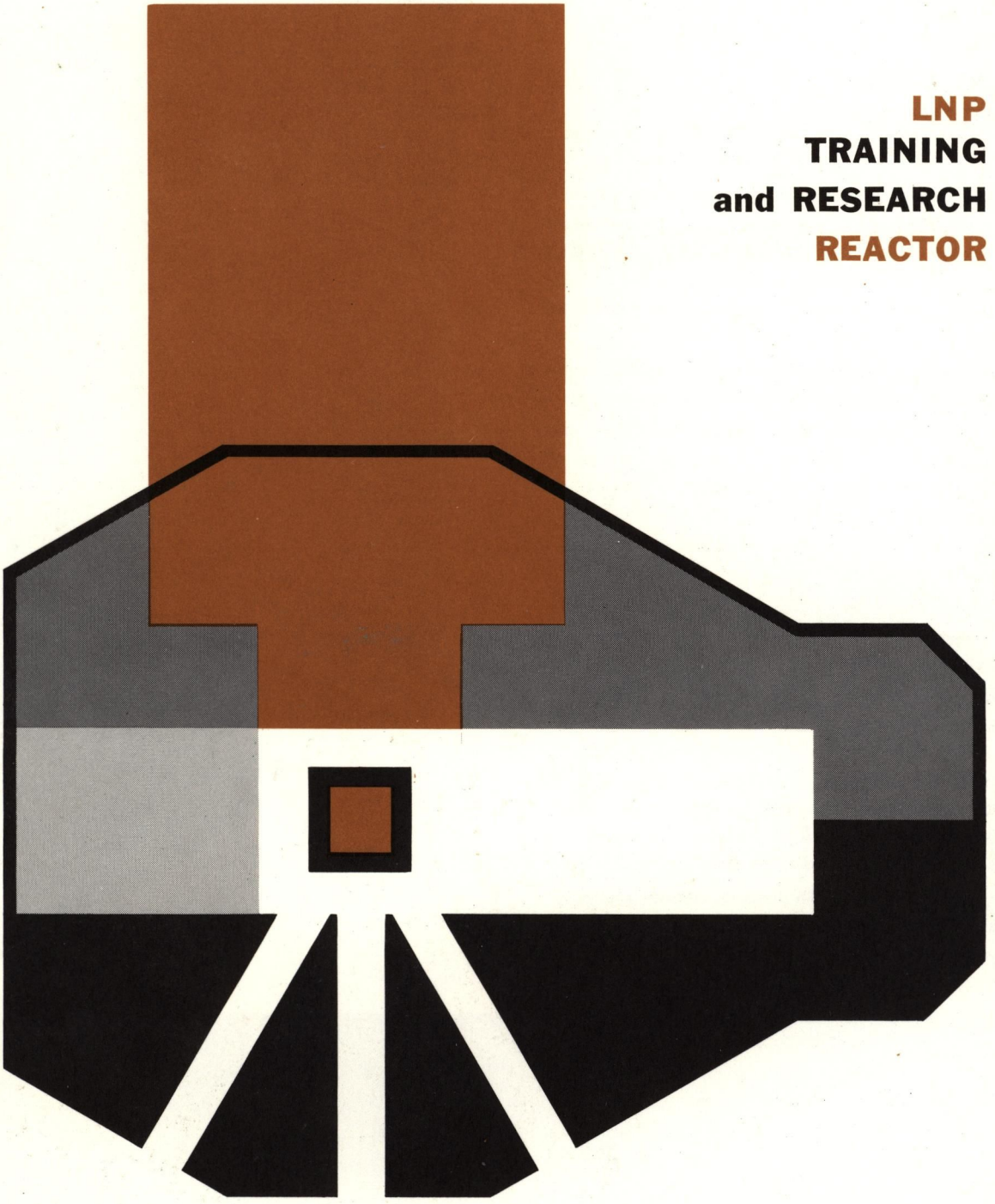
LNP
TRAINING
and RESEARCH
REACTOR



LOCKHEED Nuclear Products

BUILD YOUR NUCLEAR PROGRAM . . .

. . . around an LNP *Reactor.*

The design and installation are customized to your specific requirements. And we add to this advantage wide power range and systems that are engineered with up-to-date technical advancements to provide a reliable, easily maintained, economically operated reactor.

The pool-type configuration is the most flexible of all; it is the one used in the LNP Reactor.

The CORE is completely accessible, a feature that makes possible a great variety of sizes and shapes of experiments—whether loop experiments, capsule experiments, or shielding experiments. Core geometry can be varied from the standard BSR type to special flux-trap arrangements.

The SHIELD CONFIGURATION contributes further to versatility in that it can be changed easily to accommodate thicker or more dense materials. Changes can also be made to permit installations such as shield ports for medical irradiation when core access is desirable.

