

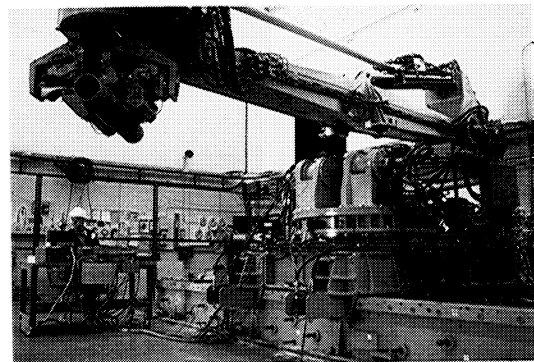
Shown at right, the "Canadarm," or Remote Manipulator System as it is known to NASA, is a Space Shuttle-based crane that performs a variety of functions, operating as a 50-foot extension of an astronaut's arm either automatically or under astronaut control. Weighing less than 1,000 pounds, the arm is capable of lifting 65,000 pounds (the equivalent of a fully-loaded bus) in the weightlessness of space. Usually employed to deposit payloads in orbit or to retrieve malfunctioning satellites for repair, the versatile Canadarm has also been used as an astronaut work platform, as a huge tool to knock an ice plug from a frozen Shuttle drain line, and as a robotic hand flicking a flyswatter in an attempt to start an errant satellite. Redesigned versions of the Canadarm are now finding Earth-use utility in energy and mining uses.

Designed and built by Spar Aerospace Limited, Toronto, Ontario, under contract to the National Research Council of Canada, the Remote Manipulator System was Canada's contribution to the Space Shuttle program, funded by the Canadian government in the conviction that the technology would generate Earth

spinoffs. The first spinoff version, its sophisticated software and some of its hardware redeveloped to work in an Earth gravity environment, will go into service late this year with Ontario Hydro, a Canadian provincial electric power company.

The Hydro manipulator (lower right) will be employed in refurbishment of the utility's Candu nuclear reactor. Capable of lifting more than 2,500 pounds, the system has a grasping accuracy to within one-tenth of an inch; it will be able to maneuver the brittle, highly radioactive calandria tubes for more than 25 feet without wavering a fraction of an inch. Additionally, the device will be used to perform about 60 other tasks under the direction of an operator outside the reactor chamber. Its use will enhance safe and timely reactor refurbishment and save the utility money in the process; its economic advantage is evident in the fact that downtime of a reactor costs Ontario Hydro \$250,000 a day for alternative energy.

Last year, Spar Aerospace signed a memorandum of



understanding with Inco Limited, Mississauga, Ontario, the world's largest nickel producer, to join in development of remotely controlled underground mining equipment, based on Canadarm technology, for improved safety and productivity in deep-Earth, hard-rock mining. ▲