director General of the Department of Nuclear Energy and Safety welcomed the participants on behalf of the Director General of the IAEA, Mr. H. Blix. He congratulated GESAMP for the important contribution it had made during its fifteen years of existence. Mr. Semenov expressed the IAEA's appreciation for GESAMP's efforts, particularly in the preparation of Reports and Studies No. 19 which has already assisted the Agency in its work for the Contracting Parties of the London Dumping Convention.
- 1.3 The Chairman of GESAMP, thanked the Director-General of IAEA on behalf of the participants for the good wishes for the success of the session, for hosting the meeting and for the facilities that were provided. He also introduced the new members of the Group.
- 1.4 The agenda for the session as adopted by the Group is given in Annex I. A list of documents submitted to the session, relating to particular items of the agenda, is given in Annex II.
- 1.5 A list of participants is given in Annex III.

2. REVIEW OF POTENTIALLY HARMFUL SUBSTANCES (WORKING GROUP 13)

- 2.1 The report on the intersessional activities of the Working Group on the Review of Potentially Hazardous Substances was introduced by its Chairman. A summary of the report is attached as Annex IV. The second session of the Working Group was convened in London from 30 January to 3 February 1984, hosted by the Monitoring and Assessment Research Centre (MARC) at Chelsea College which has become actively involved in the tasks of the Working Group. In addition, UNEP's International Register of Potentially Toxic Chemicals (IRPTC) continued to support the Working Group through the preparation of data profiles upon which the draft evaluation documents are being based.
- 2.2 The first three substances evaluated by the Working Group were cadmium, lead and tin. Revised draft documents had been circulated to all GESAMP members during the intersessional period and a number of comments received. All comments were in general agreement with the draft documents although several modifications were proposed particularly concerning the extent to which human health aspects should be discussed in a GESAMP document.
- 2.3 The Chairman of the Working Group proposed that the three documents be combined into one joint publication and subject to an editorial panel review at MARC, London, prior to publication in the series of GESAMP Reports and Studies Number 22. The Group recognized the present status of the drafts but insisted that a final review be undertaken by all GESAMP members. It was agreed, therefore, that the edited final version be circulated during the intersessional period for comments and clearance by all GESAMP members before publication.

- 2.4 Draft evaluation documents on mercury and arsenic had been prepared during the intersessional period and were reviewed at the second session of the Working Group. Whereas the arsenic document was considered largely complete, it was acknowledged that considerable updating of the marine aspects of mercury was required. This will be undertaken subsequent to the meeting on Biogeochemical Cycles of Mercury in the Mediterranean, Sienna, 27-31 August 1984. Both drafts will then be circulated to all GESAMP members for review. The Working Group felt strongly that selenium be also included in the list of substances for evaluation in the light of its interactions with mercury, cadmium and arsenic. The Group concurred with this proposal and noted that a WHO Environmental Health Criteria Document on selenium would be available. It was subsequently pointed out that ICES was also involved in a study of selenium in the marine environment and that some pooling of resources would be useful.
- 2.5 Concerning organosilicons, the Chairman of the Working Group recalled that the request to review this group of substances by GESAMP had been initiated by the concern of the producing industry over the high hazard rating of organosilicons in several international treaties on marine pollution control. Advice has been sought, therefore, from GESAMP through its co-sponsoring organizations. The Working Group at its second session reviewed the question of organosilicons and presented to the Group some of the first findings as follows:
- 2.6 The number of organosilicon compounds is extremely large because most of the organic compounds can be converted to organosilicon by replacement of one or more carbon by silicon or by silylation. The presence of silicon does not change substantially the toxic characteristics of the parent compound, therefore organosilicons do not form a distinct group from the toxicological point of view. Consequently, the Working Group did not consider it possible to evaluate the organosilicons as one single group with regard to their hazard rating in 'black' and 'grey' lists of international treaties, i.e. with regard to their toxicity, persistence and bioaccumulation.
- 2.7 As the presence of silicon facilitates polymerization, the polymerized organosilicons have found wide commercial application and are thus the ones which are likely to be found in the environment. It was agreed that the Working Group should prepare a report reviewing the problems related to the evaluation of organosilicons as a single group. Also an evaluation of a few selected, commercially important groups of organosilicons should thus be undertaken by the Working Group although most of the pertinent data would have to be taken from industry-related research and studies. It was agreed, finally, that the Working Group will consolidate its draft reports and specify the conditions and limitations for evaluation. A comprehensive review report on the various aspects of the problem will be submitted to GESAMP XV.
- 2.8 The need for evaluating substances with known or potential carcinogenic, teratogenic or mutagenic properties was brought to the attention of the Group by the IMO Technical Secretary of GESAMP who conveyed a relevant request from the Seventh Consultative Meeting of Contracting Parties to the London Dumping

## ANNEX IX

### SUMMARY OF THE REPORT OF THE WORKING GROUP ON THE METHODOLOGY AND GUIDELINES FOR THE ASSESSMENT OF THE IMPACT OF POLLUTANTS ON THE MARINE ENVIRONMENT (WORKING GROUP 23)

1. The Working Group held its first session in FAO, Rome from 26 to 30 September 1983, under the chairmanship of Mr. V. Pravdic. Mr. E.D. Gomez was Rapporteur and Mr. H. Naeve acted as Technical Secretary in lieu of Mr. R. Helmer who was unable to attend.
2. The Working Group received 12 background documents which were discussed. They covered such fields as physical oceanography, chemical reactor theory, toxicology, chemistry, biology and coastal development and management.
3. The Working Group provided a definition of the assimilative capacity of the environment as its ability to accommodate a particular activity without unacceptable consequences. It also highlighted the components which have to be taken into account in quantitative assessment of the assimilative capacity.
4. The Working Group also indicated its viewpoint that in any new activity contemplated or planned, the overall impact on the total environment must be considered. It advocated a holistic approach in assessing the impact of pollutants on the marine environment.
5. Specific characteristics of the impacted ecosystem were identified which have to be taken into account when devising guidelines for the assessment of the impact of pollutants on the marine ecosystem.
6. The Working Group has recommended that the components for such guidelines to be developed should be the following:
  - (a) the characterization of the discharge or other activities;
  - (b) the description of the environment;
  - (c) the determination of critical pathways;
  - (d) the determination of the assimilative capacity;
  - (e) the suggestion of optimization procedures; and
  - (f) the management of assimilative capacity.
7. The Working Group has also recommended that in the development of guidelines an analysis of one or several case studies would be essential.



that will result in a logical stepwise work program. First priority tasks must be defined in detail along with an action plan for their accomplishment during the coming year. This will involve intersessional work which should result in preliminary reports on the designated tasks at the next Working Group meeting.

