

Answers are required now and more will be required soon in reaching decisions on the need for expenditures of billions of dollars on:

- a. Design and construction of municipal and industrial waste treatment works.
- b. Storage of water in Federal reservoirs for regulating stream flows for water quality control.
- c. Storage of water in Federal reservoirs for municipal and industrial water supply purposes.
- d. Source development for public water supplies.
- e. Importation of water from water-surplus to water-short areas.

The development of a successful advanced waste treatment technology would have a tremendous impact on our whole water resource problem. AWT techniques could conceivably allow the development of "dry" industries and municipal treatment plants from which absolutely no pollution would enter our surface or ground waters; AWT processes could completely change our present concepts of "adequate" waste treatment and could drastically reduce the otherwise necessary expenditure of multiple billions of dollars for provision of low flow augmentation (dilution) water to reduce pollution from presently untreatable wastes; AWT could allow continued economic growth and development in water-short areas of this country whose future developable water supplies are presently limited. In short, a successful AWT technology, by renovating waste waters for deliberate reuse, would simultaneously alleviate two of our major water resource problems—water pollution and water supply.

Although a greatly expanded research and development effort is planned, the total Federal expenditure for research to develop new treatment technology through FY 1966 has been less than \$5 million. Under this funding, however, it has been shown possible, at laboratory and pilot-scale plants to achieve any degree of waste treatment desired and, in fact, to return a waste water to a quality at least as high as that of the water before use. Much research and development work remains to be done, however, before these degrees of treatment can be accomplished at any necessary location, under any necessary conditions, and at the lowest practical cost. These efforts require resources—funds, facilities, personnel, and time.

Even without any active solicitation of proposals for research projects in this area, a backlog of some \$4,000,000 in proposed but unfunded projects now exists. This illustrates, in some small measure, the high level of interest in this problem among industrial, academic, and governmental research scientists and engineers.

An increased rate of effort to completely develop presently known processes and also to explore and develop new processes and process modifications could be carried out. To the present time, approximately 35 separation or ultimate disposal processes have been considered. Of these, approximately 10 or 12 have been rejected while the rest are at some stage of feasibility determination, engineering development, or process evaluation. It can well be expected that about 10 to 12 new approaches will be considered annually and that 3 or 4 of these will deserve investigation to at least the engineering development stage.

The average cost of completely developing a process might be \$9 to \$10 million. These development costs, however, are not unreasonable in light of the annual costs of 1 to 2 billions of dollars spent in constructing municipal and industrial waste treatment plants and in the even greater amounts of low flow augmentation costs and storm sewer separation costs which could be affected directly by these research findings.

Our experience has demonstrated the great importance and efficiency of conducting simultaneous and complementary in-house and contract research projects. It has also shown that the over-all effectiveness of contract research can be very greatly enhanced through the intensive application of technical direction, coordination, and monitoring. A contract support staff of engineers, scientists, economists, and other professional personnel must provide continuing planning, data interpretation and analysis, and system optimization services to the program by using the most up-to-date techniques and principles, such as operations research, critical path analysis, and cost engineering. This staff must also solicit the interest and ideas of the most competent scientific and engineering minds in the Nation; encourage the submission of proposals in light of the over-all broad attack on the problem; monitor, direct, and coordinate projects in progress; and interpret and evaluate results and recommend continuance, termination, or redirection of the work. The Staff must also conduct adequate liaison with other agencies and organizations, both within and without the Fed-