OSPAR Priority Substances Series

Certain Brominated Flame Retardants – Polybrominated Diphenylethers, Polybrominated Biphenyls, Hexabromo Cyclododecane

OSPAR Commission

2001 (2004 Update)

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l'Espagne.

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Executive Summary

Brominated flame retardants are a diverse group of chemicals, whose common points are that they all contain bromine and are all use to retard the combustibility of commercial goods. Two substances – decabromodiphenyl ether (DecaDBE) and Tetrabromobisphenol A (TBBP-A; this will be the subject of a separate Background Document) – account for about 50% of world use of brominated flame retardants. Two other polybrominated diphenyl ethers (PolyBDE) – octabromodiphenyl ether (OctaDBE) and pentabromodiphenyl ether (PentaDBE) – are used commercially, but in much smaller quantities than DecaBDE. Hexabromocyclododecane (HBCDD) is also used in large volumes. Polybrominated biphenyls (PBB) have also been used, but production was stopped in September 2000. Some PolyBDE are toxic, especially those with smaller molecules. PentaDBE may disrupt the oestrogenic system. PBB have similar effects to polychlorinated biphenyls, and may also produce hypothyroidism. Some of these chemicals are bioaccumulated. Brominated flame retardants were given priority in the 1992 OSPAR Action Plan, and therefore included in 1998 in the List of Chemicals for Priority Action.

The quantities of PolyB DE used in the EU in 1994 were estimated as: DecaBDE (8 210 tonnes) as a general-purpose flame retardant, especially in polymers, polypropylene fabric and other textiles (other than clothing fabrics); OctaBDE (2 550 tonnes) in acrylonitrile-butadiene-styrene plastics (often used for casings of electrical and electronic equipment), nylon and other plastics and in adhesives and coatings; PentaBDE (125 tonnes) mainly in flexible polyurethane foam for furniture, as well as epoxy and phenolic resins, some polyesters and textiles. About 9 200 tonnes of HBCDD was used in the EU in 1999, 85% of it in polystyrene.

Since the products containing these chemicals are widely dispersed, their possible release from waste disposal routes may be of concern, together with their potential role in producing dioxins and furans during waste incineration. The degradation of DecaBDE to the more toxic and bioaccumulative lower levels of PolyBDE is also of concern. The overwhelming majority of samples of marine biota have not shown detectable quantities of DecaBDE; however, OctaBDE has been found in fish and molluscs (up to 325µg/kg wet weight) and PentaBDE has been found in fish and marine mammals (up to 7 700µg/kg in white-beaked dolphins). All these chemicals have been found in river or marine sediments.

Action so far has been mainly through voluntary commitments by industry within the framework of the OECD. The risk assessment for PentaBDE under the EC existing substances regulation has concluded that risk reduction measures are needed. The PolyBDEs are proposed to be included as priority hazardous substances in the list of priority substances under the EC Water Framework Directive.

The action recommended is: to support the inclusion of PBB in the draft EC Directive on Waste from Electrical and Electronic Equipment; to support early EC harmonised restrictions on PentaBDE; to await the completion of the EC risk assessment of OctaBDE, DecaBDE and HBCDD and seek appropriate risk-reduction strategies in the light of it; to support appropriate provision on PolyBDE in the draft EC Directives on Waste from Electric and Electronic Equipment and on Restrictions on Certain Hazardous Substances in Electric and Electronic Equipment; to develop an OSPAR monitoring strategy for these chemicals; to review by OSPAR in 2003 of the need for further OSPAR measures to supplement the eventual EC measures; and to ask other relevant international forums to take account of the background document.

A monitoring strategy for Certain Brominated Flame Retardants has been added to this background document.

Récapitulatif

Les retardateurs de flamme au brome représentent un groupe de produits chimiques diversifié, dont les points communs sont qu'ils contiennent tous du brome et servent tous à retarder la combustion de produits vendus dans le commerce. Deux substances – l'éther décabromodiphénylique (DecaDBE) et le tétrabromobisphénol A (TBBPA – lequel fera l'objet d'un document de fond distinct) – représentent environ 50% de la consommation mondiale de retardateurs de flamme au brome. Deux autres éthers polybromodiphényliques (PolyBDE) – l'éther octabromodiphénylique (OctaDBE) et l'éther pentabromodiphénylique (PentaDBE) – sont utilisés dans le commerce, mais en quantités nettement inférieures au DecaBDE. L'hexabromocyclododécane (HBCDD) est aussi utilisé en gros volumes. Les polybromobiphényls (PBB) ont aussi été utilisés, mais leur fabrication a été arrêtée en septembre 2000. Les PolyBDE sont toxiques, surtout ceux dont les molécules sont petites. Le PentaDBE est susceptible de perturber le système œstrogénique. Les PBB ont des effets analogues à ceux des polychorobiphényls, et peuvent aussi provoquer une hyperthyroïdie. Le HBCDD est aussi toxique. Tous ces produits chimiques ont tendance à s'accumuler biologiquement. La priorité a été donnée aux retardateurs de flamme au brome dans le Plan d'action OSPAR 1992, et ils ont donc été inscrits en 1998 sur la Liste des produits chimiques devant faire l'objet de mesures prioritaires.

Les quantités de PolyBDE consommées en 1994 dans l'Union européenne ont été estimées comme suit : DecaBDE (8 210 tonnes), comme agent ignifuge général, surtout dans les polymères, les tissus de polypropylène et autres textiles (autres que les tissus d'habillement) ; OctaBDE (2 550 tonnes) dans les matières plastiques acrylonitrile-butadiène-styrène (dont sont souvent faits les boîtiers dans le matériel électrique et électronique), le nylon et autres matières plastiques ainsi que dans les adhésifs et revêtements ; PentaBDE (125 tonnes) surtout dans la mousse de polyuréthane souple destinée au mobilier, ainsi que dans les résines époxy et les résines phénoliques, certains polyesters et textiles. Environ 9 200 tonnes de HBCDD ont été consommées dans l'Union européenne en 1999, dont 85% dans du polystyrène.

Les produits contenant ces produits chimiques étant très répandus, leurs émissions par les voies d'élimination des déchets sont très préoccupantes, ceci parallèlement au fait qu'ils sont susceptibles de produire des dioxines et des furanes pendant l'incinération des déchets. La dégradation du DecaBDE jusqu'aux niveaux inférieurs de PolyBDE, plus toxiques et s'accumulant plus dans les tissus biologiques, est elle aussi préoccupante. Dans la très vaste majorité des cas, l'on n'a pas constaté la présence de DecaBDE en quantités décelables dans les échantillons de biote marin ; toutefois, l'on a observé la présence d'OctaBDE chez le poisson et les mollusques (pouvant atteindre 325 µg /kg du poids à l'état humide) de même que du PentaBDE chez les poissons et dans les mammifères marins (jusqu'à 7 700 µg/kg chez les lagénorhynques à bec blanc. La présence de tous ces produits chimiques a été constatée dans des sédiments fluviaux ou marins.