- Item 7. Additional items to be addressed may come up at the fourteenth session of GESAMP. These will be presented as additional agenda items by the Chairman at the Working Group meeting.
- Item 8. As a final item of business a list of recommendations will be developed for presentation to GESAMP. This will include recommendations for place and time of the next meeting. Proposed activities will also be recommended.

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LAND-SEA BOUNDARY FLUX OF POLLUTANTS  
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Convention. The Group discussed various aspects of carcinogenicity, including the occurrence of tumours in fish and the risk to humans through consumption of contaminated seafood. It was considered premature, however, to prepare any hazard evaluation of specific groups of substances before a preliminary study on available data, methods and approaches had been undertaken to determine the scope and purpose of a possible GESAMP activity in this field. It was agreed that the Working Group consider the above and submit a first report to GESAMP XV.

- 2.9 The review of phosphorous and nitrogen as major nutrients contributing to eutrophication and algal blooms was considered an important task for GESAMP. To this end IRPTC data profiles are under preparation at the Marine Biology Association of the United Kingdom, Plymouth, which will be used in preparing a draft review document. An ICES meeting on algal blooms, scheduled for October 1984, will provide further information on the subject. The occurrence of paralytic shellfish poisoning (PSP), from the release of neurotoxins during algal blooms is a human health hazard which has been subject to scientific review at a recent WHO meeting. It was agreed that the Working Group, upon completion of the review of the metals and arsenic, prepare an evaluation document on the subject and adjust its membership accordingly.
3. EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS (WORKING GROUP 1)
- 3.1 The IMO Technical Secretary informed the Group that the Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships had met twice during the intersessional period, once in London (6-10 June 1983) and once in Aberdeen (9-10 January 1984). He indicated that the work of producing and reviewing hazard profiles of substances carried by ships had been continued but that in addition the Working Group had made considerable efforts to develop Guidelines for Evaluating Threshold Values for Fish-Tainting. This was shown to be necessary in the absence of a standard methodology for the assessment of tainting and of literature data on this criterion. So far the tainting ratings ("T") had been highly subjective and had therefore often been queried by the chemical industry.
- 3.2 The Group was further informed of a number of questions which had been raised by the relevant IMO bodies. In particular questions had been raised by the Marine Environment Protection Committee (MEPC) and its Sub-Committee on Bulk Chemicals concerning the hazardous properties of coal derived oils in comparison with those of oils of petroleum origin, and the evaluation of substances which have a potential for blanketing of the seabed. A summary of the reports of the Working Group is set out in Annex V.
- 3.3 The Chairman of the Working Group noted that some of the difficulties encountered by the Working Group at previous sessions in obtaining data, particularly on the aquatic toxicity of substances, had been overcome. The requirements for the prevention and control of marine pollution by noxious liquid substances carried in bulk (MARPOL 73/78, Annex II) will enter into force in October 1986. The Marine Environment Protection

Committee of IMO has decided that amendments to the Convention which, to a certain extent, are based on the GESAMP hazard profiles, should be finalized by the end of 1984. This has led to additional data from Governments and industry being received by the review group.

- 3.4 The Group noted that the Working Group, in recognizing that in many countries concerns have been expressed on the chronic toxicity, including carcinogenicity, of phthalates, had agreed to evaluate the long-term health effects of phthalate esters at its next session. The Group requested the IMO Secretary to make the outcome of this consideration available to the Working Group on the Review of Potentially Harmful Substances.
- 3.5 Several members of the Group queried the approach and evaluation method used by the Working Group. The Group accepted the explanation that the procedure followed by the Working Group had to a very large extent been embodied in the text of the International Convention for the Prevention of Marine Pollution from Ships (MARPOL 73/78) and as such could not be substantially altered. Nevertheless, as the state of knowledge and experience had improved, a number of clarifications had been made and some minor additions and changes had been included in the hazard profile rationale since its adoption by the Group in 1972.
- 3.6 The Group's attention was drawn to non-soluble substances with specific gravity greater than that of seawater which may pose a particular threat of pollution due to their potential for blanketing of the seabed, it was noted that the Working Group would continue to be alert to such substances and that it would welcome any information on accidental spillages of blanketing substances which had led to damage to marine life. In this respect the Group was informed of a case where creosote from a spillage had been shown to blanket the bottom of a Swedish lake. Fluorinated hydrocarbons of high molecular weight if shipped in sufficient quantity, were suggested as possible examples of substances which might blanket the sea bottom.
- 3.7 The Group considered the draft Guidelines for Evaluating Threshold Values for Fish-Tainting. The Group welcomed the efforts made by the Working Group in developing such Guidelines. It was noted that the Working Group will make an attempt to include in the Guidelines a definition of tainting as well as a statistical method for evaluating the threshold concentration values.
- 3.8 Several members of the Group expressed the view that the process of tainting fish by discharge or spillage of chemicals at sea might not entirely be within the category of processes generally described as 'bioaccumulation'. The Working Group was advised to consider this question when developing a definition of 'tainting' and, if necessary, revise the hazard rationale accordingly. It was also pointed out that the text of a definition would depend upon the results achieved in implementing the Guidelines on fish-tainting.
- 3.9 Several queries were also made with regard to the fish recommended as test organisms, i.e. rainbow trout and mullet. In this connection proposals were made to include shellfish as

#### ANNEX VIII

#### ANNOTATIONS TO THE AGENDA OF THE GESAMP WORKING GROUP ON THE LAND-SEA BOUNDARY FLUX OF POLLUTANTS (WORKING GROUP 22)

Because of logistical reasons this first meeting of the Working Group on the Land/Sea Boundary Flux of Pollutants is being held in Mazatlan to overlap with a meeting of the IOC/GEMSI ad hoc Group on the Use of Marine Sediments in Marine Pollution Monitoring. This will enable several participants in the IOC meeting to participate in the GESAMP meeting. This arrangement was particularly practical since the Unesco Technical Secretary to GESAMP (R. Dawson), and one member of the GESAMP Land/Sea Boundary Flux Working Group (A. Saliot) had already planned to attend the IOC meeting. Also Mr. Jan Duinker, Chairman of GEMSI, who had planned to attend the IOC meeting wished to attend the Land/Sea Boundary Flux Working Group meeting as an observer.

