

Present Conditions and Future Trends for AMP

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The Port of Los Angeles (POLA) is proceeding to apply the AMP (Alternative Maritime Power) system which feeds electric power from shore to ship, in order to prevent air pollution due to the exhaust gas from generator engines during container vessel loading and unloading. IHIMU has relevant experience all over the world. An AMP system meeting the full requirement of POLA was installed on the NYK ATLAS for NYK (6 200 TEU Container vessel) delivered in July 2004. The demand for AMP systems is increasing at overseas and domestic ports, and competitors are also developing this system. Therefore, the summary of present conditions and future trends AMP are introduced.

1. Introduction

The electric power required for a container vessel onto which freight is being loaded/unloaded is conventionally supplied by onboard diesel generators. In order to prevent the generator engine's exhaust emissions from polluting the air, POLA (The Port of Los Angeles) is moving to apply the AMP (Alternative Maritime Power) system, which supplies the required electric power from shore to vessel.

IHI Marine United Inc. (hereinafter called IHIMU) installed the AMP system, which meets the requirement of POLA, in a container vessel "NYK ATLAS" (entered service in July 2004) for the first time in the world, delivering it to NIPPON YUSEN KABUSHIKI KAISHA (hereinafter called NYK Line). Since then, the Port of Long Beach representing ports in the State of California and the Port of Tokyo representing ports in Japan have considered introducing the AMP system. The trend has influenced ship owners, and other manufacturers have launched their own development projects.

This report describes the introduction of these AMP systems and the expected trends.

2. Ports' situation

2.1 POLA situation

According to the results of various environmental surveys, POLA claims that the load on the environment can be reduced if the supply source of electric power is switched from ship-to-shore while a vessel is being loaded. **Table 1** shows the estimated reduction in exhaust emissions if the AMP system is used.⁽¹⁾ In accordance with the estimation, POLA announced the AMP program back in July 2003.

Table 1 Estimated Ship/Day Emission Reduction

	NO _x	SO _x	PM ₁₀
Ship Power*	1.07	0.59	0.044
Shore Power*	0.04	0.004	0.001
Emission Reduction	1.03	0.58	0.043

(note) * : tons/day assuming 3 MW load for 24 hrs
(Emission Factors from SCAQMD MVEI 1999)

As for this program, POLA voluntarily entered into an agreement contract with individual container vessel operators; the contract has become one of the conditions for renewing the right to use POLA terminals. Eight companies including NYK Line and China Shipping are currently introduced as AMP partners on POLA's website. Furthermore, POLA will have completed the introduction of the AMP system to each terminal by 2011 according to the action plan on environmental problems it declared in conjunction with the Port of Long Beach situated in its neighborhood in June 2006.

Hence, it will be difficult for vessels without the AMP system to enter the Port of Los Angeles (hereinafter called Port of LA).

2.2 Situation of other ports

The Port of Long Beach, which is located in California, same as the Port of LA, announced reduced pollutants as a result of the switchover in fuel for the loading equipment at first and did not enforce the installation of the AMP system. However, it plans to complete the introduction of the AMP system and take measures to mitigate the load on the environment in collaboration with POLA by 2016.

In 2004, Tokyo summoned the Vessel-Caused Aerial Pollution Measure Examination Committee, where it

announced the medium- and long-term policy of using shore power as well as the short-term policy of switching to quality fuel. Also, in Fall 2006, the Ministry of Land, Infrastructure and Transport (hereinafter called MLIT) and the Ministry of the Environment expect to conduct an experiment, as a vessel idling stop test, at Takeshiba Wharf (Tokyo) in order to understand how to deal with an emergency as well as the method of installing a shore power cable. According to MLIT, there is a good chance of reducing CO₂ emissions by a million tons annually if all domestic vessels carry out idling stop. Idling stop is expected to be effective as an environmental measure.

In Europe, it was reported the fuel of vessels would be switched to quality fuel on January 1, 2008. Also, in some countries there, the AMP system has already been implemented. As mentioned above, the use of the AMP system is expected to spread.

