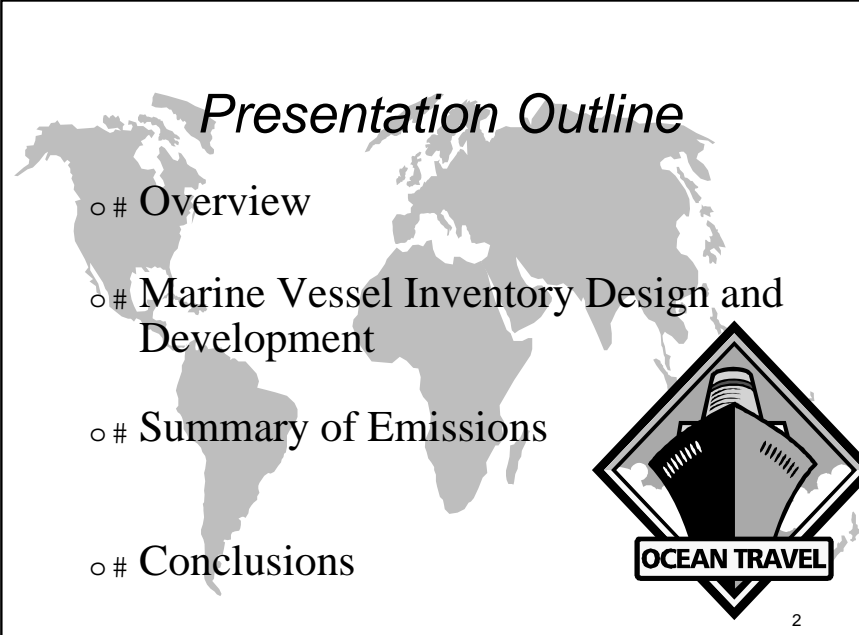


***Marine Vessel Emissions
Inventory***


**Mena Shah
Emission Inventory Branch
California Air Resources Board
(Presented by T.L. Garrett)**

Presentation at:
Marine Vessels and Air Quality Conference
San Francisco
February 1, 2001

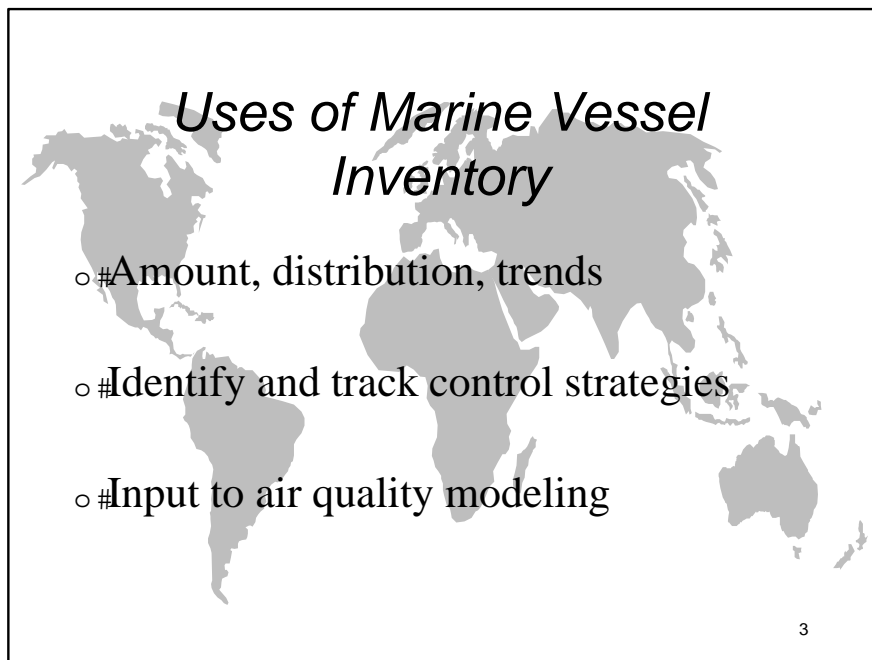


Presentation Outline

- # Overview
- # Marine Vessel Inventory Design and Development
- # Summary of Emissions
- # Conclusions