The following notes provide a more detailed description of the subjects to be considered in specific agenda items.

- Item 2. The chairman of the Land/Sea Boundary Flux Working Group, with the assistance of the Unesco Technical Secretary will explain the structure of GESAMP, its modus operandi and the origin of the Land/Sea Flux Working Group.
- Item 3. The terms of reference of the Working Group, as stated in the Report of the Thirteenth Session of GESAMP, will be reviewed and discussed. The major purpose of this agenda item is to determine whether the terms of reference provide sufficient instruction or need further elaboration.
- Item 4. The Chairman and the Unesco Technical Secretary will briefly review activities of other groups which may have bearing on the activities of the Land/Sea Boundary Flux Working Group.
- Item 5. Some discussion will be necessary to reach agreement on the definition of the "land/sea boundary". This boundary can be defined on the basis of either physical or chemical characteristics or both. Also, do we consider the "sea" the open ocean only or does it include coastal seas. If the open ocean is the sea side of the boundary then the continental shelf must be considered a part of the boundary. Perhaps separate approaches must be taken to consider both cases.
- Item 6. The most important work to be accomplished during this meeting of the Working Group is to establish objectives for the group based on the terms of reference and discussion under item 5. Once objectives have been established, appropriate tasks must be defined to accomplish the stated goals within a time table of two to three years. A priority must be established for tasks

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recommended test organisms, in particular oysters and blue mussels. The Chairman of the Working Group pointed out that his group had made the above recommendation after considering aspects such as the appropriateness of a test organism with a moderate fat content (5-10%), the feasibility of maintaining in test organisms aquaria that could be used all the year round, and the existence of an established technology relating to the tainting of fish, albeit arising from other causes. In accepting the basic approach of the Working Group, the Group nevertheless recommended that some comparative tests should also be carried out with molluscs.

- 3.10 The Group approved the reports of the Working Group including the lists of hazard profiles of substances and the Guidelines for Evaluating Threshold Values for Fish-Tainting set out in the annexes to the reports.
- 3.11 The Group agreed that the Working Group should continue with its task. The Group recommended that the Guidelines for Evaluating Threshold Values for Fish-Tainting when completed (see paragraph 3.7 above) together with results achieved by using the Guidelines should be prepared for publication in the GESAMP Reports and Studies series.
4. INTERCHANGE OF POLLUTANTS BETWEEN THE ATMOSPHERE AND THE OCEANS (WORKING GROUP 14)
- 4.1 The Chairman of the Working Group introduced a report which had been prepared for publication in the GESAMP Reports and Studies series. The report includes scientific knowledge derived from the Third Session, Miami, 1980; the *ad hoc* meeting, Tallin, 1981; Expert Consultations, Hamburg 1981; and London, 1983. Following a thorough discussion, the Group approved the draft version of the document, with the proviso that a final version, revised in accordance with the Group's advice, be sent to Group members for approval and subsequent publication as GESAMP Reports and Studies Number 23.
- 4.2 A draft report of the Fifth Session of the Working Group, Athens, 1983, was presented by Mr. Pravdic, Working Group member who chaired the Athens meeting. This session was devoted to a review of the guidelines for monitoring of atmospheric transport of pollutants originating from diffuse land-based sources into the Mediterranean Sea as part of the first two terms of reference adopted by the Group at its 13th Session. The Technical Secretary of UNEP urged that all aspects of these first two terms of reference be addressed at future Working Group Meetings because of the importance of these tasks to the development of regional monitoring programmes.
- 4.3 The Group agreed that it is important for the Working Group to continue to review air-sea material interchange. Consequently, the third term of reference was revised and made more general.
- 4.4 The Chairman noted that the Working Group was to cooperate with and provide advice to the newly proposed Working Group on Integrated Global Ocean Monitoring. To provide for this a fourth item was therefore added to the terms of reference.

To accommodate these tasks, the following revised terms of reference for the Working Group were adopted by the Group:

- (i) to describe transport processes towards and into specific regions, using the Mediterranean as the first example, and the region of the Kuwait Action Plan as a possible second example, including:
  - horizontal atmospheric transport affecting the region,
  - vertical atmospheric transport to the air-water interface,
  - air-water interchange;
- (ii) to review the scientific literature and assess the pathways and fluxes of important pollutants into particular regions, using the Mediterranean as the first example, and the region of the Kuwait Action Plan as a possible second example, and to differentiate between natural and pollutant sources;
- (iii) to provide a continuing review of air-sea material interchange with emphasis on the pollutant modification of ocean-related processes, especially those pertinent to climate; and
- (iv) to provide advice on the scientific bases for international programmes for the monitoring of pollutant levels in the atmosphere near the sea surface and pollutant fluxes across the air-sea interface.

