

R-3 REACTOR

(NCSCR-3)

GENERAL

REACTOR TYPE:	Pool type, fully enriched (90%) uranium light water moderated and cooled graphite reflected	
HISTORY:	Dec 1958	Start of Construction
	1960	Reactor Critical
	1973	Reactor Shutdown
	1980	Decommissioned
DESIGNER/BUILDER:	North Carolina State College and the Nucleodyne Company	

REACTOR PHYSICS

MAXIMUM POWER:	10 kw thermal
NEUTRON FLUX:	Average Thermal - 1.0×10^{11} n/cm ² ·sec, Average Fast - 1.0×10^{11} n/cm ² ·sec.
CORE PARAMETERS:	Excess Reactivity = 1.5% $\Delta k/k$

CORE LOADING

SHAPE:	16 x 16 inches, 24 inches high
CRITICAL MASS:	2.5 kilograms ²³⁵ U
CORE LOADING:	2.5 to 3.0 kilograms ²³⁵ U
POWER DENSITY:	0.111 kW/liter

FUEL ASSEMBLY DATA

FORM & COMPOSITION:	MTR-type, flat parallel plate meat dimension 0.02 x 2.5 x 24 inch. Enrichment 90%, alloyed with 85.4 wt% Al, 7.78 gm ²³⁵ U per plate
CLADDING:	0.02 inch aluminum
SUBASSEMBLIES:	18 plates forming an element, 3.15 x 3.15 x 24.5 inches

CORE HEAT TRANSFER

COOLANT FLOW AREA: Total flow area 136 in²

COOLANT FLOW RATE: 3.4 gpm

TEMPERATURES: Inlet approximately 78°F, Outlet approximately 113°F

CONTROL

CONTROL RODS: 2 safety rods and 1 shim rod (0.167 inch Cd foil on Al rod, 24 inch active length, 2 S aluminum cladding), 1 regulating rod (0.375 inch stainless steel, 24 inch long, 2 S aluminum cladding). Worth of safety rods = 3.0 % $\Delta k/k$ each, worth of regulating rod = 0.5 % $\Delta k/k$

SCRAM MECHANISM: Magnetic release, gravity fall

REACTOR VESSEL and OVERALL DIMENSIONS

FORM: Square prism, 4 S aluminum, 16 x 16 inches, 40 inches high

WORKING PRESSURE: Atmospheric

DIMENSIONS: Octagon, 17 feet across flats

REFLECTOR and SHIELDING

REFLECTOR: Graphite, 5 x 5 feet, 30 inches high

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

On top: 8.5 feet light water, concrete

Facility: 5.5 feet water, 6 inches lead

CONTAINMENT

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

RESEARCH FACILITIES

One 3 x 3 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 x 60 inch thermal column with 6 access ports
Irradiation Facility opposite to thermal column, 60 x 60 x 60 inches

COST

REACTOR: (not available)

SUPPORT FACILITY: Reactor Hall available from NCSCR-1 and NCSCR-2

REMARKS

During the modification of the NCSCR-2 Reactor to the NCSCR-3 design, reactor operational needs were met by the NCSCR-4 Reactor (fabricated from NCSCR-2 components and fuel) that was installed in the Bureau of Mines Building. After the NCSCR-3 began routine operation, the NCSCR-2 Reactor was shutdown. The NCSCR-3 Reactor was a significant departure in design from previous North Carolina State College water boiler type reactors. The "R-3" utilized MTR fuel with a forced cooling path, and biological shield modifications to incorporate a pool design. The NCSCR-3 was operated until the PULSTAR Reactor achieved routine operation. At this point the NCSCR-3 was shutdown and subsequently decommissioned in 1980. The site of the NCSCR-3 Reactor, and its predecessors the NCSCR-1 and NCSCR-2 Reactors, now contains the "Scaled PWR Facility".