2



Uses of Marine Vessel Inventory

- #Amount, distribution, trends
- #Identify and track control strategies
- #Input to air quality modeling

3

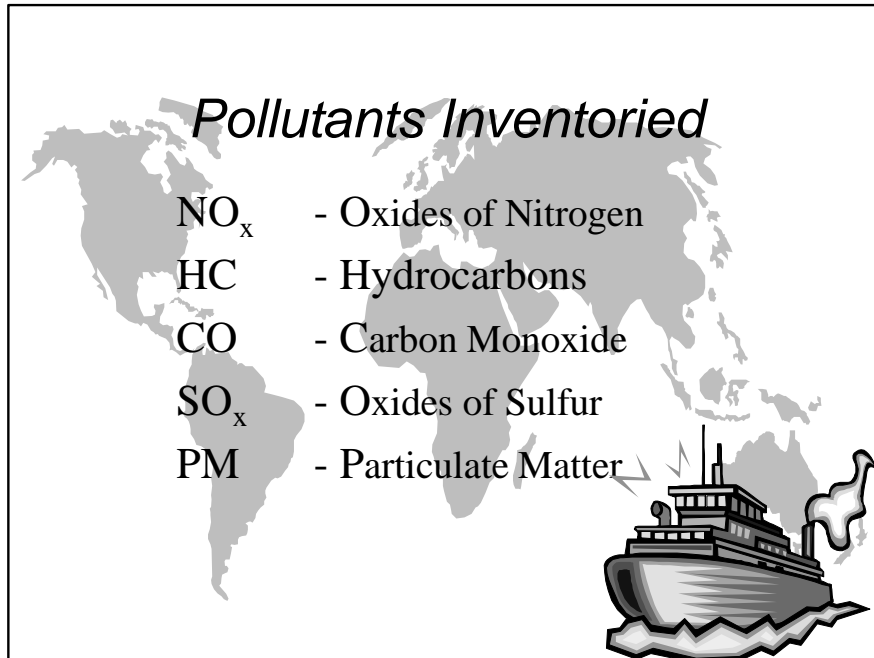


Previous Inventories

- #Limited Area
- #Assumptions
- #Annual Average only
- #No day-to-day variations

4

Pollutants Inventoried



NO_x - Oxides of Nitrogen
HC - Hydrocarbons
CO - Carbon Monoxide
SO_x - Oxides of Sulfur
PM - Particulate Matter

The slide features a world map in the background. In the bottom right corner, there is a detailed illustration of a large cargo ship with multiple masts and a smokestack emitting a plume of smoke.