Les mesures prises jusqu'à présent consistent surtout en engagements volontaires de l'industrie, contractés dans le cadre de l'OCDE. Le résultat de l'évaluation des risques suscités par les PentaBDE, effectuée en conséquence du Règlement communautaire européen sur les substances existantes, est qu'il a été conclu que des mesures de réduction des risques s'imposaient. Il est proposé d'inscrire les PolyBDE comme substances prioritaires dangereuses sur la Liste des substances prioritaires dans le contexte de la Directive communautaire européenne cadre relative aux eaux.

Les mesures recommandées sont les suivantes : soutien à l'inscription des PBB dans le projet de Directive communautaire européenne relative aux déchets de matériel électrique et électronique ; soutien aux restrictions harmonisées qu'il convient d'imposer rapidement au niveau communautaire aux PentaBDE ; attendre que l'évaluation communautaire des risques suscités par les OctaBDE, les DecaBDE et les HBCDD soit achevée, et à la lumière de ses conclusions, étudier la mise en place de stratégies de réduction des risques ; soutien à une disposition appropriée visant les PolyBDE dans les projets de directives communautaires relatives aux déchets de matériel électrique et électronique ainsi que relatives aux restrictions imposées à certaines substances dangereuses dans le matériel électrique et électronique ; élaboration d'une stratégie OSPAR de surveillance de ces produits chimiques ; en 2003, examen, par OSPAR, de la question de savoir si de nouvelles mesures OSPAR s'imposent pour compléter les mesures

communautaires européennes éventuelles ; et demander aux autres instances internationales compétentes de prendre le document de fond en considération.

Une stratégie de surveillance sur certains retardateurs de flamme au brome a été ajoutée à ce document de fond.

1. Identification of sources and pathways to the marine environment

1.1 Brominated flame retardants

1. Brominated flame retardants are a chemically diverse group of substances. Brominated flame retardants as a class include aromatic diphenyl ethers, cyclic aliphatics, phenolic derivatives, aliphatics, phthalic anhydride derivatives and others. Their major common points are that they are used to flame retard items in commerce and all contain bromine. Two brominated flame retardants, decabromodiphenyl ether (decaBDE) and tetrabromobisphenol A (TBBP-A), account for approximately 50% of all brominated flame retardants usage globally. The remaining 50% of the global volume of brominated flame retardants is composed of a number of different brominated flame retardant structural types and includes the two other commercial polybrominated diphenyl ether (PBDE) flame retardants: octabromodiphenyl ether (octaBDE) and pentabromodiphenyl ether (pentaBDE). OctaBDE and pentaBDE are produced and used in substantially smaller quantities than decaBDE. Substances that are used in large volumes are polybrominated diphenyl ethers (PBDE), hexabromo cyclododecane (HBCDD) and tetrabromobisphenol A (TBBP-A). The production of polybrominated biphenyls (PBB) ceased in September 2000. This background document covers the first three substances while a separate background document is being prepared by the United Kingdom (UK) for TBBP-A.

1.2 PBDEs production and use

2. The world production of PBDEs has been estimated at 40 000 tonnes in 1992 (including 4 000 tonnes of pentaBDE). The use of PBDEs in the European Union (EU) in 1994 was estimated at 11 000 tonnes. In its risk assessments carried out under Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances, the UK (Member State Rapporteur) has assumed the following EU quantities for the individual PBDEs: pentaBDE 125 tonnes/year, octaBDE 2 550 tonnes/year, and decaBDE 8 210 tonnes/year. The Bromine Science and Environmental Forum estimated total market demand for major brominated flame retardants for 1999. In Europe the demand was estimated to be: pentaBDE 210 tonnes/year, octaBDE 450 tonnes/year and decaBDE 7 500 tonnes/year. The total demand for PBDEs in the world was estimated to about 67 000 tonnes/year. PBDEs are used in many different applications, which may give rise to diffuse losses of the substances in the “technosphere”, for example in electrical and electronic equipment, furniture, and cars.

3. The major use of pentaBDE is as a flame retardant additive in flexible polyurethane foam for furniture and upholstery. Other reported uses include as a flame retardant additive in epoxy resins, phenolic resins (e.g. in printed circuit boards), unsaturated polyesters and textiles. It is no longer used for textile applications in the EU.

4. Around 95% of the octaBDE supplied in the EU is used as a flame retardant in acrylonitrile-butadiene-styrene (ABS) plastics (often used in covers and casings for electrical or electronic equipment). Other reported uses include nylon and low density polyethylene, polycarbonate, phenol-formaldehyde resins and unsaturated polyesters and in adhesives and coatings.

5. DecaBDE is used as a flame retardant, mostly in applications in the plastics and textile industries. It is a general purpose flame retardant and is thus used in a variety of polymer applications. Industry information indicates that decaBDE is widely used for flame retarding polypropylene drapery and upholstery fabric. DecaBDE may also be used in some synthetic carpets. It is not used as a flame retardant in textiles used for clothing. In the UK it is thought that around 95% of all upholstery materials are flame retarded, and estimated that over 50% of the total PBDE use is in the textile industry. In most other countries the amounts used in this application would be much lower.

1.3 PBBs production and use

6. DecaBBs were produced in France until 30 September 2000. The use of PBB will cease when the stock has been consumed. The yearly production was around 1 000 tonnes. PBBs are sold exclusively as technical decaBB, which consists of at least 94% decaBB and up to 6% nonaBB, with traces of octaBB. PBBs are used mainly for electrical and electronic equipment. PBBs are used in many different applications, which may give rise to diffuse losses of the substances.

1.4 HBCDD production and use

7. HBCDD is both manufactured in and imported into the EU. HBCDD is used industrially as an additive flame retardant in polymers. End products containing HBCDD are used both professionally and by consumers. The EU use of HBCDD in 1999 was 9 200-tonnes/year according to the draft Swedish risk assessment. 85% of HBCDD is used in polystyrene (PS). The predominant use of PS is in rigid insulation panels/blocks for building construction; 10% is used in textile back coating and 5% is used in high impact polystyrene (HIPS) in electric housings, e.g. housings for videocassette recorders.

1.5 Waste and recycling of brominated flame retardants

8. The waste stage is a source of at least losses of PBDE and PBB both into the working environment and into the natural environment. Once an article has reached the end of its service life, it can be recycled, incinerated or landfilled. In most countries large quantities of PBDE and PBB occur in plastic parts in electric and electronic equipment. There are various modes of disposal. In the case of goods handled by electronics disposal firms, covers are often burned in incineration plants. There may be a risk of the formation of halogenated dioxins. Printed circuit boards can be sent to metal smelting plants or treated in connection with fragmentation. There are insufficient data to assess the magnitude of the various flows of PBDE and PBB and the resulting releases.