3. AMP system proved to be effective at the port of LA

3.1 Example of china shipping

The barge-type AMP system has been implemented at a terminal exclusively reserved for China Shipping in the Port of LA. **Figure 1** shows the system configuration of barge-type AMP.

On this barge are installed a cable reel, a step-down transformer, a switchboard and so forth. The barge and the ship side are connected to each other with nine low voltage cables for power supply.

As long as the ship side is provided with low voltage power receiving equipment, cost reduction can be achieved because a barge can be shared. Still, since it takes labor and time to bring a cable to the ship side and connect it, this method may not be adopted in the future.

3.2 Example of NYK Line

3.2.1 Concept of the development

In order to develop the AMP system, which was to be installed in the "NYK ATLAS" (built in IHIMU's Kure shipyard) and to be delivered to NYK Line, engineers from the ship owner (NYK Line), the shipyard (IHIMU) and the system maker (Terasaki Electric Co., Ltd.) toured POLA and embodied the requirements of POLA through technical discussions.

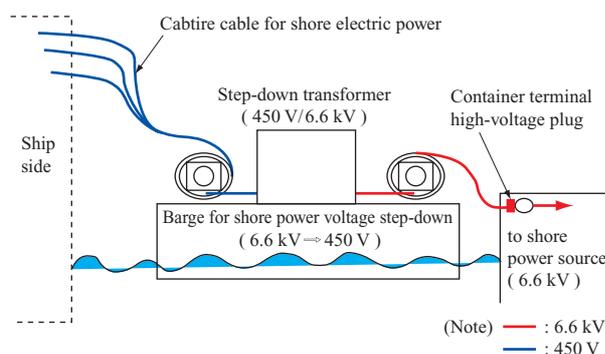


Fig. 1 System configuration of barge type AMP

POLA requires that vessels must switch to the shore power within 30 minutes of their landing and ensure safety while being supplied with shore power. Thus, the development was carried out on the basis of the following concepts.

- (1) The changeover of power source between the ship side and shore-side is to be made without power stoppage.
- (2) The shore-side power source and the tension of the shore power cable is to be monitored from the ship side so that a vessel can leave at anytime.
- (3) The cable reel is to be installed on the ship side due to lack of available space on the shore side.

3.2.2 Specifications of the AMP system

Figure 2 shows a configuration of the AMP system developed on the basis of the aforementioned concept. An outline of the specifications is given below. Since the voltage available on this vessel is 6.6 kV, a step-down transformer is unnecessary.

Shore side power source capacity

Electric power	7.5 MVA
Voltage	6.6 kV
Current	656 A

Ship-to-shore cable

Voltage	6.6 kV
Number of cores	3 (with optical fibers for communication)
Cable quantity	2
Length	Approximately 45 m

Ship side power receiving equipment

Electric power received	6.9 MVA
Voltage received	6.6 kV

Ship-to-shore power source changeover

Uninterruptible power changeover method
Shore voltage, current, frequency, electric power, etc.

Monitoring item

Control function

Over current trip, diesel generator backup, shore power shutdown, etc.

3.2.3 Characteristics of the AMP system

- (1) Since the changeover in power source between the shore side and ship side is made without power stoppage, the auxiliary machinery onboard can keep operation without stopping even during a power source changeover, which realizes the smooth changeover.
- (2) In order to implement parallel operation of the diesel generators and the shore power, the reverse power avoiding control has been adopted so that the shore-side power source is not affected.
- (3) The shore power cable is rolled in the cable reel and installed in an accommodation area of this vessel.

Figure 3 shows the installation of the cable reel equipment. This cable is ready to be used once it is