- 4.5 The Group recalled that at its thirteenth session in the course of a review of the GESAMP definition of "Marine Pollution", the Working Group on the Interchange of Pollutants between the Atmosphere and the Oceans had been asked to prepare an explanatory statement on process modification by pollutants for consideration at the fourteenth session of GESAMP (GESAMP Reports and Studies No. 18, paragraph 8.5).
- 4.6 The Group noted that such a statement is being developed by the Working Group for presentation and consideration by the Group at a future session.
5. BIOLOGICAL EFFECTS OF THERMAL DISCHARGES IN THE MARINE ENVIRONMENT (WORKING GROUP 15)
- 5.1 The FAO Technical Secretary informed the Group that the Working Group had held its third Session in Rome from 3 to 7 October 1984. The Chairman of the Working Group introduced the report, a summary of which is given in Annex VII.
- 5.2 The Group noted that the Working Group had amended its review of information on the effects of thermal discharges in coastal waters but conclusions on that subject were unchanged. Following recommendations of the 13th Session of GESAMP a new chapter had been drafted on strategies and options for thermal discharges, dealing with methodologies on social and economic aspects, regulatory criteria, engineering options and beneficial uses of waste heat, such as mariculture. The chapter on environmental assessment had been condensed without change of emphasis.

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BIOLOGICAL EFFECTS OF THERMAL DISCHARGES IN THE MARINE ENVIRONMENT  
(WORKING GROUP 15)

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9. STRATEGIES AND OPTIONS FOR THERMAL DISCHARGES
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      - 9.1.2 Decision Analysis
      - 9.1.3 Cost-Effectiveness Analysis and Risk Assessment
    - 9.2 Regulatory Criteria
      - 9.2.1 The definition of the impacted area
      - 9.2.2 The establishment of the dose-response relationships
      - 9.2.3 The receiving capacity of the environment
    - 9.3 Engineering Options
      - 9.3.1 Means of reducing the impact
      - 9.3.2 Means of reducing the discharge
      - 9.3.3 Summary and comparison of engineering options
    - 9.4 Antifouling Alternatives
    - 9.5 Ancillary Activities of Waste Heat Utilization
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      - 10.2.3 Biological assessment
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    - 10.4 Evaluation and Assessment
    - 10.5 Validation - Information Access and Use
      - 10.5.1 Model validation
      - 10.5.2 Information exchange and data access
  11. CONCLUSIONS AND RECOMMENDATIONS
  12. REFERENCES
- 5.3 The Group proposed a number of editorial and minor substantive amendments. A lively discussion arose, however, on the section on capacity of the environment to assimilate heat discharges. It was agreed that although information given in this chapter was essential, the subject could be dealt with in a more general way. Consequently, this section has been redrafted accordingly.
  - 5.4 After these amendments, the Group approved the report. Noting that the scope of the report was much wider than just biological effects of thermal discharges, the Group decided that the report be published under the title 'Thermal Discharges in the Marine Environment' as GESAMP Reports and Studies No.24.
  6. LAND-SEA BOUNDARY FLUX OF POLLUTANTS (WORKING GROUP 22)
  - 6.1 The Unesco Technical Secretary recalled the terms of reference of the Working Group as proposed at the 13th Session and informed the Group that the first meeting would take place in Mazatlan, Mexico, 3-7 April 1984 under the Chairmanship of Mr. Window.
  - 6.2 The intersessional period had seen a number of developments. Studies on riverine inputs to the sea were being addressed by a number of bodies (e.g. SCOR, ICES, JMG). The forthcoming ICES-IOC-NOAA Symposium on 'Contaminant Fluxes through the Coastal Zone', Nantes, 16-18 May 1984 is expected to contribute to the available information to be considered by the Working Group.
  - 6.3 In the context of quality assurance of coastal zone measurements and within the framework of the Comprehensive Plan for GIPME, the IOC-GIPME Group of Experts on Methods, Standards and Intercalibration (GEMSI) have repeatedly recommended a major effort to define the net-efflux of pollutants from land via rivers to the coastal zones and on to the oceans and, further, to improve the intercomparability of data on river inputs. The GESAMP Working Group would receive full support from GEMSI in their forthcoming work.
  - 6.4 The Group was informed of a case study presently being developed by IOC which would focus on river inputs to the Upper Gulf of Thailand. This exercise may provide the opportunity to test any models or approaches developed by GESAMP as indicated in the third term of reference.
  - 6.5 A proposal for the organization of the Group's work was presented for discussion by the Chairman, Mr. Window, in the form of an annotated agenda for its first session (Annex VIII).
  - 6.6 It was felt that some clarification of the boundaries was required, particularly whether the aims were to describe inputs to the coastal zone or whether the input to the oceans was the main concern. It was stressed that the wording of the terms of reference 'through the marine environment' was not intended to exclude boundary environments such as wetlands, nor was it intended to focus the Group's attention on the complexities of estuarine processes. The Group should not consider the wider geochemical cycles of the oceans but should address the riverine inputs to these cycles.

- 6.7 It was emphasised that the Review of the Health of the Oceans was intended to be a dynamic approach and the activities of this working group should continue to reflect this.
- 6.8 The observer from the Oslo-Paris Commissions pointed out that maximum and minimum river inputs had been reported in a number of instances to the Technical Working Group of the Paris Commission. Information provided by GESAMP on approaches to quantifying these inputs to the estuaries, through the estuaries and coastal waters to the open sea and ultimately to the oceans, would be welcomed by the Commissions.
- 6.9 The Group was reminded that the control of pollution from land-based sources was an integral part of many national and international protocols for the protection of the marine environment. The reports of the Working Group would thus be of considerable interest to legal experts in applying protection measures on a regional basis.
7. METHODOLOGY AND GUIDELINES FOR THE ASSESSMENT OF THE IMPACT OF POLLUTANTS ON THE MARINE ENVIRONMENT (WORKING GROUP 23)
- 7.1 The Group was informed by the WHO Technical Secretary that the Working Group held one meeting from 26 to 30 September 1983 at FAO, Rome, and acknowledged the support given to this Working Group by FAO, Unesco, IAEA and UNEP. This enabled the Working Group to invite 14 members from diverse fields of science to deliberate the task in view of the terms of reference set forth by GESAMP XIII.
- 7.2 The Report of the Working Group was introduced by its Chairman who described the background of its formation on the basis of the initial request by UNEP, and the needs of Governments of less developed countries to have guidelines in assessing the potential impact of the release of pollutants into coastal and marine waters.
- 7.3 The Chairman of the Working Group also indicated that the Working Group had had difficulties in addressing each of the two terms of reference separately, and that it was decided to deal with these simultaneously.
- 7.4 The Report of the Working Group reflects the consensus of the Members in adopting a definition for the assimilative capacity and for the various information components needed to assess it. The Report reflected the thinking of the Working Group in pursuing the idea of the Critical Pathway Analysis as an environmental protection tool beyond its traditional application in radiological protection. A general theoretical example was presented on how this could be achieved.
- 7.5 The Working Group also addressed the problem of how to define the boundaries of the impacted ecosystem, and the specific cases in which the boundaries could be influenced:
- (i) the specific site;
  - (ii) the specific contaminant;
  - (iii) the specific inputs;
  - (iv) the hydrodynamics of the environment;

alternatively as means of reducing discharge. The steps necessary to establish regulatory criteria for the planned discharge are described.