1.6 Pathways to the marine environment

9. A detailed analysis of the specific pathways to the marine environment of the sources mentioned above in paragraphs 1.2 to 1.5 is generally beyond the scope of this background document. Brominated flame retardants reach the marine environment from these sources generally via rivers and via the atmosphere. However, there is a lack of data. It has not been possible to estimate which is the dominant pathway.

2. Monitoring data and quantification of sources

2.1 PBDEs

2.1.1 Monitoring data

10. The UK risk assessments contain several monitoring data that are summarised below.

Concentrations in the marine environment

PentaBDE

11. No levels of pentaBDE have been reported in water. In Japan, water samples have been analysed for hexaBDE, but it has not been detected in any sample.

12. Components of commercial pentaBDE have been measured in sediments in several EU countries and also in Japan. The results are reported for various isomers of the commercial mixtures. Thus the measured results can be used only to obtain an approximate indication of the levels found in sediment.

13. Levels of commercial pentaBDE of 561-1 271 µg/kg dry weight have been measured in a river and heavily industrialised estuary close to a pentaBDE production site in the UK. The highest levels were found in the heavily industrialised estuary, which may indicate that sources other than the production site contribute to these levels. No production currently occurs in the EU. Higher levels of 1 400 µg/kg dry weight have been measured near to a factory in Sweden. Surficial sediment samples taken from the southern part of the Baltic Sea (Baltic Proper) were found to contain 0,21 to 1,1 µg/kg dry weight as the sum of two congeners. PentaBDE was not detected in samples taken from the northern part of the Baltic Sea (Bothnian Bay).

OctaBDE

14. The levels of octaBDE in water have been analysed in Japan, but it has not been detected.

15. Levels of octaBDE of up to 3 030 µg/kg dry weight (wt) have been detected in sediments in industrialised areas in the UK. The measured levels in other industrialised areas are generally 20-200 µg/kg dry wt.

DecaBDE

16. DecaBDE has not been reported in water samples, which is consistent with its low water solubility (<0,1 µg/L). DecaBDE was not detected in 15 water samples collected in Japan in 1977 (DL= 0,2-2,5 µg/L). DecaBDE was not detected in 75 water samples collected in 1987 (DL= 0,1 µg/L) and was not detected in 141 samples collected in 47 locations in 1988-89 in Japan (DL= 0,06 µg/L). DecaBDE was not detected in 12 samples from the Kino River water in Japan (DL= 0,1 µg/L). The samples were taken from several industrial, urban and rural areas of Japan and are thought to be representative of the country as a whole. (EU, 1999).

17. Levels of decaBDE in sediments in the UK near possible sources of release ranged from less than the detection limit (DL, 0,6 µg/kg dry wt) to 3 190 µg/kg dry wt. Results from 11 out of 24 of these samples were reported as less than the DL. Sediments from two streams, collected downstream of landfills receiving brominated wastes, also reported results as less than the DL. Ten out of 11 samples collected in a second study in the UK near possible sources of release reported all values <200 or 500 µg/kg dry wt, which are the presumed detection limits. One sample was reported to possibly contain decaBDE at ~850 µg/kg, but interference in the analysis did not allow confirmation. (EU, 1999).

18. A recent survey of marine sediments in estuaries discharging in to the North Sea has been carried out. DecaBDE concentrations in 22 samples ranged from less than the DL (0,51 µg/kg dry wt) to 1 700 µg/kg dry wt. The highest level, 1 700 µg/kg dry wt, was detected in the Mersey Estuary, a site used formerly for dumping sewage sludge. The next highest level, 200 µg/kg, was detected in the Schelde estuary. The lowest levels reported in this survey were samples collected 100 km off Terschdling (less than the DL of 0,51 µg/kg dry wt), from the Glomma Estuary (<DL of 0,52 µg/kg), from the Otria Estuary (0,71 µg/kg), and from the Elbe estuary (0,83 µg/kg dry wt). (EU, 1999).

19. DecaBDE levels up to 0,2 mg/kg-wet weight in sediment collected in Sweden were reported. Surface sediment (0-2 cm) collected at 8 locations in the River Viskan and other nearby water systems ranged from <1,1 to 241 µg decaBDE/kg wet wt. Five of the nine samples analysed had decaBDE concentrations <1,7 µg/kg wet wt. The highest levels were generally found downstream from industry. (EU, 1999).

20. A number of sediment monitoring studies were conducted in Japan between 1977 and ~1989. In 15 sediment samples collected in Japan in 1977, decaBDE was not detected (DL=25-870 µg/kg dry wt). Marine, estuarine and river sediment samples were collected at different locations in Japan in 1981-83; decaBDE was detected in 7 out of 15 samples in the range of 20-375 µg/kg dry wt. Further decaBDE was identified at 20 µg/kg dry wt in one of 3 estuarine sediment samples from Osaka. However it was not detected in samples from Tokyo, Matsuyama, or Hiroshima. DecaBDE was detected in 16 out of 60 sediment samples at concentrations ranging from 10 to 1 370 µg/kg in 1987 and was detected in 39 out of 129 samples collected at 43 locations at concentrations ranging from 4-6 000 µg/kg in 1988-89. The upper sediment layer of the Second Neya River in Osaka, Japan was found to contain ~0,2 mg decaBDE/kg dry wt in 1983. Twenty sediment samples from the Kino River in Japan contained decaBDE ranging from 0,003-11,6 mg/kg dry wt. (EU, 1999).

21. Near its manufacture in the U.S. in 1978, sediment levels of decaBDE were reported to range from not detectable up to 14 mg/kg. (EU, 1999).

Concentration in biota

PentaBDE

22. There is a consistent pattern in the levels of commercial pentaBDE measured in biota in Europe. The major isomer detected is 2,2',4,4'-tetraBDE which typically makes up >70 % of the total components detected. Levels in freshwater fish are generally slightly higher than in marine fish, possibly reflecting the proximity to likely sources of pentaBDE. On a lipid basis, levels of up to 88 mg/kg on a formulation basis have been measured in fish liver in Sweden. High levels have been measured in marine fish in the UK in industrialised areas near to a pentaBDE production site. Analyses of a number of PBDE congeners (BDE-47, BDE-99, BDE-100) in flounder collected in the Scheldt Estuary in 2000 showed values ranging from <0,2-260 and 0,4-7,8 µg/kg wet weight in liver tissue and muscle tissue, respectively (data from RIVO transmitted by Mr. van Zeijl, NL).