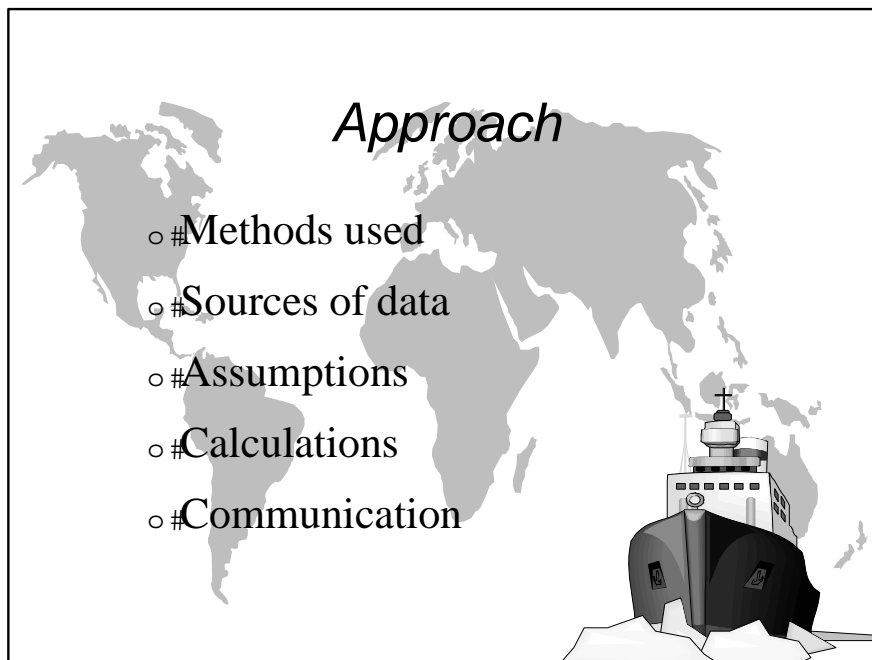
Technical Working Group



- #California Air Resources Board
- #U.S. EPA
- #SCAQMD
- #ARCADIS
- #Ports of LA/LB
- #U.S. Navy
- #Pacific Merchant Shipping Association

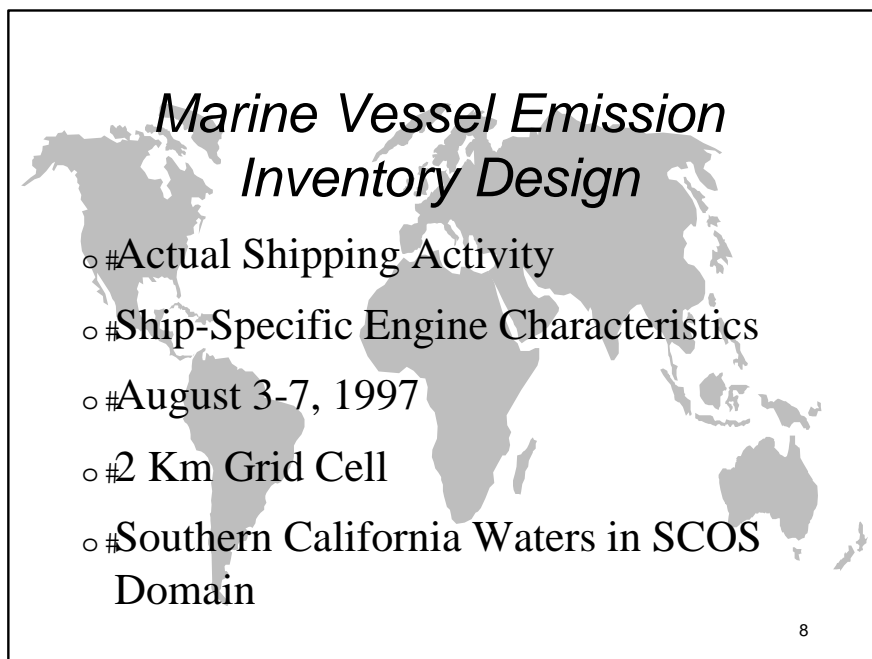
6

The slide features a world map in the background. The text is overlaid on the map, listing the members of the Technical Working Group.



Approach

- #Methods used
- #Sources of data
- #Assumptions
- #Calculations
- #Communication



Marine Vessel Emission Inventory Design

- #Actual Shipping Activity
- #Ship-Specific Engine Characteristics
- #August 3-7, 1997
- #2 Km Grid Cell
- #Southern California Waters in SCOS Domain

8



Key Data Needs

SHIP ACTIVITY DATA

- ◆ Identification of Ship Modes of Operation
- ◆ Commercial Shipping Arrivals and Departures
- ◆ Maneuvering, Berthing and Hotelling
- ◆ U.S. Navy Vessel Inventory

9



Key Data Needs

SHIP MACHINERY AND OPERATIONAL CHARACTERISTICS

- ◆ Ship-Specific Engine Characteristics
- ◆ Ship Speed
- ◆ Stack Information
- ◆ Engine Loads
- ◆ Emission Factors (Energy Output Based)