5. With the aim of minimal environmental disturbance, assessment procedures for siting, design and plant operation have been developed, with survey and monitoring data gathered at each stage from initial site selection through to commercial operation. The Working Group, while recognizing that an ideal assessment programme might not be achieved, recommends that some assessment procedure should always be adopted. Experience of past developments can be used to help define conditions for siting and operation that will result in least environmental disturbance.

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ANNEX VII

SUMMARY OF THE REPORT OF THE WORKING GROUP ON BIOLOGICAL EFFECTS OF  
THERMAL DISCHARGES IN THE MARINE ENVIRONMENT  
(WORKING GROUP 15)

- (v) the biological processes operating in the environment;
- (vi) the biogeochemical processes occurring in the ecosystem;
- (vii) the kinetic parameters; and
- (viii) the uses made of the ecosystem.

The Working Group had elaborated on each of these cases. It devoted special attention to define the mean life of a chemical species in a closed system, and the mean residence time for open systems in a steady state.

1. The Working Group has met on three occasions. At its first meeting (21-25 September 1981, Dubrovnik), the Working Group reviewed information on the effects of thermal discharges to coastal waters, the first of its terms of reference. At the second meeting (18-22 October 1982, Rome) this review was extended to include additional information relating to experience in tropical waters, and in biocide practices. In consideration of its second term of reference, to develop guidelines for siting, an idealized schedule and time-scale for site assessment was set out. At the third meeting (3-7 October 1983, Rome) strategies and options for thermal discharges were elaborated.
2. While, in temperate waters, little environmental disturbance can be seen when discharges are about 10°C above ambient, in tropical areas this temperature increment will approach or exceed the thermal tolerance limits of organisms in the receiving areas. In tropical regions, water temperatures are generally 25 to 32°C, with summer temperatures commonly about 30°C. A thermal discharge with an increment of 5°C could be damaging. At some sites, even discharges of  $\Delta T$  3-5°C have led to damage, especially where the discharge is made to shallow, enclosed areas, or across shorelines. At other sites, higher incremental temperatures have not led to damage. Information is not always available on biocide practice, which may partially explain these differences.
3. It is common practice to control macrofouling of culverts and microfouling of heat exchangers by the application of chlorine in some form. Until recently the understanding of chlorine behaviour in seawater was hampered by inability to analyse at the concentrations discharged. Within a thermal discharge it is now known that decay and dilution reduce residual concentrations so that the "chlorine plume" is within the "thermal plume", and use of the latter for prediction of effects is conservative. The toxicity and persistence of different chlorine compounds differ, and dose-effect depends on mode of operation and the chemical used, as well as on concentration, exposure time, temperature, pH, and on biomass and sensitivity of organisms.
4. In most coastal and estuarine locations where thermal discharges will occur, economic, social or administrative considerations will figure largely. Decision analysis offers an objective and systematic procedure for giving comparable weighting to these different facets, even where there are areas of uncertainty. It recognizes that some value judgements will have to be made. A procedure for decision analysis is outlined and examples of decision criteria, including acceptable environmental impact, identified. Where the expected impact is deemed unacceptable, a variety of engineering options can be considered as means of reducing impact or

- 7.6 The Group accepted the conclusion of the Working Group that each ecosystem has a finite capacity to assimilate pollutants, but questioned the feasibility of its quantitative assessment. The Group also expressed its opinion that the term 'assimilative capacity' should be used with much restraint, although it was aware that it has entered into use in legal documents and has been incorporated into some international conventions and protocols.
- 7.7 The Group also advised the Working Group to look into alternative procedures, such as decision analysis in assessing the impact of pollutants on the marine environment. It expressed strong reservation against using the critical pathway analysis in all cases where the target is other than man, or not identified, or where the pollutant is a chemical which might be degraded or modified by chemical, biochemical or microbiological processes in the marine environment.
- 7.8 On the basis of the results of the deliberations within the Working Group and the comments expressed on the proposed methodology, the Group accepted the Report of the First Session as a basis to proceed. The Group decided to modify the terms of reference of the Working Group for the next intersessional period. The following were adopted:

To provide specific guidelines for the assessment of the impact of potentially harmful substances released from land-based (coastal) sources into the marine environment. The guidelines should consist of:

  - (a) a short introduction outlining the basic concepts and premises;
  - (b) a description of parameters and processes to be taken into account in the assessment of the environmental impact of pollution relevant to human health, marine organisms, ecosystems and amenities;
  - (c) a description of techniques to be used in order to assess the magnitude of parameters and rates of processes and their importance in the overall evaluation of impacts.
- 7.9 The Group also recommended that the Working Group perform a typical case analysis, and if feasible, convene at the actual site. It was recommended that the co-sponsoring agencies assist in the identification of a suitable case study area and make the necessary arrangements with the respective government.

8. FUTURE WORK PROGRAMME

8.1 Integrated Global Ocean Monitoring (Working Group 24)

8.1.1 The Technical Secretary of UNEP introduced document GESAMP XIV/8 reviewing the background of and containing the proposal for the establishment of a GESAMP Working Group on integrated global ocean monitoring. He indicated that UNEP would be ready to support the Working Group, subject to satisfactory agreement with the lead agency on matters relevant to the composition, activity and use of outputs of the Working Group. Should such an agreement fail to be reached, UNEP would be willing to be the lead agency.