The optional addition of a bulk shielding facility permits experiments in large homogeneous media, irradiation from spent fuel elements, and isotope sources, as well as conventional shielding experiments.

Other MODIFICATIONS possible include provisions for rabbit tubes, isotope production, and instrumented fuel elements.

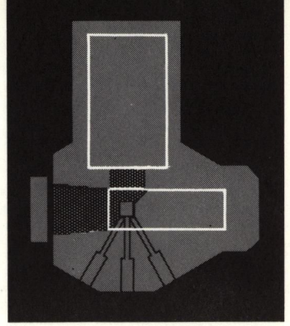
The CONTROL AND INSTRUMENTATION SYSTEM is based on a design concept proved by years of successful operation. Incorporated in this design are fail-safe devices to assure reliability, and other features to promote ease of maintenance as well as increased capability.

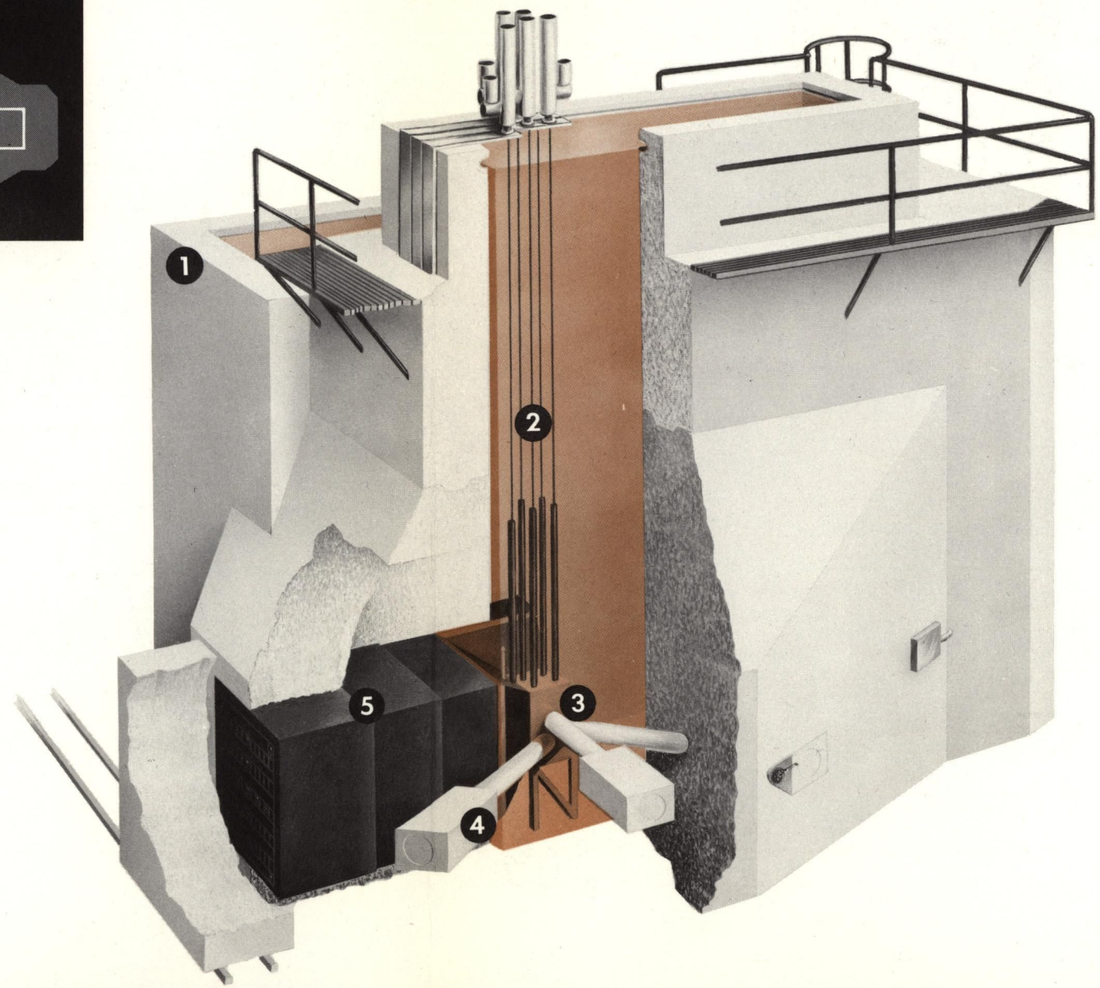
The CONSOLE used with this system was designed for maximum range of visibility and facility of operation.

ADDED SERVICES include information on how to apply for your AEC grant, help in getting your reactor and operator licenses, and assistance in adapting or planning your overall nuclear facility.

