Auriga Leader Mid-Term Report

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In April of 2008, NYK Line President Koji Miyahara launched a Special Environmental Project, called the NYK Cool Earth Project, in order to promote more environmentally friendly approaches to the shipping industry. This project, which operates under the direct control of the President, has greatly accelerated the progress of NYK's environmental initiatives. One early result of this new project is the *Auriga Leader*, a 60,000 gt solar panel equipped car carrier that was delivered in December 2008. This report introduces the results of the *Auriga Leader*'s demonstration tests, which took place over a seven month period following the ship's delivery.

NYK and Environmental Awareness

Thanks to their ability to carry large amounts of cargo, ships are more environmentally friendly than other types of cargo transportation. However, due to growing cargo volumes around the world, CO_2 emissions from the international shipping industry continue to increase. Along with the safe operation of its ships, NYK has made preserving the environment one of its top operational priorities for a number of years and has begun a variety of initiatives and projects to achieve these objectives. In 2005, for example, NYK Line began a company-wide "Save Bunker Campaign" in an effort to reduce fuel consumption and CO_2 emissions. However, according to a report issued by the International Maritime Organization (IMO), CO_2 emissions from shipping reached 840 million tons in 2007, roughly 3% of the total world emissions that year. In light of this situation, NYK Line felt that more aggressive steps needed to be taken to protect the environment, and in April 2008, the company launched a new Special Environmental Project called the NYK Cool Earth Project.

In addition to NYK's other ongoing environmental activities, the Special Environmental Project aims to develop environmentally friendly initiatives in an even wider variety of transportation related fields. The NYK Cool Earth Project, for example, will specifically focus on environmental engineering, the development and application of energy saving equipment, and the use of wind, solar and other renewable energy sources. As part of this project, NYK and the Nippon Oil Corporation jointly developed the car carrier *Auriga Leader*, the first ship in the world to use solar power to provide part of the energy required for ship propulsion.

The Solar Power Equipment on the *Auriga Leader*

As part of a two-year test to demonstrate the viability of using solar energy to power ship propulsion, a total of 328 large solar panels capable of producing 40 kW, as well as electrical generating equipment, were installed on the *Auriga Leader*. Previously, only low capacity 100V solar power generation equipment capable of powering the lights in dining spaces had been installed aboard ships. However, in order to use solar energy as part of the power supply for ship propulsion, larger scale power generation systems are necessary. For this reason, the *Auriga Leader* makes use of a large solar power generating system capable of being connected to the 440V system used in large merchant ships. (Fig. 1)

Difficulties Related to Shipboard Installation

Unlike the roof of a house, the deck of a ship is a work space that crew members frequently traverse, and it is relatively easy for the crew to approach and come in

contact with the solar panels. Consequently, if electricity were to leak from the panels or generating equipment, it could expose crewmembers to high voltage electricity and life threatening electric shocks. As a result, insulation and detection equipment must be installed, and to prevent potential accidents, it is necessary to install additional countermeasure that are not needed in shore-based systems. To address this problem, NYK developed a system to continuously monitor and regulate insulation levels at two separate points along the circuit. This is a completely new, patent-pending system that was developed specifically for the *Auriga Leader* and is not found in conventional solar power generation systems.

Another difference compared with land-based solar power systems is the constant motion of the ship due to waves and engine vibration. One of the primary objectives of the current demonstration test is to verify whether the solar power system and the solar panels can withstand the constant vibrations, as well the continual repetitive motions of the ship.

