past ten years in developing satisfactory waste management systems for both categories of waste. The success, over the years, of the Commission's waste management program is illustrated by the excellent effluent control record which has been achieved by the industry and AEC contractors. AEC production and research facilities and large commercial nuclear power plants limit releases of radioactive materials to the environment to concentrations which are only a small fraction of internationally accepted radiation protection standards. Highlights of the R&D program are briefly summarized:

1. Advanced low-level waste treatment and disposal technology involving the use of evaporation, ion exchange, foam separation, electrodialysis, water recycle, and asphalt solidification has been developed. This technology is now being used in the design of commercial power reactor and fuel reprocessing waste management facilities.

2. The disposal of actual intermediate level waste by hydraulic fracturing of shale has been demonstrated with an engineering-scale pilot plant at ORNL. This technique which was obtained from the petroleum industry, consists of injecting a waste-cement-clay mixture under high pressure through a slotted well casing into an impermeable formation at depths of, in the case of ORNL, 700–1000 feet. A hydrofracturing plant was placed in operation at Oak Ridge during 1966 for the disposal of evaporator slurries; the use of this disposal method at other sites is now under study.

3. The Waste Calcining Facility at the National Reactor Testing Station in Idaho became the world's first plant-scale facility for converting actual high-level radioactive wastes to a safer, solid form in December 1963. This plant has continued to operate satisfactorily over the past four years, during which time about 1.3 million gallons of high-activity aluminum type waste from the reprocessing of test reactor fuel have been solidified with a volume reduction to about 1/10 the original, and then stored in stainless steel bins in underground vaults.

4. The technology for solidification of power reactor fuel reprocessing high-level waste has reached the engineering-scale demonstration phase with a "hot"-pilot plant having been placed in operation at the Commission's Laboratories in Hanford, Washington, in November 1966. Operational data are now being obtained for three waste solidification processes using full-scale high activity waste; results of this program will be available for industrial use during 1969–70.

5. ORNL laboratory and field research involving the storage of high-level waste solids in a salt mine has culminated in a full-scale field test program at the Carey Salt Company Mine in Lyons, Kansas (details provided above). Results of this field study and engineering design information will be available for industrial use by 1969.

In brief, the waste management R&D program has been and is providing the technology to engineer systems for effluent control, as required by an expanding nuclear energy industry, and no "breakthroughs" are required to meet future loads. The nature and quantity of waste effluents from thermal and fast breeder reactors are being evaluated as development proceeds on these future reactor systems.

WASTE RECONCENTRATION BY BIOLOGICAL ORGANISMS (ECOLOGICAL PROCESSES)

Certain radionuclides are known to be concentrated by biological processes in organisms. This concentration by biological processes may occur in the food chain leading to man. Four notable examples are the reconcentration of (1) cesium–137 from fallout in Caribou meat which is eaten by Eskimos; (2) phosphorous–32 by fish in the Columbia River from cooling water which passes through the Hanford production reactors and is then discharged to the river; (3) zinc–65 by shellfish, particularly oysters, that live in locations near the mouth of the Columbia River, and (4) iodine–131 in animal and human thyroid glands. The reconcentration of radionuclides in man's food chains must always be considered whenever radionuclides are released to the environment. The Commission takes into account reconcentration aspects in setting release limits to the environment from operating facilities. The U.S. Fish and Wildlife Service is regularly consulted on questions in this area.

In the case of waste released by power reactors and fuel reprocessing plants the radionuclides most likely to be reconcentrated are the iodine-131 released to the atmosphere and zinc-65 released to a water system. Evidence available from