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**INTERPRETATIONS OF, AND AMENDMENTS TO, MARPOL
AND RELATED INSTRUMENTS**

**Proposal to Designate an Emission Control Area for Nitrogen Oxides,
Sulphur Oxides and Particulate Matter**

Submitted by the United States and Canada

SUMMARY

Executive summary: This document sets forth a proposal to designate as an Emission Control Area specific portions of the coastal waters of the United States and Canada, in accordance with regulations 13 and 14 and Appendix III of MARPOL Annex VI.

This proposal shows that the designation of this Emission Control Area is supported by a demonstrated need to prevent, reduce and control emissions of nitrogen oxides, sulphur oxides, and particulate matter from ships. Moreover, adoption of the proposed Emission Control Area will result in significant reductions in ambient levels of air pollution in the United States and Canada, which will achieve substantial benefits to human health and the environment.

The United States and Canada invite the Committee to review this proposal at this session with a view toward the adoption by the Parties to MARPOL Annex VI, at MEPC 60, of amendments to Regulations 13.6 and 14.3 designating a new Emission Control Area.

Strategic direction: 7.3

High-level action: 7.3.1

Planned output: 7.3.1.1

Action to be taken: Paragraph 17

Related documents: Revised MARPOL Annex VI and MEPC 59/INF.8.

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Introduction

1 The United States and Canada propose the designation of an Emission Control Area (ECA) for specified portions of the United States and Canadian coastal waters, for the control of nitrogen oxides (NO_x), sulphur oxides (SO_x), and particulate matter (PM) emissions. Designation is necessary to protect public health and the environment in the United States and Canada by reducing exposure to harmful levels of air pollution resulting from these emissions. The burden on international shipping is small compared to the improvements in air quality, the reductions in premature mortality and health incidences associated with this air pollution, and the other benefits to the environment resulting from designation of this ECA. Annex 1 to this proposal provides a complete analysis of how the proposal satisfies each of the eight Criteria for Designation of an ECA established under MARPOL Annex VI Appendix III; annex 2 sets forth a detailed description of the proposed ECA; and annex 3 presents a chart of the proposed area. The United States and Canada have also prepared draft amendments, presented in annex 4 of this proposal, to include the proposed ECA in the appropriate paragraphs of Regulations 13 and 14. Lastly, a comprehensive bibliography of all the information considered in preparing this proposal has been submitted to this Committee as a separate document, MEPC 59-INF.13, herein referred to as the Information Document.

Summary of Proposal

2 Designation of this ECA will significantly reduce emissions from ships, and deliver substantial benefits to large segments of the population, as well as to marine and terrestrial ecosystems. Air pollution from ships occurs not just in the United States and Canadian ports and coastlines, but is also carried hundreds of kilometres inland. When people breathe this polluted air, their health is adversely affected, leading to lost productivity due to increased illnesses, hospitalizations and even premature deaths. As of early this decade, more than 100 million people in the United States and Canada lived in areas with air pollution at levels exceeding our respective national ambient air quality standards, levels which are unhealthy according to the World Health Organization (WHO). Moreover, scientists have not identified any ambient threshold for particulate matter below which no damage to health is observed. Thus, air pollution below the WHO levels is still harmful and the health of millions of people in all areas can be enhanced by improving air quality further. In addition, the gains that have been made by extensive domestic regulations to control emissions from land-based sources over the last four decades could be eroded or even reversed by expected growth in human and economic activity, including shipping. To maintain and improve air quality, public health and the environment, decisive action must be taken to realize the benefits that can be gained from additional emissions reductions.

3 The United States and Canadian Governments have coordinated in proposing this ECA, in line with common interests, shared geography and interrelated economies. The two governments have consulted with stakeholders, including representatives from the shipping industry, ports, master mariners, environmental interests and representatives from state and provincial governments. This proposal takes into account the issues raised during consultations and strives to minimize the impact on the shipping community, while achieving needed environmental protection. It is believed that by acting at the international level to reduce the impacts of shipping on air quality, human health and ecosystems, the designation of this ECA will remove pressure on national and sub-national (e.g., state, local) jurisdictions to consider regulatory actions to reduce ship emissions.

