COMMENTARY

JAMES A. LAWRIE is Technical Division Director
of Ocean Systems, Inc., Arlington, Virginia

NUCLEAR APPLICATIONS IN OCEAN ENGINEERING

Despite what many may say, ocean engineering is not a science unto itself. Rather, it is a family of sciences.

All of the traditional and well-established arts merge into this supradiscipline. Chemistry, physics, electronics, and the entire range of engineering-associated fields are parts of the whole. Just as these separate sciences build the total field of ocean engineering, there are building blocks of specific capabilities that also make up the technology.

One of these—and perhaps the most important—is energy conversion. The ability to work in the oceans—which is at the heart of the science—directly relates to man's ability to translate power into work in a hostile environment. Undersea vehicles, habitats, tools, life-support systems, sensors, monitoring equipment, buoys, wellheads—in fact, the entire complex mixture of oceanic hardware—depend on power and, of all the major candidates for deep ocean power applications, *nuclear power* seems to hold the most promise.

Currently, ocean power needs are supplied by secondary batteries, chemically fueled dynamic-machinery power plants, and fuel cells. However, each of these types is limited by the capability of the fuel supply.

The vastness of the earth's water surface precludes frequent refueling at remote locations. Often, the flexibility and overall capability of a particular system is reduced by the need to provide for fuel storage space. Add to this the lack of air for combustion processes, and the non-air-breathing nuclear system displays inherent advantages over other methods in terms of oceanic applications.

The tremendous military success of nuclear power is evidenced in the daily travels of the U.S. nuclear surface and submarine fleet. One could safely say that nuclear power has affected contemporary marine power plants to a degree equaling the effect of steam on sail. We are not far from the twilight of conventional power.

Unfortunately, application of nuclear power to ocean engineering has lagged. There is much to be done, and some pioneering efforts have already taken place.

The Atomic Energy Commission has operated small mobile nuclear power units (SNAP 10A and SNAP 2) for several years for the Air Force Satellite Program, and another small reactor (SNAP 8) is planned for NASA's moon base and manned orbital space station program. The U.S. Coast Guard is currently using a SNAP 7A device to power a lighted buoy.

Recently, Aeroject-General Corporation developed a family of small nuclear power systems URIPS (Undersea Radioisotopic Power System) that provide 3 to 50 watts of electrical power thousands of feet under the sea for up to five years. The units, which harness heat from the radioactive decay of a radioisotope, are the size of a five-gallon drum and can be used as power sources for data links in telemetry systems, surveillance systems, and acoustic navigation beacons. Recently, one such system was employed to provide power for valve control on a subsea wellhead installed by Sinclair in the Gulf of Mexico.

Undersea vehicles are an especially appropriate area for nuclear power. The ability of these vehicles to operate effectively depends entirely on such key characteristics as mobility, speed, and endurance. On April 18, 1965, President Johnson announced that the AEC and the Navy had begun development of a nuclear-powered deep submergence vehicle. This submersible will be able to move at maximum speed for periods of time limited only by the physical needs of her crew and will effectively open the deeper ranges of the resource-rich Continental Shelf.

The entire U.S. buoy program is just beginning to find its feet. Recently, large "monster" buoys were set adrift and have been collecting and sending considerable amounts of ocean data. More collection buoys will soon be putting to sea for extended periods and will form a growing market for nuclear power sources.

Finally, one of the greatest future applications for nuclear power in the oceans is in the area of subsea habitats and stations. At the present time, prototype underwater manned installations are planned for developing construction techniques, equipment, and methods. Submerged military bases and oil fields will be able to operate independent of weather and sea surface conditions. Conceptual designs for deep (6000-ft) stations already exist.

One of the basic criteria for these stations is the ability to support a crew at atmospheric pressure in a shirt-sleeve environment for an *indefinite period of time*. The last phrase clearly points to nuclear power.

Widespread use of nuclear power in the oceans is going to take an enormous investment.

Much has been said about the great similarity of space and oceanic problems. However, the oceans far outstrip space as a potential application for nuclear power. The natural shielding of sea water, greater load capacities of ships and submersibles vs air or space craft, and the ease of cooling make design and operation of nuclear systems much more advantageous in the oceans.

It has already been proved that nuclear systems can be used with a wide range of associated power and transmission systems. Eventually, this power source should prove to be the diesel engine of the deeps. Nuclear technology will have to be expanded to provide a base from which to design, test, and build a great spectrum of power systems.

Unfortunately, in our time, one of the greatest uses of the oceans regarding nuclear power has been as a dumping ground for radioactive wastes. What it *really* holds for the nuclear power industry is a realizable, ever expanding, creative market.

Right now, we are peeking through the keyhole . . . American engineers are fashioning keys . . . and hopefully we will soon open the door to what is sure to be a very bright room.