10

Sources of Data

DATA	AGENCY
Commercial Ship Activity Data	ARCADIS, POLA, MAREX
Maneuvering, Berthing and Hotelling	Wharfinger Agencies, POLA, POLB
U.S. Navy Vessel Inventory	U.S. Navy, JJMA
Ship-Specific Engine Characteristics	JJMA
Ship Speed	MAREX, POLA
Stack Information	Pacific Merchant Shipping Association
Engine Loads	ARCADIS and JJMA
Emission Factors	ARCADIS, JJMA, and U.S.EPA

11

Ship Operational Modes

MODE	DIRECTION
Cruise	Entry (Inbound)
Cruise	Exit (Outbound)
Precautionary Zone	Entry (Inbound)
Precautionary Zone	Exit (Outbound)
Maneuvering	Entry (Inbound)
Maneuvering	Exit (Outbound)
Hotelling	-

12

Summary of Ship Activity During August Episode

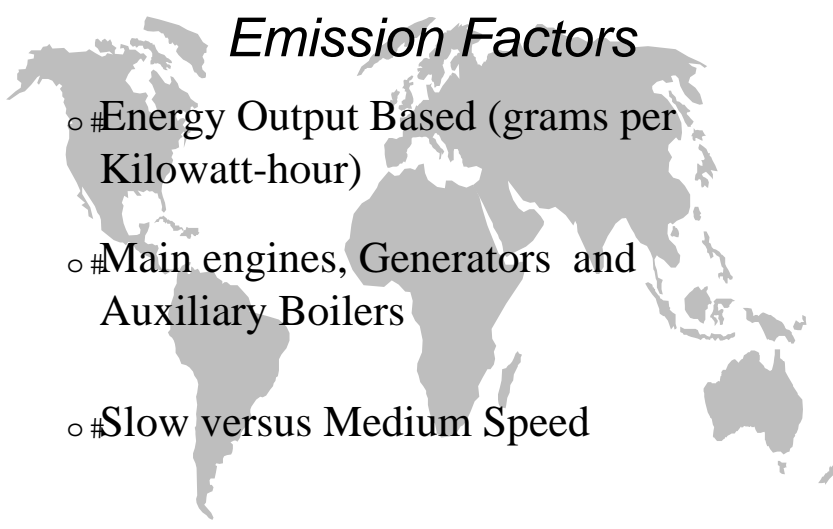
Ship Type	Count
Bulk Carrier	9
Bulk/Container Carrier	3
General Cargo	3
Refrigerated Cargo	3
Passenger	3
Vehicle Carrier	6
Container Carrier	47
Chemical Tanker	1
Tanker	11
RORO Container	1
TOTAL	87

13

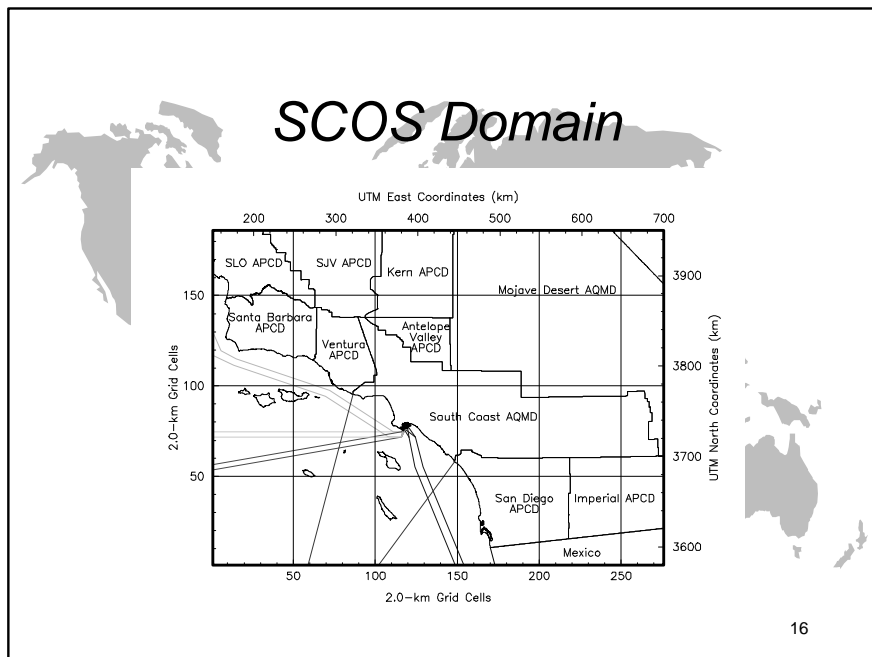
- ### *Engine Characteristics*
- ◆ Actual horsepower for each ship
 - ◆ Slow speed versus medium speed
 - ◆ Actual kW for each generator
 - ◆ Steam ship-specific fuel consumption information
 - ◆ Propulsion type emission factors
- 14