23. The total tetra- and pentaBDE concentration in sperm whale blubber were found to be about 100 µg/kg. The concentrations found in whitebeaked dolphins and harbour seals were 7 700 µg/kg and 1 400 µg/kg respectively. The presence of tetra- and pentaBDE in sperm whales suggests that these compounds have reached deep ocean waters (de Boer, 1998). This indicates the stability and long-range transportation of the substance.

24. In human samples, the presence of the various components of commercial pentaBDE has been shown in many samples of adipose tissue and milk. The levels found, when expressed on a lipid weight basis, show a remarkably consistent picture between the various surveys and samples with the levels generally being 2-4 µg/kg lipid in both milk and adipose tissue with up to around 100 µg/kg lipid in adipose tissue and 11 µg/kg in human milk being measured in some samples.

OctaBDE

25. OctaBDE has been detected in biota samples of dab, flounder, plaice and mussels. The highest level, 325 µg/kg wet weight, was found in dab liver off River Tees, UK. The monitoring data indicate that commercial octaBDE is only found in biota at measurable concentrations in industrial areas, particularly where sources of octaBDE are thought to be found.

DecaBDE

26. Over 270 biological samples collected in the environment (fish, marine mammals) have been analysed for decaBDE. DecaBDE was detected in only one of these 270 samples at a level of 0,001 mg/kg wet wt. In the EU, decaBDE was not detected in dab, whiting, flounder, plaice, winkles, mussels, pike, sperm whale, dolphin, minke whale, harbour seal, mackerel or mussels. In Japan, decaBDE was not detected in 229 samples from different aquatic species, but was detected at 0,001 mg/kg wet wt in 1 mussel (EU, 1999). DecaBDE has been found in eggs of Peregrine Falcons breeding in Sweden which indicates that decaBDE can bioaccumulate (Sellström, 2001).

2.1.2 Releases

27. The UK risk assessments contain a number of release estimations, made by using various models and assumptions. In summary, they indicate the following releases in the EU:

PentaBDE: 39 tonnes/year to air (from polyurethane foam use), 5 tonnes/year to surface and waste water (from polyurethane foam manufacture), 14 tonnes/year to industrial soil and 932 tonnes/year to landfills (or incineration) (from polyurethane foam disposal).

OctaBDE: 13 tonnes/year to air (mainly from service life of polymers), 1 tonne/year to waste water (mainly from compounding and conversion of polymers), and 2 295 tonnes/year to landfill/disposal (from polymers).

DecaBDE: 26 tonnes/year to air (mainly from service life of polymers), 245 tonnes/year to waste water (mainly from washing of textiles), and 7 476 tonnes/year to landfill/incineration (mainly from polymers).

2.1.3 Exposure to pentaBDE

28. According to the UK risk assessment, occupational exposure may occur during the production of polyurethane foams and subsequent manufacture of equipment. It is estimated that several thousands of workers in the EU could be exposed to materials containing pentaBDE. Dermal exposure may occur during the handling of receptacles containing pentaBDE, and when coming into contact with vessels and surfaces that have become contaminated from spillage. Regarding consumers, the current use pattern provided by industry is that pentaBDE is only used in polyurethane foam and that consumers do not come into direct contact with these foams.

29. The daily human intake of pentaBDE through environmental routes is estimated as:

- Local sources (polyurethane foam production): 0,043-0,048 mg/kg bw/day.
- Regional sources: 0,0008mg/kg bw/day.

The time trend data indicate that the levels in human breast milk increased markedly over the period 1972-1997. In biological samples collected in the environment the time trend indicates declining levels (de Wit, 2000).

30. In the human health risk assessment the UK concludes that although further information should be gathered in order to refine the risk assessment, in the light of the properties of pentaBDE and the time it would take to gather the information, consideration should be given at a policy level to the need to take risk reduction measures now. Regarding the environment it is further concluded by the UK that there is a need to limit the risks. This applies to the assessment of secondary poisoning arising from use in polyurethane foams. High levels of pentaBDE have been both predicted and measured in fish and earthworms near to sources of release, and lead to a risk of secondary poisoning that is linked to local releases from foam production sites. A possible risk of secondary poisoning has also been identified at the regional level (linked

to diffuse releases arising from use of the foam) for the earthworm-based food chain. The widespread environmental occurrence and bioaccumulative nature of the substance also lend support to the overall concern for this end-point.

2.1.4 Exposure to octa- and decaBDE

31. The draft environmental risk assessment concludes for the aquatic compartment that the risk from exposure via surface water is thought to be low. Exposure to organisms via sediment is thought to be much more relevant for these substances and a risk to sediment dwelling organisms could not be ruled out using the available data in the local scenario for polymer processing (octa) and the estimated concentrations from local and regional sources (deca). Measured levels near to sources of release also indicate a possible concern for sediment (octa). For the terrestrial compartment, a risk could not be ruled out using the available data in the local (octa, deca) and regional (deca) scenarios where sewage sludge containing the substances is applied to agricultural soil. Toxicity studies on sediment and soil are being investigated further. The results will be available during spring 2001.

32. A possible concern is the formation of lower brominated diphenyl ethers from the photochemical degradation of octaBDE in the environment, since these compounds, particularly tetra- and pentaBDE have been found extensively in the environment and are potentially more toxic and bioaccumulative. No information is currently available on this point for octaBDE. Limited data are available on the direct photolysis of decaBDE in water, which show that it does not appear to form significant amounts of lower brominated congeners, such as penta- and tetraBDE, on exposure to sunlight in environmentally relevant media. However, this is currently being investigated further. Photolysis and anaerobic biodegradation tests under environmentally relevant conditions have been initiated.

33. Another area of possible concern with regard to secondary poisoning (and also direct toxicity) is the formation of brominated dibenzo-*p*-dioxins and dibenzofurans during combustion or other high temperature processes (e.g. incineration, landfill where fires could occur), metal recycling (if the metal is contaminated with plastic containing octa- or decaBDE), or accidental fires involving articles containing PBDEs. These brominated dioxins and furans have been identified in flue gas from municipal waste incineration. However, they have not been identified in the very limited number of environmental samples analysed so far.

2.2 PBB

34. Human and environmental exposure may occur in connection with the use of products, in the recycling of plastics containing PBBs and after disposal to landfills. Emission is probably very slow, but PBBs may be released after degradation of PBB-bearing material.

35. DecaBB and hexaBB have been found in several sediment samples from the estuaries of large rivers in western Europe. Outside the PBB production plant in France, biphenyls with between five and ten bromines have been found in mussels, algae and seaweed. HexaBB has been identified in edible fish from northern Europe (Jansson *et al*., 1993). Although hexaBB has previously been used as a flame retardant, the possibility of their resulting from the debromination of decaBB cannot be ruled out. DecaBB are persistent, but there are studies to suggest that debromination can take place in UV light. Microbial debromination in an anaerobic environment is also a possible transformation path. DecaBB may have a potential for airborne distribution, but it is not likely that decaBB will undergo significant long-range airborne distribution.