Status Report

The *Auriga Leader* was completed and delivered by Mitsubishi Heavy Industries, Ltd. Kobe Shipyard in December 2008. For roughly the next seven months, the *Auriga Leader* was commissioned to sail to the Middle East, the Caribbean, and North America. Over this period the ship encountered a variety of severe weather conditions, including three hours of thunderstorms, twenty hours of strong winds (of roughly 20 m/sec.), and 48 hours of 3-4 m waves. However, the solar power system operated flawlessly throughout this period. Further, the system generated more power than initially expected, with the total power generation over the seven month period reaching 32,300 Wh. This value is equivalent to the power consumed by about 17 households over the same period. Additionally, the system reduced the amount of CO_2 emitted by the ship over this period by roughly 22 tons. This system is currently expected to reduce annual CO_2 emissions by approximately 40 tons and provide a fuel savings of roughly 13 tons per year.

The ship has also received a considerable amount of interest internationally. For example when the *Auriga Leader* entered the port of Long Beach, California, where environmental awareness is particularly high, the ship received significant media attention and acclaim from port personnel as an environmentally friendly car carrier.

Future Initiatives

The solar power generation system installed on the *Auriga Leader* has a maximum output of 40 kW, however, the actual output can change rapidly and exhibits a great deal of fluctuation. In order to install a larger version of this system onboard in the future, it will be necessary to install systems to smooth out these power fluctuations, as well as to prevent problems that would affect ship operations in the event of a power outage or similar electrical failure. To address these issues, NYK is currently developing the technology to combine solar power generating systems with storage batteries in order to pave the way for the installation of larger systems in the future.

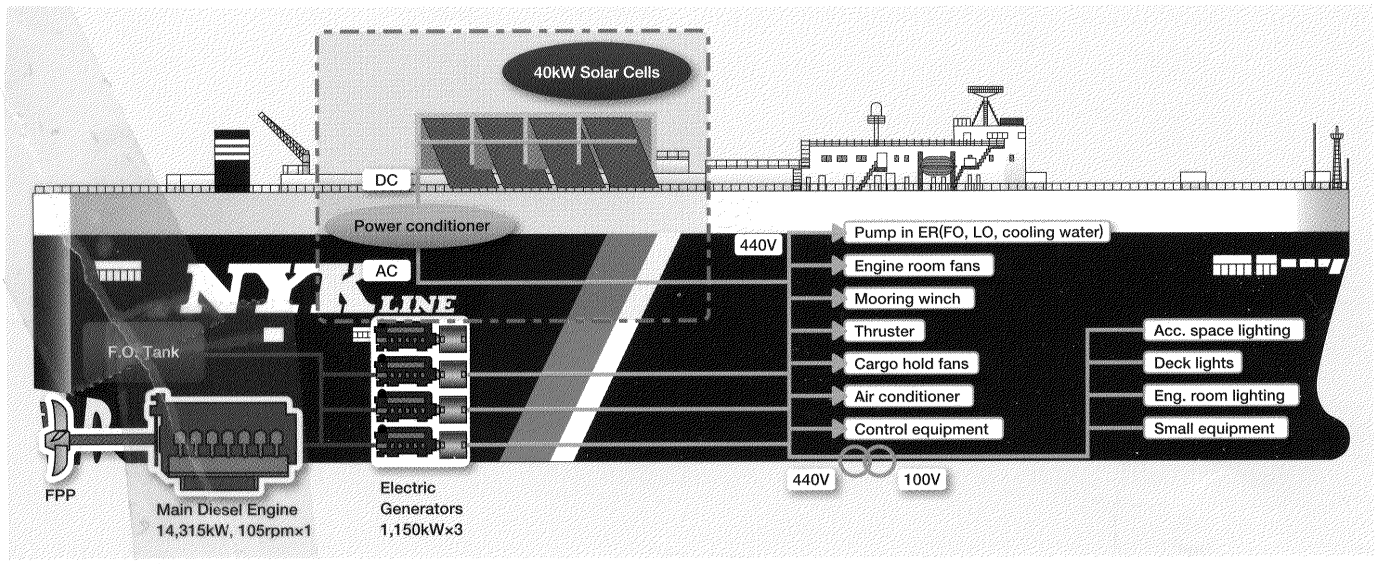

Fig. 1: The *Auriga Leader*'s electrical system