Populations and Areas at Risk

4 Millions of people and many important ecosystems in the United States and Canada are deleteriously affected by emissions from ships today, and are at risk of additional harm in the future. We have a combined population in excess of 330 million, over half of which reside along the Pacific and Atlantic coasts in centres of global commerce such as Vancouver, Los Angeles, Miami and New York. There are over 50 metropolitan areas (both inland and coastal) with populations greater than one million. Further, because ship pollution travels great distances, much of the inland population is also affected by ship emissions and will benefit from the cleaner air made possible by ECA fuel and engine controls. For example, pollution from ships travels as far as the Dallas, Texas^A area of the United States, which has over 6 million residents, including an especially sensitive population of approximately 1.6 million children and half a million persons over the age of 65. All of the above populations are at risk of increased harm from shipping if an ECA is not designated.

5 Annex 1 to this submission describes the ways in which air pollution from ships contributes to the impairment of various ecosystems, including: nitrogen nutrient loading, acidification, smog caused by NO_x and other precursor gases, and changes in visibility. SO_x and NO_x emissions from ships are carried over land and they and their derivatives (including PM and sulphur and nitrogen containing compounds) are deposited on surface waters, soils and vegetation. Importantly, air pollution can contribute a significant portion of the sulphur and nitrogen loading that an ecosystem receives. Some areas are more sensitive than others, and many have multiple stressors. Some ecosystems are sensitive especially to acidification due to sulphuric and nitric acids formed from SO_x and NO_x, while other ecosystems are particularly sensitive to excess nitrogen, which contributes to aquatic eutrophication that alters biogeochemical cycles and harms animal and plant life. Areas where ships' emissions are deposited are at risk of further damage in the future. Adoption of this ECA would help reduce the stresses on a large number of sensitive ecosystems, including numerous forests, grasslands, alpine areas, wetlands, rivers, lakes, estuaries, and coastal waters.

6 As established in MARPOL Annex VI, an ECA designation is intended to prevent and reduce the adverse impacts on human health and the environment in areas that can demonstrate a need to prevent, reduce, and control emissions of NO_x, SO_x, and PM. The Parties to Annex VI chose this objective because of the known public health and environmental effects associated with NO_x, SO_x and PM emissions. Designation of the proposed ECA directly furthers this objective by reducing the emissions of NO_x, SO_x and PM from ships operating in the proposed area, thus reducing exposures of the public to and deposition to sensitive ecosystems of these pollutants and their derivatives, in the United States and Canada.

Contributions from Ships to Adverse Impacts

7 In developing the current proposal, the Governments of the United States and Canada performed a comprehensive analysis to quantify the degree of human health risk and environmental degradation that is posed by air emissions from ships operating in their ports and off their coasts. For gauging the risk to human populations, state-of-the-art assessment tools were used to apply widely accepted methods with advanced computer modelling techniques, and such methods produced highly reliable and replicable results. The analyses incorporated detailed ship traffic and fuel data, the most recent emissions estimates, detailed meteorological data, current scientific understanding of exhaust plume behaviour: physical dispersion and

^A The Dallas-Fort Worth Metroplex area of Texas in the United States is located approximately 380 kilometres inland from the Gulf of Mexico. This is comparable to the distance from Munich, Germany to the Mediterranean Sea.

photochemical reactions, the latest epidemiologic databases of health effects attributable to pollutant exposure levels and assessments of ecosystem sensitivity, to estimate the current impacts of shipping on human health and the environment. According to our analysis, the proposed ECA is expected to save thousands of lives each year, relieve millions of cases of acute respiratory symptoms, and benefit many sensitive ecosystems.