36. There are great similarities between less brominated PBBs such as hexaBB and certain PCB compounds as regards biological effects, chemical structure and occurrence in the natural environment. If, therefore, decaBB is debrominated to less brominated PBBs of this kind, there is a risk of detrimental effects, resembling those which PCB has caused, occurring in human beings and in the environment.

37. Studies of industrial workers exposed to decaBB and decaBDE have pointed to effects on the thyroid system (hypothyroidism) resembling those seen in experimental animals (Bahn *et al*., 1980).

38. PBB compounds are fat-soluble and persistent. Some PBB compounds metabolise very slowly in the body and therefore accumulate in the fat of organisms. After release into the environment they can reach the food chain and accumulate there.

39. Bioaccumulation of different PBB compounds increases with increasing bromination up to at least tetraBB. Uptake will be less efficient, however, if the molecule is too large, as for example in the case of decaBB. Bioaccumulation of decaBB in fish, therefore, is unlikely to occur to any significant extent (BCF<5). Molecular size can be one reason for low uptake through the gill membranes. Bioavailability through food or for other aquatic organisms is regarded as a possible exposure path.

40. Few toxicity data are available from short-term tests on aquatic organisms. These data suggest moderate toxicity. Studies carried out in 1992 by MITI (Japan) found the 48 hr LC50 of DBB to be 250 and >66 mg/L in *Oryzias laties* and *Daphnia magna*, respectively.

2.3 HBCDD

2.3.1 Monitoring data

Concentrations in the marine environment

41. Very few data are available on HBCDD in water. HBCDD was monitored in marine and river sediment in Japan. Three out of 69 sediment samples contained HBCDD in the range 0,02 – 0,09 mg/kg dry weight.

42. In sediments taken in a river in Sweden down-stream from a possible point source HBCDD was found. The approximate wet weight concentrations ranged from 0,04 to 0,37 mg/kg. (Sellström *et al*., 1998)

Concentrations in biota

43. HBCDD has been found in fish (pike) muscle in Sweden at concentrations of 4 000 to 8 000 ng/g lipid weight. This corresponds to 0,02 to 0,06 mg/kg wet weight (Sellström *et al*., 1998). HBCDD was also found in four out of 66 fish samples analysed in the Japanese study mentioned above (0,01 – 0,023 mg/kg fresh weight).

2.3.2 Releases

44. According to the draft Swedish risk assessment humans may be exposed from many different sources owing to the wide use of HBCDD in products in society. Inhalation of vapour and airborne dust and via dermal contact is considered relevant at the workplace while producing, formulating and processing HBCDD or the polymer containing HBCDD. Exposure occurs via inhalation and dermal contact during industrial and consumer use of products containing HBCDD. Indirectly, exposure can also occur via food, soil, water and air.

45. Exposure to HBCDD may be equated with long-term (during the entire human lifetime) and low dose exposure.

46. In view of the potential ability of HBCDD to be transported long range, releases from diffuse sources are likely to influence areas remote from point sources and in that way exposure to humans.

47. Inhalator exposure during the manufacture (packing, filling of sacks) of HBCDD is considered to be 5 mg/m^3 in a reasonable worst-case scenario. Short-term exposure may be twice as high or 10 mg/m^3.

48. Dermal exposure levels have been calculated in reasonable worst-case scenarios. During manufacture (packing, filling of sacks) and during industrial use of HBCDD as an additive the exposure level will be 840 mg/day.

49. The amount of waste containing HBCDD will increase in the future. Up until now mostly end products with a service life shorter than 20 years have been wasted. It is not known to what extent end products containing HBCDD are landfilled, incinerated, left in the environment or recycled. Municipal waste is likely to be landfilled or incinerated. Construction material used on or under the soil could be left or is used as filling material e.g. for road construction. In the case of incineration the generation of polybrominated dibenzofurans and dibenzo-*p*-dioxins will have to be considered.

50. Recycling of expanded polystyrene, EPS, does occur in several European countries. Wasted EPS blocks are ground and put in the moulding process together with virgin EPS to form new blocks. However it is not clear to what extent a distinction is made between streams of flame retarded and non-flame retarded material. It is possible that HBCDD will end up in applications where fire resistance is not needed nor wanted and the substance flow will be out of control.

2.4 Further considerations

51. It should be noted that for certain important aspects, elaborated methods are presently lacking in the Technical Guidance Document used for risk assessment within the EU Existing Substances Programme. This has relevance both for assessments and consideration of measures for substances like brominated flame retardants. The following should therefore be considered when discussing the need for measures:

a. releases from articles in use.

The widespread distribution of these persistent substances in society via articles makes sources of exposure hard to locate. A slow release of some PBDE from articles is known to occur. The fact that octaBDE has been measured in the blood of workers employed on premises where computers and TV sets are used could be an indication of that. No single exposure source, however, can be reliably identified. The source may be computers and TV sets emitting octaBDE, but food may also be a source of uptake;

b. releases from waste.

There is a general background exposure to PBDE. This can be elevated in the case of occupational exposure, including waste handling. Among occupational categories employed in the dismantling of electronics, the blood concentration of heptaBDE (the most common compound in technical octaBDE) was 65 times higher than among hospital cleaning staff. This suggests a connection between professional handling of products containing PBDE and concentrations of these PBDE found in the bloodstream. Elevated concentrations of nona- and decaBDE were also found. Releases to the environment, e.g. from landfills, have also to be considered;

c. cumulative exposure during a lifetime.

Exposure from these chemicals occurs during the whole life. Quantitative information is lacking concerning the magnitude of exposure, and concerning consequences of lifetime exposure for human health. However, recent data have shown that in Sweden the concentration of tetraBDE and pentaBDE in breast milk has been increasing exponentially since 1972, with concentrations doubling every five years;

d. marine environment.

The Technical Guidance Document does not yet contain methods specific for risk assessment in the marine environment. Both PBDE and PBB occur in the marine environment. HexaBB and tetra- and pentaBDE have been found in many animal species from a wide variety of regions, including marine organisms like seal from Svalbard, and pike, perch and eel from more industrialised regions. Their occurrence in areas where exposure sources are lacking suggests long-distance transport of PBDE and PBB. Experience from substances of this type, e.g. PCB, has shown that exposure reduction takes a long time. Once the environmental concentrations have reached a level giving rise to serious effects, slow degradation of these substances may sustain such levels.

