

RALEIGH RESEARCH REACTOR

(NCSCR-1)

GENERAL

REACTOR TYPE: Aqueous homogenous, fully enriched (93%) uranium, light water moderated, graphite reflected

HISTORY:

September 1953	Reactor Critical
August 1954	Full Power Operation
December 1954	Routine Operation
June 1955	Shutdown due to corrosion problem

DESIGNER/BUILDER: North Carolina State College

REACTOR PHYSICS

MAXIMUM POWER: 10 kW thermal

NEUTRON FLUX: Average Thermal - 3×10^{11} n/cm²·sec, Average Fast - 3×10^{11} n/cm²·sec.

CORE PARAMETERS: Core Excess Reactivity = 1.2% $\Delta k/k$

CORE LOADING

SHAPE: Cylinder, 10.75 inch diameter, 9.2 inches high

CRITICAL MASS: 788 grams ²³⁵U

CORE LOADING: 836 grams ²³⁵U in form of 1.39 kg UO₂SO₄, enrichment 93%, diluted in 12.5 liter H₂O solution

POWER DENSITY: 0.8 kW/liter

FUEL ASSEMBLY DATA

FORM & COMPOSITION: (not applicable)

CLADDING: (not applicable)

SUBASSEMBLIES: (not applicable)

CORE HEAT TRANSFER

COOLANT FLOW AREA: (not available)

COOLANT FLOW RATE: (not available)

TEMPERATURES: (not available)

CONTROL

CONTROL RODS: Two combined regulating and safety rods (similar to NCSCR-2), 0.625 inch diameter. Two shim rods, 0.031 inch Cd, 4 x 10 inch operating vertically outside of core vessel

SCRAM MECHANISM: Gravity fall of both rods

REACTOR VESSEL and OVERALL DIMENSIONS

FORM: Cylinder, type 347 stainless steel, inside diameter = 10.75 inches, wall thickness = 0.0625 inches, overall height = 11.125 inches

WORKING PRESSURE: 15 inches H₂O vacuum

DIMENSIONS: Octagon, 17 feet across flats, 11 feet high

REFLECTOR and SHIELDING

REFLECTOR: Graphite, forming cube of 5 feet

SHIELDING: On sides: 4 inches lead, 6 feet heavy concrete containing barytes and colmanite ore

On top: 0.25 inches boral, 2 inches lead, 3 inches steel, 3 feet heavy concrete

CONTAINMENT

TYPE & MATERIAL: Core vessel contained in secondary enclosure: 0.0625 inch thick aluminum cylinder, 34.06 inches long, free space filled with graphite

Shielded reactor located below ground level in center of 57 feet diameter reactor hall, surrounded by laboratories

RESEARCH FACILITIES

One 1 inch vertical exposure tube
One 3 inch diameter horizontal beam tube (tangential to core)
Four 4 inch diameter horizontal beam tubes (radial to vessel surface)
One 60 x 60 inch thermal column with 6 access ports

COST

REACTOR:	Design and construction of reactor	\$ 130,000
SUPPORT FACILITY:	Reactor Building	\$ 380,000
	Laboratory Equipment & Furniture	\$ 120,000

REMARKS

The NCSCR-1 was the United States' first privately owned nuclear reactor. Leaks developed in the core vessel in May 1955 resulting in its shutdown. The radioactive gases and liquids were contained safely in the secondary aluminum envelope surrounding the core. In May 1987, the American Nuclear Society's Board of Directors designated the Raleigh Research Reactor a "Nuclear Historic Landmark", with the following citation:

"The Raleigh Research Reactor was a 4-gallon tank of uranyl sulfate using 718 grams of Uranium-235, graphite reflected, with two boron control rods. The reactor was designed by a group of scientist and engineers who had gained experience in government laboratories, who then formed the staff of the NCSU Nuclear Department.

This reactor was the first to be used entirely for peaceful training and research, the first to be operated on any college as a non-USAEC reactor, and the first to be open for public inspection and visitation. As a result, NCSU awarded in 1954 the first two PhD degrees ever granted in nuclear engineering, and developed the nation's first curriculum in nuclear engineering to offer the BS, MS, and PhD degrees.

Research using the water boiler continued until shutdown February 12, 1959. Major contributions were made using radiation for experiments in all areas of physics, chemistry, biology, medicine, agriculture, and engineering -- as well as exploration of ways and means of removing heat from larger power reactors."