Sound basic design, reliable construction, and dependable supporting services have all gone into making this LNP Reactor . . .

. . . THE CORE OF YOUR NUCLEAR TRAINING PROGRAM.





1. **BULK SHIELD FACILITY (OPTIONAL)** — A concrete-walled pool with provision for a fission plate coupled to the core by a D_2O or graphite thermal column.
2. **CONTROL RODS** — Shim safety rods containing boron carbide powder and a stainless steel regulating rod.
3. **FUEL ELEMENTS (FLAT PLATE TYPE)** — Highly enriched uranium-aluminum fuel alloy; control rod fuel elements modified to accommodate an internal control rod.
4. **BEAM PORTS** — Of which there are three (and a maximum of six), leading to the face of the core and focused on the core center to provide maximum neutron flux.
5. **THERMAL COLUMN** — Constructed of machined graphite stringers, several of which are removable for sample insertions.

TYPICAL EXPERIMENTS

ACTIVATION EXPERIMENTS permit production of useful quantities of isotopes. Space is provided for 36 capsules with an option for 72 more, and fast acting "rabbit systems" permit production of short-lived elements.

REACTOR PHYSICS EXPERIMENTS may be performed with the highly flexible core. Control rod worths, kinetic critical approaches, temperature coefficient, and critical flux distributions are examples of the capability.

RADIATION EFFECTS experiments ranging from comprehensive shielding studies to radiation damage measurements can be used in the analysis of special nuclear engineering problems. Also, a broad spectrum of other radiation effects can be studied, including basic measurement and detection of radiation, radiation chemistry, and sterilization of biological samples.

MEDICAL APPLICATIONS made possible by the design features include medical isotope production, activation analysis of tissue samples, and beam or whole-body irradiation in neutron or gamma fields.

UNUSUAL NUCLEAR PHYSICS STUDIES, such as those using neutron diffraction, the interaction of subthermal neutrons with matter, or exotic radioisotopes resulting from multiple neutron capture, are typical research programs possible with the LNP Reactor, particularly when accessories such as a flux-trap core, large fission plate assemblies, or cryogenic loops are added.

SPECIFICATIONS

CORE

Grid plate	Array: 6 x 7 Active Lattice: 12 x 12 x 24 in.
Fuel	20% or 90% enriched U-235
Fuel elements	2.8 x 23.63 x 0.110 in. 11 plates contained in each of 13 fully loaded assemblies 6 plates—plus 2 guard plates—in each of 3 control rod elements
Moderator	Light water; metal-to-water ratio in core, 0.75
Reflector	Graphite in 1100 alloy aluminum

CORE PHYSICS
(100 kw nominal power level)

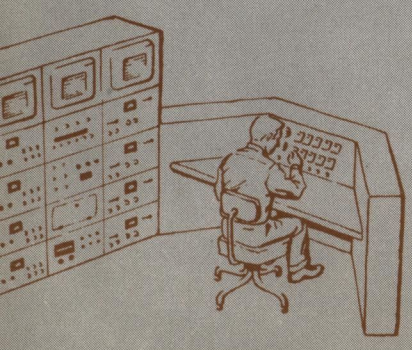
Minimum total cold, clean, excess reactivity	0.5% (80°F)
Core loading	2.80 kg U-235
Total shim rod worth	−7.5% Δ k/k
Total regulating rod worth	−0.5% Δ k/k
Average thermal neutron flux	9 x 10^{11} n/cm^2—sec
Peak thermal neutron flux	2 x 10^{12} n/cm^2—sec
Maximum thermal flux in experimental facilities	1 x 10^{12} n/m^2—sec
Temperature coefficient (80°F)	−0.8 x 10^{-4} Δ k/k/°C
Average neutron lifetime	7 x 10^{-5} sec

CONTROL RODS

2 shim safety rods, stainless steel clad boron carbide	Driven speed: 3.6 in. per min. (Total scram time: $<$ 500 msec)
1 regulating rod, stainless steel	Driven speed: 13 in. per min.

INSTRUMENTATION

Startup pulse channels	Range 1, source level to 10^{-7} N_f Range 2, 10^{-8} to 10^{-4} N_f Detector: fission chamber
Log N and period channel	Range 10^{-5} to 3.0 x N_f ∞ to +3 sec Period Detector: compensated ion chamber
Linear level and servo channel	Range: One decade variable from 10^{-4} to 1.5 x N_f Fixed for servo control 0—1.5 N_f Detector: uncompensated ion chamber
Independent safety channel	Effective Range: 10^{-4} to 1.5 N_f Detector: uncompensated ion chamber



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GEORGIA DIVISION
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