52. One recent *in vitro* study indicates that a few of the congeners in pentaBDE may interact with the estrogenic system by binding to the oestrogen receptor (Meerts *et al*., 2001). Although this interaction has not been confirmed *in vivo*, it supports the need for a proper evaluation of the potential reproductive toxicity of pentaBDE.

53. Another complicating factor for assessments is that most PBDE data refer to tetraBDE and pentaBDE. The occurrence of octaBDE and decaBDE are less well known. One explanation may be that analyses often are lacking. Analyses of highly brominated compounds are more complicated and require additional analytical stages.

54. Finally, during the past year, new data indicate behavioural effects on mice. A single, low dose of tetraBDE or pentaBDE given to new-born mice has been found to affect these animals' behaviour in adulthood. In similar animal experiments, PCB has affected the animals' behaviour in the same way. In the case of PCB these effects are accompanied by biochemical changes in the brain of the experimental animals, and there is strong evidence that the behavioural effects induced in animals can also occur in human beings. In addition, it is possible that these persistent compounds may have synergic effects on the brain.

55. For hexabromocyclododecane work on a risk assessment report is ongoing within the EU Programme on Existing Substances. At present the risk assessment report is being substantially revised. When finalised the report should be taken into consideration.

3. Desired reduction

56. Brominated flame retardants are on the OSPAR List of Chemicals for Priority Action since 1998 (see the OSPAR Strategy with regard to Hazardous Substances). The OSPAR objective with regard to hazardous substances on this list is to prevent pollution of the maritime area by continuing to reduce discharges, emissions and losses of hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances. Every endeavour will be made to move towards the target of cessation of discharges, emissions and losses of hazardous substances by the year 2020.

57. In the Esbjerg Declaration of the 4th North Sea Conference (1995), Ministers agreed to take concerted action within the framework of the competent international forum to substitute the use of brominated flame retardants by less hazardous or preferably non-hazardous substances where these alternatives are available.

58. Occurrence in the environment, high persistence, potential for long-range air transport are reasons for concern relating to certain PBDEs and PBBs. For some of the substances, high bioaccumulation and high toxicity are also of concern. Based on available data these substances seem to be the most important substances for risk reduction. HBCDD is used in large volumes, has a very high potential to bioaccumulate and is not readily biodegraded.

59. The following substances are commercially used:

CAS-no	Name	Abbreviation used
32534-81-9	Pentabromodiphenyl ether	PentaBDE
32536-52-0	Octabromodiphenyl ether	OctaBDE
1163-19-5	Decabromodiphenyl ether	DecaBDE
13654-09-6	Decabromobiphenyl	DecaBB
25637-99-4 3194-55-6	Hexabromocyclododecane	HBCDD

60. The aim is to achieve the 2020 target of the cessation of discharges, emissions and losses of brominated flame retardants.

4. Identification of possible measures

4.1 Ongoing activities

61. The work of the OECD at present involves discussions of how industry has performed on its commitment to reduce the hazards of PBDE, PBB and TBBP-A. This commitment includes e.g. the use of best available technique when manufacturing the substances, but not a phase-out. With the exception of decaBB, industry has made the commitment that PBB will not be further produced. The need for the continued exemption for decaBB was to be reviewed in the year 2000. Industry has submitted a report to the OECD in February 2000. The report describes measures taken to reduce emissions from the production plants, e.g. reducing emissions from packaging facilities but this will not affect emissions from the use of products containing flame retardants. The exemption for decaBB is no longer needed because the manufacturer has made a statement to cease production on 30 September 2000.

62. For the moment, it cannot be judged to what extent the work presently in progress within the framework of the Existing Substances Regulation (EEC) 793/93 will result in reduction of the risks posed by use of commercial octa- and decaBDE mixtures. The risk assessment for pentaBDE has concluded that there is a need for specific measures to limit the risks. This has been justified by risks posed by the particular characteristics of this substance, especially its environmental persistency, potential for bioaccumulation, toxicity, levels in biota and occurrence in breast milk in concentrations that may be increasing with time.

63. Restrictions on marketing and use, that in fact will constitute a ban, have been proposed for pentaBDE. These measures will contribute to achieving the 2020 target. This and other measures such as emission limits or waste disposal stipulations may need to be considered for other brominated flame retardants. Neither disposal at the waste stage nor emission reduction measures, however, will prevent the influx of these substances or exposure during the utilisation phase. Nor are these measures sufficient for quickly guaranteeing an end to the diffuse discharge of these substances into the environment.

64. In the framework of Directive 2000/60/EC of the European Parliament and of the Council of establishing a framework for Community action in the field of water policy (Water Framework Directive) the Council has reached on 7 June 2001 a common position on the establishment of a list of priority substances including substances identified as priority hazardous substances. The list awaits formal adoption by the Council and the European Parliament Brominated diphenyl ethers are included in this list with an indication that only pentabromobiphenyl ether is identified as a priority hazardous substance. With respect to the priority substances, the European Commission shall submit proposals of controls for the progressive reduction of discharges, emission and losses of substances concerned, and, in particular the cessation or phasing out of discharges, emissions and losses of priority hazardous substances. Hazardous substances are defined in the Water Framework Directive as "substances or groups of substances that are toxic, persistent

and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern". In drawing up the above list in its proposal, the European Commission has taken into account OSPAR work on the prioritisation of hazardous substances.

65. PBBs are at present not subject to investigations or discussions within the EU.

66. HBCDD is on the 2nd priority list of existing chemicals within the EU programme on Existing Chemicals. Sweden as rapporteur is currently preparing a risk assessment report according to Regulation (EEC) 793/93.

67. Within the European Commission, work is in progress on drafting directives concerning Waste from Electric and Electronic Equipment (WEEE), and restrictions on use of hazardous substances in electric and electronic equipment. The latter directive includes provisions for the substitution of the brominated flame retardants PBDE and PBB. The proposal has been discussed in the EU Council. The WEEE directive includes systems for collecting electric and electronic waste as well as improved handling of waste. These measures will contribute to achieving the 2020 target, but it is too early to judge to what extent this work may lead to a reduction in the use of brominated flame retardants.

68. A broader work than that at present conducted within the OECD and EC will be needed to be able to reach the targets described in chapter 3. Major parts of total releases depend on the use of brominated flame retardants which are manufactured in other parts of the world. These flame retarded articles are imported as such or in devices into OSPAR States.

69. Nearly 10 years ago the Swedish Government set up the goal to phase out the most harmful brominated flame retardants. Sincethen, a number of voluntary commitments have only resulted in a reduction of use to a limited degree. At present, the Government is considering a draft proposal for a ban on all PBDEs and PBBs. The draft proposal also calls for effective action to bring about a phase-out in other markets in which important suppliers of PBDEs and PBBs operate, e.g. with respect to the import of articles.