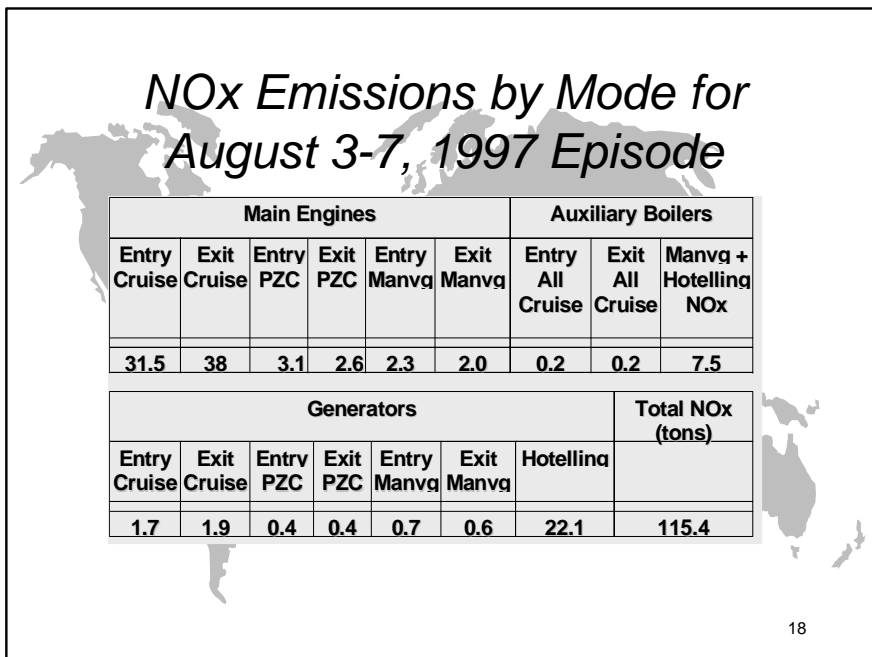
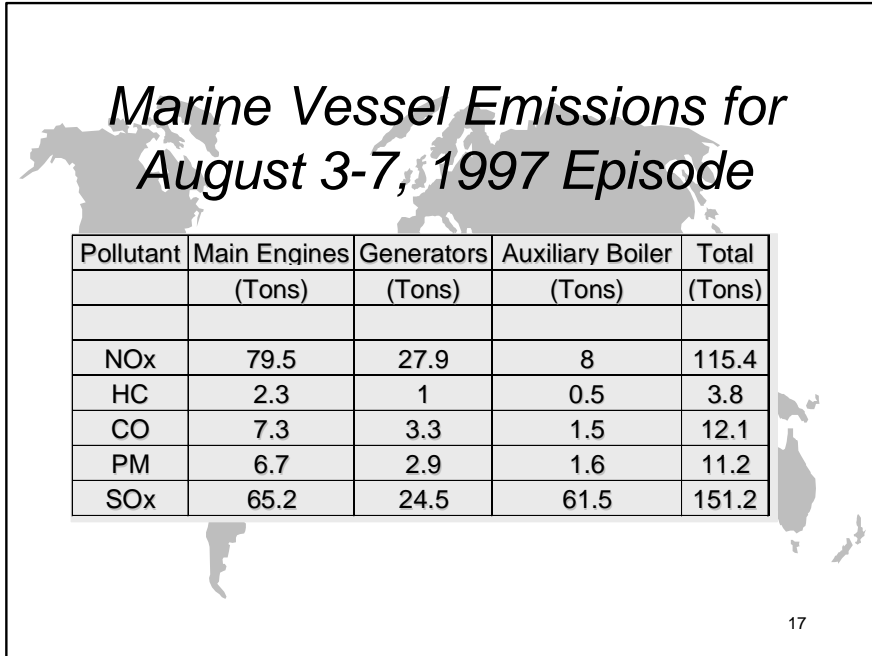
Emission Factors