7.1 Emissions from ships contribute to substantially increased ambient concentrations of air pollutants over vast land and sea areas. Section 3 of annex 1 of this proposal presents maps that display the air quality impact of shipping emissions on ambient concentrations of PM and ground-level ozone (smog). The physical dispersion models used to create these maps account for the varying wind patterns over the course of a representative year and simulate the paths that NO_x or SO_x or PM travel once emitted from the funnel of a ship operating in the proposed area. The photochemical models predict the extent to which the NO_x molecules react to form ground-level ozone and the extent to which either NO_x molecules or SO_x molecules react to form very small particles, known as PM_{2.5}.^B These maps show that the increased ambient concentrations of PM_{2.5} and ozone due to ship emissions are largest near the coasts, where many of the most populous cities are located, but emissions are also transported over large distances and have significant impacts well into the interior of the United States and Canada.

7.2 Ship emissions contribute to a large number of adverse human health impacts in the United States and Canada, especially in densely populated coastal areas. Ships generate emissions that lead to elevated ambient concentrations of PM_{2.5} and ground-level ozone that impair the health of humans. The following table presents the annual reduction of ship-related adverse health impacts in 2020 that would result from applying the ECA standards. The figures in this table clearly illustrate the health benefits of designating the proposed ECA for the United States and Canada. Our analysis shows that as many as 8,300 lives will be saved and over three million people will experience relief from acute respiratory symptoms each year.

Estimated PM_{2.5}- and Ozone-Related Human Health Impacts Associated with Ship Emissions in the United States and Canada

Health Effect	2020 Annual Ship-Related Incidence	2020 Annual Reduction in Ship-Related Incidence with an ECA ^a
Premature Mortality ^b	5,100 – 12,000	3,700 – 8,300
Chronic Bronchitis	4,600	3,500
Hospital Admissions ^c	8,400	3,300
Emergency Room Visits	4,100	2,300
Acute Bronchitis	13,000	9,300
Acute Respiratory Symptoms	6,500,000	3,400,000

^a Based on ship emission inventory reductions due to switching from 2.7% sulphur residual fuel to 0.1% sulphur distillate fuel and an overall fleet NO_x reduction in the ECA of 23%, in 2020, from Tier II levels. In the long term, a 75% reduction in NO_x emissions from Tier II levels would be expected in the ECA.

^b Includes both PM_{2.5}- and ozone-related estimates of premature mortality. The range is based on the high- and low-end estimate of incidence derived from several alternative studies used to estimate PM_{2.5}- and ozone-related premature mortality in the United States.

^c Includes estimates of both cardiovascular- and respiratory-related hospital admissions.

^B PM_{2.5} is defined as Particulate Matter with aerodynamic diameter less than 2.5 micrometers.

7.3 The Governments of the United States and Canada have also gauged the damage to sensitive ecosystems that is attributable to emissions from ships, and the improvement that will be achieved by designation of this ECA. Different ecosystems can be sensitive to and harmed by different pollutants, including nitrogen nutrient loading and acidification. About 30 per cent of the nitrogen in the Chesapeake Bay in the mid-Atlantic coast of the United States comes from atmospheric deposition, and ships are an important source of that pollution. The sensitivity of an ecosystem to acidification depends on the ability of the soils to neutralize (or buffer) the deposited acidic pollutants formed from SO_x and NO_x. Differences in soil buffering capacity are an important reason why some areas that receive acid precipitation show a lot of damage, while other areas do not appear to be harmed at all. Using combined modelling of atmospheric, aquatic and terrestrial systems, the Government of Canada predicts that improving ship emissions from current performance to ECA standards will significantly reduce the amount of sulphur and nitrogen deposition in sensitive ecosystems. For example an ECA will result in a 19 per cent reduction in excess deposition in southwestern British Columbia and it will eliminate excess deposition over about 13,500 km² across Canada. In the northeastern United States and eastern Canada, many decades of acid deposition resulted in the widespread loss of calcium and other essential nutrients from several watersheds. These losses have been linked to a decline in sugar maple growth in Canada as well as a decline in aquatic micro-organisms that are an important food source for fish and other predators. Section 5 of annex 1 of this proposal presents detailed ecosystem maps illustrating the widespread nature of impacted ecosystems in the both the United States and Canada. Designating an ECA will help some of these areas begin to recover their natural balance.

