

SAGA-N: A NUCLEAR-POWERED SUBMARINE VEHICLE  
FOR COMMERCIAL OPERATION

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The name "SAGA" embraces a number of significant new developments in nuclear and submarine technology.

The Stirling engine powered commercial submarine, SAGA-1, currently being constructed in Marseilles and scheduled for first service in late 1986, features accommodations for a crew of six, plus seven saturation divers. It is considered to be the most advanced facility for research and service operations at depths to 600 metres, with mission times and ranges of 15 days and 150 nautical miles, respectively. Built for the later installation of a nuclear propulsion system, SAGA-1 will be brought to Canada in 1988 for the integration of the nuclear power source currently under development specifically for such submarine applications. The converted vehicle, to be re-named SAGA-N, will be the world's first nuclear powered submarine intended for commercial operations. The SAGA series will displace approximately 600 tonnes submerged and rely on motive power of the order of 70 kW, alternately Diesel, Stirling or nuclear.

The addition of nuclear power enhances SAGA'S extensive repertoire of advanced submarine operations, which includes saturation diving, self-borne robotics and remotely operated vehicles, both tethered and untethered. After integration with the nuclear power source, all of these facilities may be deployed on extended under-ice sea-shuttle missions, limited only by crew endurance. Nuclear power provides for a favourable combination of mission time, mobility, autonomy, and reliability that cannot be envisaged under the limitations of the conventional energy sources alone.

The nuclear power source designed to provide electric power and heating during SAGA transit and on-site operations is known as AMPS (autonomous marine power source) and is a project of Energy Conversion Systems Inc. (ECS). The SAGA series sea-shuttle is by International Submarine Transportation Systems Inc. (ISTS), a Canadian-based company with international participation.

The project as a whole represents a remarkable opportunity for Canadian technical development along several avenues, including:

- (i) the extension of small reactor technology to the marine environment,

- (ii) the implementation of the principles of intrinsically safe reactor design in a new environment (The AMPS project incorporates a number of reactor design principles described by Mills<sup>1</sup> and later incorporated in the SLOWPOKE<sup>2,3</sup> and SECURE/PIUS<sup>4</sup> reactor concepts), and
- (iii) the exploitation of the unique capabilities of SAGA-N in under-ice exploration, resource recovery and subsea equipment installation and service.

The AMPS consists of two main components, the reactor low-temperature heat source (RHS), and the energy conversion plant (ECP) based on low-temperature Rankine cycle technology. The RHS design follows the principles of intrinsic safety referred to above and now applied in the marine environment. Approximately 1.5 MW of thermal power will be delivered at about 95°C. The ECP will provide a nominal net electrical power of 100kW. Reliability is enhanced through facilities for cross-connecting redundant components. The AMPS output will be interfaced with the main submarine vehicle through its electrical bus and its space and diver heating systems.

The development program currently underway calls for the participation of a number of consultants, designers and manufacturers working in collaboration with ECS staff towards the integration of AMPS with SAGA in 1988-89.

#### REFERENCES:

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