8.1.2 In the ensuing discussion, the Group emphasized the existence of global and regional programmes, such as MARPOLMON, GIPME, Regional Seas etc., dealing with ocean monitoring, but nevertheless considered that GESAMP was an appropriate forum to debate scientific issues where clear decisions among the community had hitherto not been reached. GESAMP's role was not seen as the initiator of monitoring programmes since other specialized bodies, such as UNEP and IOC, existed for that task.

8.1.3 The Group agreed to establish the Working Group with the following terms of reference:

- (i) To examine the scientific basis, rationale, feasibility and the technical requirement for monitoring biological and chemical conditions and the ecological consequences of pollution i.e. the scientific justification for an integrated global ocean (by which is meant all sea areas) monitoring study (IGOM) related to marine pollution and the ecological consequences thereof, taking account of what is already being done in these fields. In examining the scientific justification for IGOM the Working Group should consider:
  - (a) the type of observations and measurements that could be included in IGOM i.e. the parameters which could be included and the areas in which they may be required;
  - (b) the methodological feasibility of IGOM i.e. the availability of adequate sampling and analytical techniques which can be expected to provide reliable data on a world wide basis and to advise on the extent to which these can actually be applied and what, if any, further facilities may be required;
  - (c) the type of observations/ measurements which it is practicable to include in an IGOM programme;
  - (d) the type of observations and sampling strategy which would be required i.e. the frequency of sampling in both space and time and the distribution/location of sampling stations; and
  - (e) the support needed to initiate and implement the IGOM study such as intercalibration, quality control of data, coordination, data processing and institutional arrangements and what further facilities, if any, may be necessary; and
- (ii) to prepare an interim report for the 15th session of GESAMP on the progress achieved in considering the subjects defined by these terms of reference.

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## 8.2 Other intersessional work

Following the above decisions on the establishment of a new working group, the Group noted that intersessional work would take place on the subjects listed below. The sponsoring organizations responsible for coordinating the intersessional work and the GESAMP members assigned to each working group are indicated. Additional members from outside GESAMP are selected by the Chairmen in consultation with the relevant organizations.

- (a) Review of Potentially Harmful Substances (Working Group No. 13)
- |                       |                                   |
|-----------------------|-----------------------------------|
| Lead Agency           | : WHO                             |
| Co-operating Agencies | : UNEP, FAO and IMO               |
| Chairman              | : L. Friberg                      |
| Members               | : A.B. Jernelöv<br>: L.P.A. Magos |
- (b) Evaluation of the Hazards of Harmful Substances Carried by Ships (Working Group No. 1)
- |                     |              |
|---------------------|--------------|
| Lead Agency         | : IMO        |
| Co-operating Agency | : UNEP       |
| Chairman            | : P. Jeffery |
| Member              | : W. Ernst   |
- (c) Interchange of Pollutants between the Atmosphere and the Oceans (Working Group No. 14)
- |                       |   |
|-----------------------|---|
| Lead Agency           | : WMO   |
| Co-operating Agencies | : UNEP and IAEA                                   |
| Chairman              | : W.D. Garrett                                    |
| Members               | : V. Koropalov<br>: V. Pravidic<br>: M. Waldichuk |
- (d) Land-Sea Boundary Flux of Pollutants (Working Group No. 22)
- |                       |                  |
|-----------------------|------------------|
| Lead Agency           | : Unesco         |
| Co-operating Agencies | : UNEP* and IAEA |
| Chairman              | : H. Windom      |
| Members               | : V. Pravidic    |
- (e) Methodology and Guidelines for the Assessment of the Impact of Pollutants on the Marine Environment (Working Group No. 23)
- |                       |   |
|-----------------------|---|
| Lead Agency           | : FAO   |
| Co-operating Agencies | : UNEP, Unesco, WHO, IMO and IAEA   |
| Chairman              | : V. Pravidic   |
| Members               | : E.D. Gomez<br>: E.P. Myers<br>: G.D. Howells<br>: W. Ernst<br>: H. Windom |
- (f) Integrated Global Ocean Monitoring (Working Group No. 24)
- |                       |  |
|-----------------------|--|
| Lead Agency           | : Unesco*  |
| Co-operating Agencies | : UNEP and WMO*  |
| Chairman              | : A. Tsyban  |
| Members               | : M. Waldichuk<br>: M.E. Vinogradov<br>: A.B. Jernelöv |

\* Subject to approval by Headquarters

9. DATE AND PLACE OF NEXT SESSION

The Group noted that the 15th session of GESAMP would be held at UN Headquarters in New York from 25 to 29 March 1985. It was agreed that the deadline for distribution to GESAMP members of documents for consideration at the session shall be 15 February 1985.

10. OTHER MATTERS

10.1 The Group noted that the draft report of the Working Group on Marine Pollution Implications of Ocean Energy Development had been circulated during the intersessional period to all GESAMP members. The comments had been included in the final text of the report. The report is being prepared for publication in the GESAMP Reports and Studies as No. 20.

10.2 Several members of the Group proposed that the sponsoring agencies should consider ways and means for wider distribution of GESAMP Reports and Studies in order to make these easier available to the scientific community. The Group noted that the Intersecretariat Meeting had discussed this problem. The sponsoring agencies had agreed to:

- (i) set out a list of previous publications of GESAMP on the last page of each document published in the GESAMP Reports and Studies;
- (ii) investigate the possibility of including in the lists of publications of the agencies references to the GESAMP Reports and Studies;
- (iii) announce the publications of GESAMP Reports and Studies to the media and in bulletins and press releases prepared by their public information services;

10.3 The Group welcomed this information. It proposed that in addition to the above action the Administrative Secretary in co-operation with the Chairman should inform the editor of the Marine Pollution Bulletin of the publication of new GESAMP Reports and Studies and provide him with a short summary of the new publication.

11. ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR THE NEXT INTER-SESSIONAL PERIOD AND FOR THE FIFTEENTH SESSION

The Group unanimously elected Mr. E.D. Gomez as Chairman and Ms. G.D. Howells as Vice-Chairman for the next intersessional period and for the fifteenth session of GESAMP.

