"Despite his enthusiasm, Weinberg found AEC's staff decidedly bearish on homogeneous reactors."

Laboratory concentrated on three possible options: fuels in solution, fuels suspended in liquid (or slurries), and molten salt fuels. Each one posed fundamental challenges in chemistry and chemical technology. Moving confidently from solids to liquids to gases in support of the AEC efforts on behalf of the atom, the Laboratory also conducted research for heterogeneous, solid-fuel reactors. It also provided conceptual designs for a transportable Army package reactor, a maritime reactor, and a gas-cooled reactor.

The Cold War and President Eisenhower's "Atoms for Peace" speech reenergized and refocused the Laboratory's research efforts. In effect, it gave the Laboratory a multifaceted research agenda, many aspects of which were tied to the development and application of nuclear power. Summarizing the impact of the nation's postwar aims on the work of the Laboratory, Director Clarence Larson commented, "1954 has witnessed the transition that many of us have hoped for since the war. The increasing emphasis on peacetime applications of atomic energy," he went on to say, "has been a particular source of gratification."

Homogeneous Reactor

In addition to the Aircraft Reactor Experiment, the Bulk Shielding Reactor, and the Tower Shielding Facility built as part of its Aircraft Nuclear Project for the Air Force, the Laboratory had three other major reactor designs in progress during the mid-1950s: its own new research reactor with a high neutron flux; a portable package reactor for the Army; and the Aqueous Homogeneous Reactor, which was unique because it combined fuel, moderator, and coolant in a single solution (designed as one of five demonstration reactors under AEC auspices).

Initial studies of homogeneous reactors took place toward the close of World War II. It pained chemists to see precisely fabricated solid-fuel elements of heterogeneous reactors eventually dissolved in acids to remove fission products—the "ashes" of a nuclear reaction. Chemical engineers hoped to design liquid-fuel reactors that would dispense with the costly destruction and processing of solid fuel elements. The formation of gas bubbles in liquid fuels and the corrosive attack on materials, however, presented daunting design and materials challenges.

With the help of experienced chemical engineers brought to the Laboratory after its acquisition of the Y-12 laboratories, the Laboratory proposed to address these design challenges. George Felbeck, Union Carbide manager, encouraged their efforts. Rather than await theoretical solutions, Laboratory staff attacked the problems empirically by building a small, cheap experimental homogeneous reactor model. Engineering and design studies began in the Reactor Experimental Engineering Division under Charles Winters, and in 1951 the effort formally became a project under John Swartout and Samuel Beall.

This was the Laboratory's first cross-divisional program. Swartout provided program direction to groups assigned in the Chemistry, Chemical Technology, Metallurgy, and Engineering divisions, while Samuel Beall led construction and operations. Beecher Briggs headed reactor design; Ted Welton, Milton Edlund, and William Breazeale were in charge of reactor physics; Edward Bohlmann directed corrosion testing; and Richard Lyon and Irving Spiewak performed fluid flow studies and component development.

A homogeneous (liquid-fuel) reactor had two major advantages over heterogeneous (solid-fuel and liquid-coolant) reactors. Its fuel solution would circulate continuously between the reactor core and a processing plant that would remove unwanted fissionable products. Thus, unlike a solid-fuel reactor, a homogeneous reactor would not have to be taken off-line periodically to discard spent fuel. Equally important, a homogeneous reactor's fuel and the solution in which it was dissolved served as the source of power generation. For this reason, a homogeneous reactor held the promise of simplifying nuclear reactor designs.

A building to house the Homogeneous Reactor Experiment was completed in March 1951. The first model to test the feasibility of this reactor used uranyl sulfate fuel. After leaks were plugged in the high-temperature piping system, the power