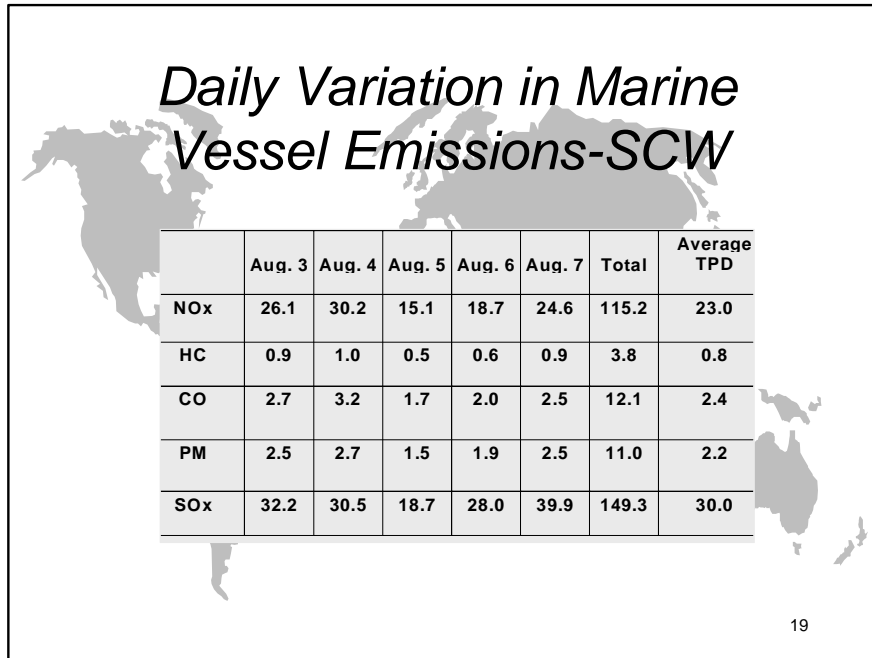
- #Energy Output Based (grams per Kilowatt-hour)
- #Main engines, Generators and Auxiliary Boilers
- #Slow versus Medium Speed