12. CONSIDERATION AND APPROVAL OF THE REPORT OF THE MEETING

The report of the fifteenth session of GESAMP was considered and approved by the Group on the final day of the Session. At the conclusion of the Session the Group expressed its deep appreciation to Mr. A.D. McIntyre for his most able guidance during his period of office. Mr. E.D. Gomez was welcomed as the new Chairman of GESAMP.

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  - 2.6. The Air-Sea Transport of Man-Made Radionuclides
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5. REFERENCES

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ANNEX VI

SUMMARY OF THE REPORT OF THE WORKING GROUP ON THE  
INTERCHANGE OF POLLUTANTS BETWEEN THE  
ATMOSPHERE AND THE OCEANS  
(WORKING GROUP 14)

The present document describes the work of this Working Group subsequent to its first report which has been published in the GESAMP Reports and Studies series (GESAMP No.13, 1980). These two reports should be taken together, since material included in the first report is generally not repeated in the second. If a distinction can be made between the two reports, then the first constitutes a rather broad overview of the whole topic, whereas the present report is more concerned with the behaviour of specific pollutants, or group of pollutants, including those related to fossil fuel burning and those which have a potential for altering climate.

The present report has three main sections. The first deals with the air-sea exchange of specific substances, and the second reviews some processes important in effecting this exchange. In the final section an outline is given of the criteria which need to be considered in designing a global programme to study pollutant interchange at the air-sea interface.

The Working Group made assessment of air-sea exchange of particular pollutants such as carbon dioxide, sulphur gases, aerosols and trace elements, low molecular weight halocarbons, heavy chlorinated hydrocarbons, man-made radionuclides and particulate carbon.

Consideration was given to some processes and mechanisms important for the air-sea interchange of pollutants including formation and distribution of cloud condensation nuclei in maritime air, sea-salt inversion, air bubble bursting, biodegradation of petroleum and other organic pollutants, and the residence time of pollutants in the sea surface microlayer.

Scientific bases were developed for future international programmes related to air-sea interchange of pollutants and the effects of such pollutants on atmospheric properties and processes. Critical pollutants for study in such a programme have been identified, as were areas and sites where the measurements should be made.

ANNEX I

AGENDA

- Opening of the meeting
- 1 Adoption of the Agenda
  - 2 Review of potentially harmful substances
  - 3 Evaluation of the hazards of harmful substances carried by ships
  - 4 Interchange of pollutants between the atmosphere and the oceans
  - 5 Biological effects of thermal discharges in the marine environment
  - 6 Land-sea boundary flux of pollutants
  - 7 Methodology and guidelines for the assessment of the impact of pollutants on the marine environment
  - 8 Future work programme
  - 9 Date and place of next session
  - 10 Other matters
  - 11 Election of Chairman and Vice-Chairman for the next intersessional period and for the fifteenth session
  - 12 Consideration and approval of the report of the meeting

## ANNEX II

## LIST OF DOCUMENTS

GESAMP No.	Agenda No.	Author, Source	Title
XIV/1	1	Administrative Secretary	Provisional Agenda for the 14th Session of GESAMP
XIV/2	2	Working Group	Report of the 2nd Session of the GESAMP Working Group on the Review of Potentially Harmful Substances
/2/1		Working Group	Draft Review of Potential Harmful Substances: Cadmium, Lead and Tin
/2/2		IMO	Review of Potentially Harmful Substances. Substances with carcinogenic, teratogenic and mutagenic properties. Note by IMO Secretariat.
XIV/3	3	Working Group	Report of the 14th Session of the Working Group on Evaluation of the Hazards of Harmful Substances carried by Ships
/3/1	3	Working Group	Report of the 15th Session of the Working Group on Evaluation of the Hazards of Harmful Substances carried by Ships
/3/1 Corr.1	3	Working Group	Corrections
XIV/4	4	Working Group	Report of the 5th Session of the GESAMP Working Group on the Interchange of Pollutants between the Atmosphere and the Oceans
/4/1	4	Working Group	Interchange of Pollutants between the Atmosphere and the Oceans

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6. The Working Group prepared draft Guidelines for Evaluating Threshold Values for Fish-Tainting. The Working Group welcomed the announcement of chemical manufacturer's associations that they consider the establishment of a task force on 'Test Method Development for Tainting of Seafood'. The Working Group also agreed that an attempt should be made to include in the Guidelines an appropriate text for defining 'tainting'. It was also considered that a statistical method for expressing and evaluating the concentration/response data for tainting should be developed at a subsequent session of the Working Group.

LIST OF PARTICIPANTS OF THE FOURTEENTH AND FIFTEENTH SESSIONS OF  
THE WORKING GROUP ON THE EVALUATION OF THE HAZARDS OF  
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GESAMP No.	Agenda No.	Author, Source	Title
XIV/5	5	Working Group	Report of the 3rd Session of GESAMP Working Group on the Biological Effects of Thermal Discharges in the Marine Environment
/5 Add.1	5	Working Group	Corrections
/5 Add.2	5	Working Group	Corrections
/5 Add.3	5	Working Group Chairman	Corrections
XIV/6	6	Unesco	Annotations to Agenda of the Meeting of GESAMP Working Group on Land/Sea Boundary Flux of Pollutants
XIV/7	7	Working Group	Report on the 1st Session of the GESAMP Working Group on the Methodology and Guidelines for the Assessment of the Impact of Pollutants on the Marine Environment
/7 Add.1	7	Working Group Chairman	Note from the Working Group Chairman to GESAMP
/7 Add.2	7	GESAMP Expert	Letter from GESAMP Expert to WHO Technical Secretary
XIV/8	8	UNEP	Proposal for the Establishment of a Working Group on Integrated Global Ocean Monitoring
/8 Add.1	8	UNEP	Revised Terms of Reference

\* unable to attend the Fifteenth Session of the Working Group

## ANNEX III

## GESAMP MEMBERS, SECRETARIAT AND OBSERVERS

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## ANNEX V

SUMMARY OF THE REPORTS OF THE WORKING GROUP ON THE  
EVALUATION OF THE HAZARDS OF HARMFUL SUBSTANCES CARRIED BY SHIPS  
(WORKING GROUP 1)