Description of Area

8 The area, the United States and Canada are proposing for ECA designation, is illustrated in Section 2 of annex 1 to this proposal. A detailed description of the ECA, including select coordinates, is provided in annex 2 and a chart is presented in annex 3. The proposed area of the ECA includes waters adjacent to the Pacific coast, the Atlantic/Gulf coast and the Hawaiian Islands. The Pacific portion of the proposed ECA is bounded in the north such that it includes the approaches into Anchorage, Alaska, but not the Aleutian Islands or points north. It continues contiguously to the South including water adjacent to the Pacific coasts of Canada and the United States, with its southernmost boundary at the point where California meets the border with Mexico. The Atlantic/Gulf portion of the proposed ECA is bounded in the West by the border of Texas with Mexico and continues contiguously to the East around the peninsula of Florida and north up the Atlantic coasts of the United States and Canada and is bounded in the north by the 60th North parallel. The Hawaiian Islands portion of the proposed ECA includes only the eight main^C Hawaiian Islands. The proposed ECA will extend 200 nautical miles from the territorial sea baseline, except that it will not extend into marine areas subject to the sovereignty, sovereign rights, or jurisdiction of any State other than the United States or Canada consistent with international law and is without prejudice to any undelimited maritime boundaries.

^C As used here, the main Hawaiian Islands include the islands of Hawaii, Maui, Oahu, Molokai, Niihau, Kauai, Lanai, and Kahoolawe. These islands are the main populated islands of the Hawaiian Islands chain, with the exception of Kahoolawe, which is an uninhabited nature reserve.

9 Not included in the proposed ECA are the Pacific United States territories, smaller Hawaiian Islands, the United States territories of Puerto Rico and the United States Virgin Islands, the Aleutian Islands and Western Alaska, and the United States and Canadian Arctic. The United States and Canada are not making a determination that areas not included in the present proposal suffer no adverse impact from shipping. Further information must be gathered to properly assess these areas. If such further information were to demonstrate a need for protection of other areas, the affected State(s) would submit a proposal for ECA designation of such areas.

Ship Traffic and Meteorological Conditions

10 Ship traffic in the area that would be covered by the proposed ECA is substantial. The United States and Canada typically see over 93 thousand vessel calls at their ports annually. In addition, many vessels operate in these areas that do not call on the United States or Canadian ports, but instead are en route to other countries. Much of the ship traffic around the United States and Canada is upwind of, and in close proximity to, heavily populated areas collectively containing hundreds of millions of inhabitants.

11 Meteorological conditions in the United States and Canada ensure that a significant portion of emissions from ships at-sea and the resulting pollution formed in the atmosphere are transported to land. The emissions from ships of NO_x, SO_x and their derivatives (including PM) can have lifetimes of about five to ten days before they are removed from the atmosphere (e.g., by deposition or chemical transformation). The eastern Pacific and southwestern Atlantic Oceans are areas with a general pattern of limited precipitation. In these areas, pollutants are more likely to have long atmospheric lifetimes due to the limited chance of being washed out of the air by rain, snow or fog. During the time from being emitted into and removed from the air, pollutants can be transported hundreds of nautical miles over the ocean and can be transported hundreds of kilometres inland by the winds commonly observed offshore and over the United States and Canada. Because meteorology can vary from day-to-day and because some wind patterns are more common than others, the impact of air pollution from ships at-sea is larger in some areas than others. The analysis conducted for this proposal indicates that winds frequently blow onshore in all areas of the proposed ECA. Further, NO_x, SO_x and PM emitted from ships remain airborne long enough to be transported long distances, adversely affecting large portions of the United States and Canada.

Land-Based Emissions Controls

12 Governments in the United States and Canada have already imposed stringent restrictions on emissions of NO_x, SO_x, PM and other air pollutants from a wide range of industrial, commercial and transportation activities. Examples of industrial and commercial sources subject to emissions restrictions include large and small manufacturing plants, smelting and refining facilities, paper mills, chemical and pharmaceutical companies; and combustion sources at factories and power plants such as boilers, turbines, and engines. Examples of transportation sources subject to emissions restrictions and fuel quality standards include automobiles, trucks, buses, locomotives and domestic commercial and recreational watercraft. Due to the interrelated nature of their economies, Canada's policy is to align its vehicle and engine emission standards, and fuel quality standards, with the United States standards.