15



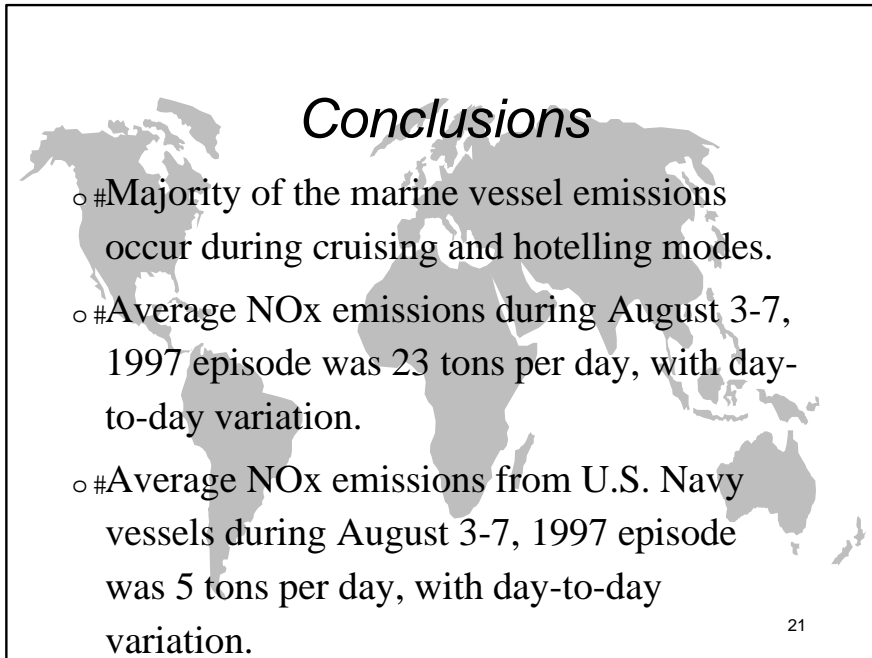




Conclusions

- #Key to the Project = Unprecedented access to marine vessel data + TEAMWORK
- #Successful multi-agency approach leads to the development of a quality inventory
- #Most comprehensive day-specific information collection
- #Cooperative efforts needed between agencies & businesses

20



Conclusions

- #Majority of the marine vessel emissions occur during cruising and hotelling modes.
- #Average NOx emissions during August 3-7, 1997 episode was 23 tons per day, with day-to-day variation.
- #Average NOx emissions from U.S. Navy vessels during August 3-7, 1997 episode was 5 tons per day, with day-to-day variation.

21



Acknowledgements

- #T.L Garrett
- #Don Johnson
- #Charlotte Pera
- #Bill Remley
- #Captain McKenna
- #Dale Shimp

22

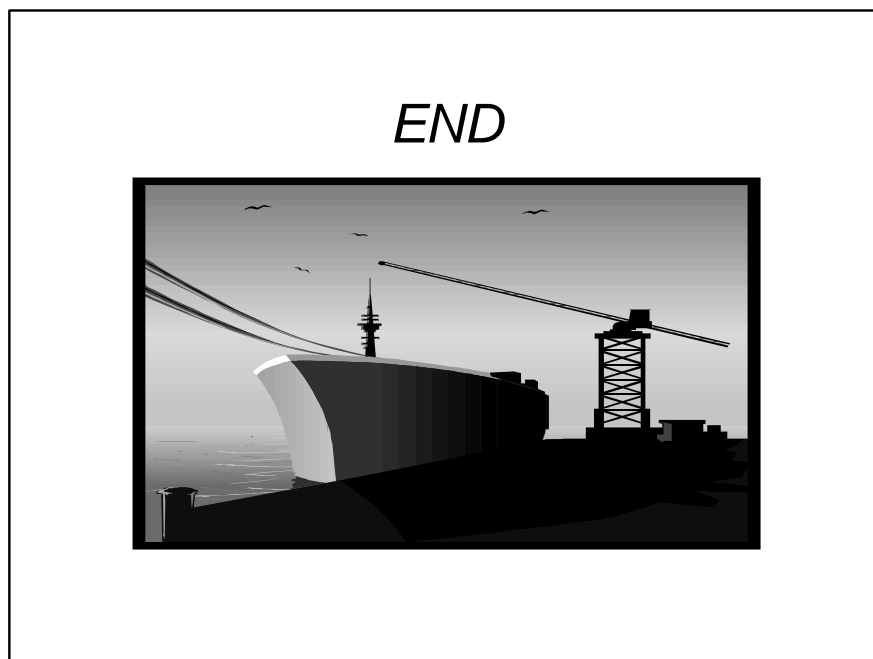
Contact and Information

ARB Emissions Contact:
Mena Shah
mshah@arb.ca.gov
916-324-7165

ARB Web Site:
<http://www.arb.ca.gov/>

A graphic featuring a world map in the background. In the foreground, there is a stylized ship with a radar dome and a circular logo with a leaf-like shape. The text is overlaid on the map.

END

A black and white photograph showing a large ship docked at a port. Several cranes are visible in the background against a light sky with a few birds flying.