1. The Working Group met under the Chairmanship of Mr. Paul Jeffery in London, from 6 to 10 June 1983, and in Aberdeen from 9 to 13 January 1984.
2. The Working Group established new hazard profiles of substances and reviewed existing hazard profiles of substances for which members of the Working Group had undertaken to carry out work during the intersessional period. Background information which had been submitted by national maritime administrators and the chemical industry to the IMO Secretariat and/or Chairman was also used in the preparation of new or revised hazard profiles.
3. The Working Group upon request of the Marine Environment Protection Committee (MEPC) of IMO considered whether the hazardous properties of coal derived oils were comparable with those related to oils of petroleum origin. The Working Group noted that the analysis of products derived from coal indicate a high percentage of aromatic compounds. The Working Group therefore felt that a very cautious approach was necessary, particularly at the lower boiling end of the range and that such substances were clearly more hazardous than oils of the same boiling point range derived from petroleum. There was also a wide range of possible compositions of coal derived oils depending upon the processes used for their production and therefore a case-by-case study would be necessary to decide whether a particular coal-derived oil is more hazardous than a similar product derived from petroleum.
4. The Working Group agreed that it should keep under review during its evaluation exercise the potential of liquid noxious substances to blanket the seafloor due to their low solubility and high specific gravity. The Working Group, recalled that it had so far not identified any liquid as being sufficiently dense and insoluble that it was likely to blanket the seabed and cause a significant problem.
5. The Working Group considered the problems related to the use of tradenames in chemical transport. The Working Group so far had assigned hazard profiles to such tradenamed substances in cases where results of biological tests carried out with the tradenamed substance were available and provided that other adequate information on the properties were supplied. The Working Group agreed to continue this practice but that in each case an assurance would be required of the manufacturers or shippers of such substances that the composition would remain constant within stated limits. In light of the MARPOL 73/78 provisions which require that all noxious liquid substances will have to be assigned a pollution category, the Working Group agreed to draw the attention of the relevant IMO bodies to the problems related to the carriage of tradenamed substances.

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organosilicon polymers which at present are commercially available have not been shown to be absorbed and also have extremely low toxicity in mammals.

6. The Working Group proposed to concentrate most of its efforts during the forthcoming intersessional period on the finalization of the first five substances reviewed. Two combined publications should be prepared, one covering cadmium, lead and tin, and one on mercury together with arsenic. Two editorial committee meetings should be convened at MARC for this purpose in 1984.
7. Resulting from the evaluation of the first five substances, the need emerged to review selenium. Although the Working Group recognized that selenium is not a marine pollutant in the strict sense of the GESAMP definition, the members strongly felt that it should be reviewed. The presence of selenium in edible marine organisms and its interactions with other substances such as arsenic, cadmium and mercury, make its evaluation a necessary supplement to the reviews undertaken so far. A WHO Environmental Health Criteria Document is in an advanced state of preparation and would be available for the review by GESAMP.
8. The review of phosphorus and nitrogen as major nutrients contributing to eutrophication and algal blooms was considered an important task of GESAMP, taking into account the indirect health effects due to the potential release of various types of toxins. Paralytic shellfish poisoning and related phenomena were subject to review by the International Programme on Chemical Safety recently. The Working Group felt, however, that a GESAMP review of phosphorus and nitrogen would require supplementary expertise to be added to the Working Group.
9. The IMO Technical Secretary of GESAMP had informed the Working Group about the intentions of his organization to submit to GESAMP XIV a proposal concerning the evaluation of substances of known or potential carcinogenicity, mutagenicity or teratogenicity. An informal discussion was held on the importance and feasibility of such a review. It appeared that a preliminary study on available data, methods and approaches would be required to determine the scope and purpose of a relevant GESAMP activity. The Working Group felt that it would be in a position to undertake a preliminary review of this problem area during the forthcoming GESAMP intersessional period.

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ANNEX IV

SUMMARY OF THE REPORT OF THE WORKING GROUP  
ON THE REVIEW OF POTENTIALLY HARMFUL SUBSTANCES  
(WORKING GROUP 13)

1. The second session of the Working Group was held at the Monitoring and Assessment Research Centre (MARC) at Chelsea College, London, from 30 January to 3 February 1984. Close collaboration with the Centre was initiated and substantive support provided to the activities of the Working Group. In addition, UNEP's International Register of Potentially Toxic Chemicals (IRPTC) arranged for the preparation of data profiles which are used as a basis for the drafting of review documents.
2. During the inter-sessional period, draft evaluation documents on cadmium, lead and tin were revised and then circulated to all Working Group and GESAMP members. The comments received were submitted to the second session of the Working Group for consideration. In light of these comments it was concluded to compress the relevant health sections but still to retain the information essential for an overall assessment of the potential health effects. Also, technical editing would be required and some updating of the marine data base.
3. Draft review documents on mercury and arsenic were prepared on marine environmental and human health aspects and submitted to the second session of the Working Group. It was considered that the marine environment section on mercury required expansion and more recent data, particularly from the Mediterranean, should be considered. Also, a clear distinction between situations with high natural mercury concentrations and 'hot spot' areas should be made in the evaluation. The marine environment section on arsenic was considered rather comprehensive, particularly since no previous review existed elsewhere. A section on conclusions was then prepared for each of the two substances.
4. As requested by GESAMP, the Working Group undertook a review of organosilicons, starting with the preparation of draft sections on marine environment and human health aspects. It was noted with great concern that the data base available largely related to the producing industry and that very little reference could be made to research findings published in the open literature. Any conclusions reached would therefore have to be qualified accordingly. Concern was also expressed over the large and open-ended group of substances which the organosilicons represent. A meaningful hazard assessment would therefore have to be limited to defined groups of organosilicons which are presently of significance with regard to production and usage.
5. In discussing the draft review on marine environment aspects, the Working Group recognized the stated high persistence and the generally low toxicity of most polymerized components of organosilicon groups but could not evaluate the bioaccumulative properties due to an almost total lack of conclusive research findings. As concerns human health aspects, it was noted that