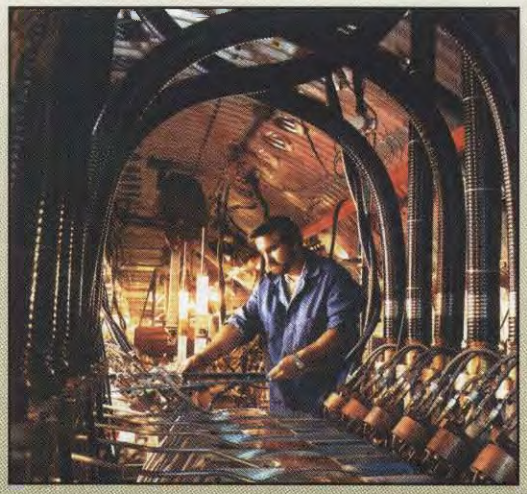
Improved Nonnuclear Testing Capabilities

Site 300, the Laboratory's remote experimental test site, was a busy place in 1960. In the midst of a nuclear testing moratorium, Livermore was enhancing its nonnuclear testing capabilities. Two test complexes, a chemistry facility, a high-explosives preparation facility, a remote disassembly complex, and three other buildings were completed that year. In addition, a new linear accelerator (linac) was delivered to Site 300. That machine, which was installed in Bunker 351 (now 851), has undergone numerous upgrades and is still used for hydrodynamics experiments. The accelerator generates the powerful x-ray flashes needed for taking images of mock nuclear-weapon primaries as they implode.

The linac for Bunker 351 superceded the capabilities of Bunker 312's XR2 machine, which had been moved from Sugar Bunker at the Nevada Test Site to Site 300 in the late 1950s. Charles McDonald, who later rose to senior management positions at the Laboratory, was one of the graduate students who helped build the XR2 in 1951 at the Radiation Laboratory in Berkeley. Starting at the Laboratory in fusion science research, McDonald became a weapon primary designer and then used the machine at Sugar Bunker.

Meanwhile, in another part of the Laboratory, Nicholas Christofilos, one of his generation's most original thinkers in physics, was pursuing a magnetic fusion concept, ASTRON. Born in Boston, Christofilos grew up in Greece, where he received a degree in engineering, privately studied physics, and first invented and patented the concept of alternate gradient (strong) focusing for particle accelerators. ASTRON required the invention of a new kind of electron accelerator, the induction linear accelerator (or induction linac), to produce an intense circulating electron beam to magnetically confine and heat a plasma to, it was hoped, thermonuclear ignition temperatures. The world's first induction linac was built for the ASTRON project in 1963.

Induction linacs are now the heart of the nation's two most modern hydrodynamic testing facilities—the Contained Firing Facility at Site 300 (with the Flash X Ray machine) and the Dual Axis Radiographic Hydrodynamic Test Facility (DARHT) at Los Alamos. Built in 1982 and subsequently upgraded, the Flash X Ray machine was used in the 1990s to perform the first experiments in which scientists recorded a detailed digital image of a highly compressed gas cavity inside a weapon (see Year 1985). Other successor induction linacs include the Electron Ring Accelerator at Berkeley and three accelerators built at Livermore for beam research: the Electron Test Accelerator (ETA), ETA-II, and the Advanced Test Accelerator at Site 300.

Accelerator Technology Development

The Laboratory has a long history of advancing the technology of electron linear accelerators for scientific and national security applications. After ASTRON, the Electron Test Accelerator (ETA) was built to study electron beam propagation in air as a possible directed-energy weapon. Completed in 1983, the 10-times more energetic Advanced Test Accelerator at Site 300 (right) furthered the study of beam propagation, and the beam was used as a pump for a free electron laser (FEL). ETA-II was designed to further FEL research and is contributing to the development of advanced radiographic capabilities for stockpile stewardship. In the 1990s, Livermore also collaborated with the Stanford Linear Accelerator Center (SLAC) and Lawrence Berkeley National Laboratory to design and build the B-Factory at SLAC.