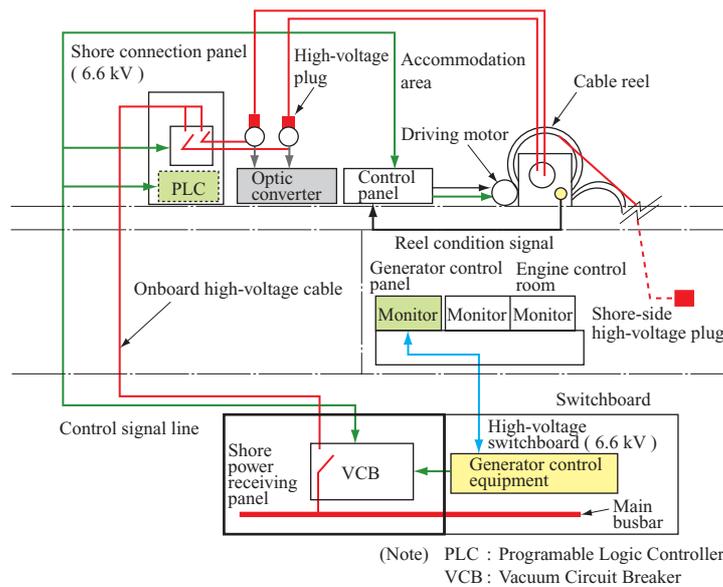


Fig. 2 AMP system configuration (NYK ATLAS)

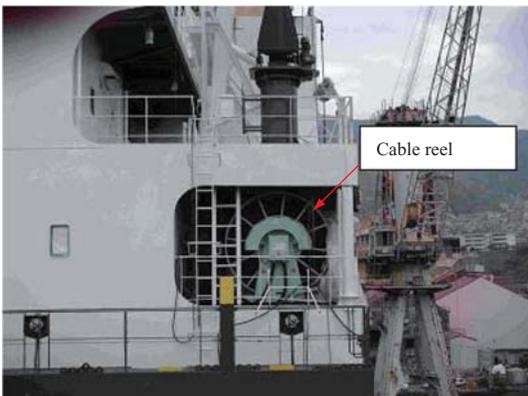


Fig. 3 Installation of cable reel equipment

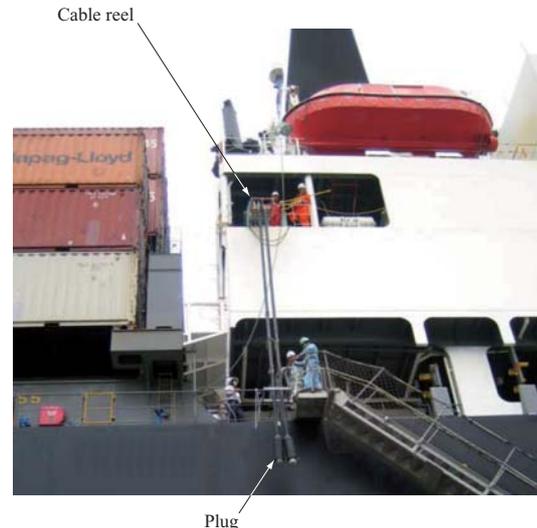


Fig. 4 AMP cable reel-out operation

reeled out to the shore side and a plug fixed at its end is connected with the socket on the shore side. **Figure 4** shows the AMP cable reel-out operation. This cable reel is provided with a tension control function for its cable in order to adjust itself to the up and down movements of the vessel due to the rise and fall of the tide and changes in draft caused by loaded freight.

- (4) When there are problems with the shore-side power source, an emergency signal is sent over to the ship side through optic fibers in the shore power cable. Then the protection equipment (breaker) onboard is cut off; at the same time, onboard diesel generators start operating. Such control as the protection equipment on the shore side being similarly cut off in case of problems on the ship side has been adopted and systemized to prevent fatal accidents.
- (5) The one-touch format, which is highly operable, was adopted for the plug and socket of the shore power cable. **Figure 5** shows the AMP plug and

socket on the shore connection panel.

3.2.4 Schedule in the future

The AMP system provided for this vessel is scheduled to be in operation in the wake of the burn-in test carried out after July 2007.

4. Future of the AMP system

4.1 Themes for improvements

The AMP system explained in **Section 3.2** above, which was adopted for “NYK ATLAS” delivered to NYK Line, meets the requirements of POLA, and its operation is readily conducted. At the same time, improvements are desired in the following areas.

- (1) Retrofitting existing vessels

Since the installation of the AMP system is required for the use of a terminal, existing vessels need to be retrofitted, let alone newly-built ones. It



Fig. 5 AMP plug and socket on shore connection panel

is critical to minimize the extent of conversion and minimize the time and cost required.