4.2 Alternatives

70. Brominated flame retardants only account for about 15% of the global flame retardant consumption. Consequently a large number of compounds may be considered as alternatives. Substitution can take place at three levels:

- brominated flame retardants can in some applications be replaced by another flame retardant without changing the base polymer;
- the plastic material, i.e. the base polymer containing flame retardants and other additives, can be replaced by another plastic material;
- a different product can replace the product, e.g. the plastic material is replaced by another material, or the function can be fulfilled by the use of a totally different solution.

71. Alternatives mentioned under the first indent for electric and electronic equipment are e.g. aluminium trihydroxide, magnesium hydroxide, red phosphorus or organic phosphorus compounds. These substances may not be viable for equipment which needs to meet certain demands with respect to technical and safety standards.

72. The flame retarded plastics used for switches, sockets and other applications where the material is in direct contact with live parts of electronic and electrical appliances are mainly made of thermoplastic polyester and polyamides. According to the Danish Environmental Protection Agency decaBDE has been substituted by TBBP-A and brominated styrene, but diarylphosphonate, melamine cyanurate or red phosphorus may be used as well.

73. Flame retardants for rigid polyurethane foams may be based on ammonium polyphosphates or red phosphorus. For flexible foams chlorinated phosphate esters, in some cases combined with melamine, ammonium polyphosphates and reactive phosphorus polyols are used.

74. Polysulfone, polyaryletherketone and polyethersulfone are plastics that are self-extinguishing and can be used without the addition of flame retardants. Less flammable materials e.g. wood and metals can also replace plastic material. Another example of the substitution of material is using wool instead of a more flammable fabric.

75. Available data show that there are less hazardous alternatives e.g. aluminium trihydroxide. But it cannot be disregarded that less suitable substances might be among the alternatives. When industry selects a method to inhibit fire, data has to be generated in order to allow a good choice from an industrial/product and environmental point of view.

5. Choice for action/measures

76. According to CEFIC/European Brominated Flame Retardant Industry Panel and the European manufacturer (Bakés, 2000), the production of PBB ceased during 2000. They also state that there is no production of PBB outside Europe. This seems to have been the case for at least some decades. Provided there are no hidden sources, such as products coming from non-EU countries, no further action by OSPAR is considered necessary. Therefore,

- OSPAR is recommended to note that production of PBB has ceased;
- OSPAR Contracting Parties that are also EU Member States are recommended to include PBBs in the EC Directive on Waste from Electric and Electronic Equipment. The reason for this is the use of PBBs in electric and electronic equipment housing.

77. Work within the EU Existing Substances Regulation on pentaBDE has so far provided a sufficient basis for restricting the uses that give rise to the major part of emissions and discharges. An amendment to Council Directive 76/769/EEC is proposed, banning all marketing and use of pentaBDE. The EU Council will adopt this in 2001. On this basis,

- no further OSPAR action will be necessary, but
- OSPAR Contracting Parties that are also EU Member States should work for an early final decision on the proposed harmonised EC restrictions on pentaBDE,
- because the effects of possible actions of EC directives may take years, Contracting Parties could meanwhile pay attention to local emission sources and emission control.

78. For octaBDE, decaBDE and HBCDD, risk assessments within the framework of the Existing Substances Regulation have not yet been completed. According to the available information on the ongoing risk assessment on octaBDE, there is concern about the toxic risks in some industrial uses. However, the EC risk assessment still contains several important gaps in data (e.g. on photolytic debromination and (eco)toxicity), which are expected to be filled in the near future. With the same qualification, the EU risk assessment has so far identified no concerns about decaBDE. Therefore,

- final conclusions about EC risk-reduction measures should be postponed until the risk assessments are finalised; and
- in the light of the conclusions of that risk assessment, OSPAR Contracting Parties that are also EU Member States should work for proposals on risk-reduction strategies for octaBDE, decaBDE and HBCDD, including decisions on harmonised EU-restrictions, that will contribute to achieving the OSPAR 2020 target. This aim should include taking account of the fact that octaBDE, like pentaBDE, is a commercial mixture of different PBDEs and that it is therefore possible for pentaBDE to occur in products containing octaBDE.

79. The proposed EC Directives on Waste from Electric and Electronic Equipment and on Restrictions on Certain Hazardous Substances in Electric and Electronic Equipment could contribute to achieving the OSPAR 2020 target by reducing the possibility of discharges, emissions and losses of PBDE. Therefore,

- OSPAR Contracting Parties that are also EU Member States should work to ensure that these directives take account of the conclusions of the risk assessments of PBDE, as well as actions taken within the framework of Restrictions on Marketing and Use of Certain Hazardous Substances.

80. Under the EC Water Framework Directive a list of priority substances, including the identification of priority hazardous substances, has been established. PentaBDE is included on this list as a priority hazardous substance. Following the formal adoption of this list, and in the light of the conclusions of the risk assessments of other PBDEs,

- OSPAR Contracting Parties that are also EU Member States should seek:
  (i) further measures for PentaBDE as appropriate;
  (ii) to have all PBDEs included on that list in a first revision of the Water Framework Directive within three years.

81. In order to provide a sound basis both for future decisions and assessments of the quality status of the marine environment,

- OSPAR should invite Sweden, on the basis of a survey of the available monitoring and research data, to identify gaps in knowledge and any monitoring and assessment tools that need to be developed, and to propose a monitoring strategy for the brominated flame retardant covered by this Background Document.

82. Since it is not yet possible to judge to what extent measures resulting from the work in progress in the EC will enable the OSPAR 2020 target to be achieved for brominated flame retardants in general, OSPAR should in 2003:

- review what is likely to be achieved by the EC measures that have by then been adopted;
- consider the need for further OSPAR actions in order to achieve the year 2020 target.

83. To ensure that the information in this background document and the conclusions reached by OSPAR are formally communicated to the European Commission,

- OSPAR should write to the European Commission in terms of a letter to be drafted by Sweden.

84. To ensure that the information in this background document can be considered in the context of other international agreements, which deal with hazardous substances and to, which Contracting Parties are associated.

- OSPAR should send copies of this background document to the appropriate bodies dealing with those agreements and invite Contracting Parties who are common parties to OSPAR and those other agreements to promote action to take account of this background document by those other international bodies in a consistent manner.

References

EU Draft Risk Assessment biphenylether, octabromo derivative, Human Health (UK/F) Oct 1997.

EU Draft Risk Assessment bis(pentabromophenylether), Human Health (UK/F) Feb 2000.

EU Draft Risk Assessment biphenylether, pentabromo derivative, (UK) Aug 2000.

EU Draft Risk Assessment biphenylether, octabromo derivative, Environment (UK/F) Aug 1999.

EU Draft Risk Assessment bis(pentabromophenylether), Environment (UK/F) Aug 1999.