13 The United States and Canadian air pollution control programmes for sources of air pollution other than ships have been highly successful, reducing total emissions of NO_x, SO_x and PM from sources in the United States and Canada by 30 per cent, 43 per cent and 26 per cent respectively, over the period from 1990 to 2007, even while the United States and Canadian combined gross domestic product rose 67 per cent (inflation-adjusted). The most significant source categories have applied advanced emission control technology where feasible, reducing emissions by as much as 99 per cent in many cases. As the largest emitters have reduced their emissions, the United States and Canadian emission inventories have shifted and we continue to find cost-effective reductions that can be achieved from additional controls on the remaining sources. Adoption of the proposed ECA will greatly reduce emissions from the increasingly significant ocean transportation sector.

Estimated Costs

14 The costs of implementing and complying with the proposed ECA are expected to be small both absolutely and compared to the costs of achieving similar emissions reductions through additional controls on land-based sources. The Governments of the United States and Canada estimate the total costs of improving ship emissions from current performance to ECA standards will be approximately US\$3.2 billion in 2020. The costs for each tonne of NO_x, SO_x and PM avoided are estimated at US\$2,600, US\$1,200 and US\$11,000, respectively. These costs per tonne are a measure of cost-effectiveness, and are comparable or favourable to the cost-effectiveness of the controls imposed on many land-based sources. For example, the programme to clean up heavy-duty highway diesel trucks cost US\$2,700/tonne for NO_x and US\$17,000/tonne for PM. Improving current ship emission levels to ECA standards is one of the most cost-effective measures available to obtain necessary improvements to the air quality in the United States and Canada. Consistent with the analyses conducted by the Cross Government/Industry Scientific Group of Experts in support of the recent revisions to MARPOL Annex VI, it is expected the appropriate fuels and technologies will be available in sufficient quantities to meet the agreed-to ECA emission limit implementation dates.

15 The economic impacts of complying with the program on ships engaged in international trade are expected to be modest. Analysis of a ship in liner service between Singapore, Seattle, and Los Angeles/Long Beach suggests that improving from current performance to ECA standards would increase the cost of shipping a twenty-foot-equivalent container by about US\$18. Overall, operating costs for a ship in such a route, which includes about 1,700 nm of operation in the proposed ECA, would increase by about 3 per cent. Similarly, the impacts on cruise vessels are expected to be small. The per passenger price of a seven-day Alaska cruise operating entirely within the ECA would increase about US\$7 per day. The expected increase in total operating costs would be smaller for ships that do not operate as extensively in the proposed ECA. For the vast majority of goods currently moved by ship, there are no close transportation alternatives. Therefore ship owners are expected to be able to pass all or nearly all of the additional costs associated with complying with the ECA NO_x and fuel sulphur control measures to the purchasers of marine transportation services. These increases in transportation costs ultimately would be passed on in the form of slightly higher prices for the goods being shipped. These price impacts are expected to be small because transportation is only a small share of total production costs for finished goods.

Conclusion

16 Ship emissions contribute significantly to air pollution, adverse human health outcomes and ecosystem damage in the United States and Canada. Adoption of the proposed ECA will dramatically reduce these effects and improve public health and the environment within our countries. The United States and Canada have already implemented stringent emission controls on land-based sources of air pollution, and applying similar controls to vessels engaged in international shipping will achieve substantial benefits at comparable, and reasonable, costs. More broadly, adoption of the proposed ECA will also demonstrate the effectiveness of the regional control provisions contained in MARPOL Annex VI toward helping countries achieve their important human health and environmental goals through the application of stringent marine engine emission and fuel sulphur controls.

Action requested of the Committee

17 The Committee is invited to consider the information presented in this document and its annexes and approve the proposed Emission Control Area, as described, for the control of NO_x, SO_x and PM, with a view for adoption, at MEPC 60, of amendments to regulations 13.6 and 14.3 to formally designate this Emission Control Area under MARPOL Annex VI.