(2) Handling both starboard and portside situations

Although cable reel equipment is installed on the portside in the example of **Section 3.2** above, a container vessel does not necessarily come alongside the pier on the portside. However, it is uneconomical to install cable reel equipment on both the starboard and portside in anticipation of landing otherwise. Moreover, the space for equipment is limited.

(3) Reduction in cost

Installing the AMP system on vessels is a major burden on ship owners. To popularize the AMP system and contribute to the environment, it is important to reduce the costs.

(4) World-wide standardization of the plug and socket

Even though the plug and socket that are currently used at POLA are made in Europe, it is desirable to have these standardized so that they are used at ports throughout the world. Furthermore, details of the plug and socket should be disclosed and standardized to avoid monopolizing by this European company.

4.2 Idea of container-mounted type AMP

A container-mounted type AMP has been conceived in consideration of the themes for improvements given in **Section 4.1** above. **Figure 6** shows the AMP system configuration of the container-mounted type. In this idea, it is assumed that a container with a cable reel and power receiving panel contained in it is loaded in a container slot of the vessel. It is also possible for the container to be provided with a step-down transformer for vessels which applies the low-voltage system if installation space for a cable is allowed.

The adoption of this format enables the number of pieces of equipment to be reduced in retrofitting an existing vessel and facilitates the handling of starboard and portside situations. Furthermore, when AMP equipment is not required for the vessel due to change in

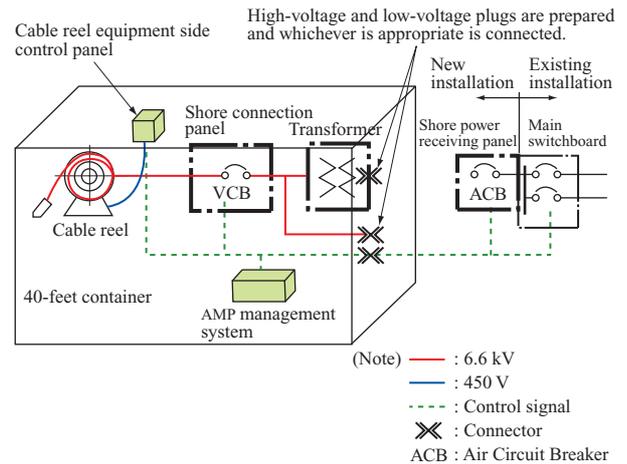


Fig. 6 AMP system configuration of container-mounted type

the shipping route, it can be moved to another one.

Other companies are in the process of developing this format, and ship owners are showing increasing interest. Hence, this format is expected to spearhead development of the AMP system. However, the cost of the whole equipment including a container is still high, so it is vital to further reduce the cost.

4.3 Other problems

Other problems in developing the AMP system are as follows:

(1) Frequency conversion

Although frequency of the onboard power source is 60 Hz in general, that of the onshore commercial power source is 50 Hz in regions such as eastern Japan and Europe. Hence, a frequency converter is needed to convert the frequency from 50 Hz to 60 Hz.

There are two methods for a frequency converter: an MG (motor generator) and a static-type using an inverter and a converter. The former method has problems in load following capability and safety; the latter method, electric noise and cost.

(2) Application to other types of vessels

The development of the AMP system has been aimed at container vessels, however, other types of vessels such as passenger ships, car carrier and domestic vessels are increasingly in need of the system. It is necessary to establish the optimal system for these vessels and to standardize it.

5. Conclusion

Adoption of the AMP system is a world trend thanks to increased interest in environmental problems, and it will be used in all types of vessels.

As the optimal AMP system cannot be established by shipyards alone, it is vital for them to cooperate with ship owners, system makers and other suppliers. IHIMU is committed to preserving the environment by establishing even better systems in conjunction with related companies.

— Acknowledgments —

IHIMU are grateful to Mr. Tomohiro Ura on the Technical Group at NYK Line, Mr. Yuji Kotani in charge of the System Division of the Marine Technical Department at Terasaki Electric Co., Ltd., both of whom have been engaged in developing the AMP system, and thanks are also due to all those who contributed to the development of the AMP system.

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