EU Draft Risk Assessment hexabromocyclododecane, (S) March 1999.

Bakés, J., Elf Atochem, personnel communication, 2000.

de Boer, J., Wester, P.G., Rodriguez, D.P., Lewis, W.E. and Boon, J.P. Organohalogen Compounds, Vol 35 (383-386), 1998.

Brominated Flame retardants - Substance Flow Analysis and Assessment of Alternatives, Danish Environmental Protection Agency, Report No. 494, 1999.

Meerts, I.A.T.M., Letcher, R.J., Hoving, S., Marsh, G. Bergman, Å., Lemmen, J.G., van der Berg, B., Brouwer, A. In vitro Estrogenicity of Polybrominated Diphenyl Ethers, Hydroxylated PBDEs, and Polybrominated Bisphenil A Compounds. Environ Health Perspec 109:399-407, 2001.

Phase-out of PBDEs and PBBs - Report on a Governmental Commission, KemI report 2/99, Solna, Sweden, 1999.

Sellström, U., Kierkegaard, A., de Wit, C. and Jansson, B. Environmental Toxicology and Chemistry, Vol 17 (6), 1998.

Sellström, U., Lindberg, P., Häggberg, L. And de Wit, C. Bromerade flamskyddsmedel funna i ägg av pilgrimsfalkar (Falco peregrinus) häckande i sverige, Rapport utgiven av Svenska Naturskyddsföreningen i samarbete med TCO-Utveckling AB, 2001.

Van Zeijl, H., Report of the results of the one-off survey DIFFCHEM- project.

De Wit, C., Brominated Flame retardants, Swedish Environmental Protection Agency Report 5065, Stockholm, Sweden 2000.

WWF briefing – Brominated Flame retardants.

Appendix 1: Monitoring strategy for Certain Brominated Flame Retardants

As part of the Joint Assessment and Monitoring Programme (*reference number 2003-22*), OSPAR 2004 adopted an Agreement on monitoring strategies for OSPAR Chemicals for Priority Chemicals (*reference number 2004-15*) to implement the following monitoring for tracking progress towards the objectives of the OSPAR Hazardous Substances Strategy (*reference number 2003-21*) with regard to certain brominated flame retardants. The Monitoring Strategy for certain brominated flame retardants will be updated as and when necessary, and redirected in the light of subsequent experience.

This monitoring strategy covers those brominated flame retardants (BFRs) covered by the recommendations of the OSPAR Background Document on certain brominated flame retardants - pentabrominated diphenyl-ether, octabrominated diphenyl-ether, decabrominated diphenyl-ether, hexabromocyclododecane and decabromobiphenyl. Penta- and octabromodiphenyl ether will be banned in 2004. Hexabromocyclododecane is still in use and may be increasingly used as a substitute for the banned diphenyl ethers.

There are a number of relevant controls (e.g. regulations, directives, recommendations and decisions) on a) marketing and/or use, b) emissions and/or discharges of BFRs which have been agreed by Contracting Parties both in OSPAR and in other international forums and have been highlighted as important measures for achieving the OSPAR Hazardous Substances objective with respect to BFRs in the "choice for actions" chapter of the Background Document. Evidence from reports on the implementation of such measures will be used to make an initial judgement of the extent to which the amounts of these substances emitted or discharged are reduced.

Bearing in mind the widely dispersed and diffuse sources of BFRs, environmental monitoring may offer a better option than the source oriented approach for tracking the progress towards the 2020 cessation target. Methodologies for monitoring BFRs in the environment are available. Monitoring that has been carried out in the marine environment shows concentrations above the detection limit in biota and sediment.

On the evidence available, it would not appear to be sensible to include BFRs in the RID or CAMP programmes.

Since the laboratories of several Contracting Parties have developed sufficient analytical capability to measure BFRs they appear to be good candidates to be included in the review of the CEMP in 2005-06. Any future proposal for inclusion of BFRs in the CEMP, should take into account:

a. the possible need for monitoring in relation to agreed Ecological Quality Objectives (organochlorine concentrations in seabird eggs). The Swedish long-term monitoring programme using guillemot eggs as an indicator of the reductions of BFRs in the Baltic marine environment could be shown as a good example;

b. brominated diphenyl ethers are included as a priority hazardous substances under the EC Water Framework Directive, and OSPAR will seek to make use of the results of Water Framework Directive monitoring. The Water Framework Directive catchment assessments may assist the identification of monitoring locations.

In the meantime Contracting Parties are urged to extend their monitoring programmes to cover BFRs and to report results on a voluntary basis through the data-handling mechanism operated by ICES for the CEMP.

OSPAR will consider the need to developing an EAC for certain BFRs, taking into account the development of an environmental quality standard under the WFD.

Some BFRs may disrupt the oestrogenic system, and biological effects monitoring may also need to be considered. Available information on the occurrence of BFRs and their biological effects in marine biota will be evaluated to gauge whether there is a gap in knowledge which OSPAR should seek to fill, prior to the 2009 Quality Status Report for the Convention Area.

CERTAIN BROMINATED FLAME RETARDANTS MONITORING STRATEGY[1]	
Implementation of actions and measures	• Examination of progress in the implementation of regulations on marketing and/or use or emission and/or discharge which have been agreed, or are endorsed, by the Background Document
Concentrations in sediments	• The review of the CEMP in 2005-06 will consider whether to add an additional appendix on these substances • Before [2006] the lead country will collate information on concentration of these substances in the marine environment in order to assess whether this is a gap in knowledge which OSPAR should fill prior to the 2009 QSR • The need for EACs and BRCs will be considered *Additional voluntary monitoring* • *In the meantime, Contracting Parties will be encouraged to extend their monitoring programmes to cover brominated flame retardants and to report results on a voluntary basis through the data-handling mechanism operated by ICES for the CEMP*
Concentrations in biota	• The review of the CEMP in 2005-06 will consider whether to add an additional appendix on these substances. Any proposal for such an appendix should consider possible synergies with monitoring related to the North Sea Pilot Project EcoQO on organochlorine concentrations in seabirds' eggs • Before 2006 the lead country will collate information on concentration of these substances in order to assess whether this is a gap in knowledge which OSPAR should fill prior to the 2009 QSR *Additional voluntary monitoring* • *In the meantime, Contracting Parties will be encouraged to extend their monitoring programmes to cover brominated flame retardants and to report results on a voluntary basis through the data-handling mechanism operated by ICES for the CEMP*
Biological effects	• Before 2006 the lead country will collate information on concentration of these substances in order to assess whether this is a gap in knowledge which OSPAR should fill prior to the 2009 QSR

[1] That is, pentabrominated diphenyl-ether, octabrominated diphenyl-ether, decabrominated diphenyl-ether, hexabromocyclododecane and decabromobiphenyl

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