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COMPILATION OF CONTRACT YEAR 1964
PRELIMINARY TEST PLANS OF THE
WANL - RADIATION EFFECTS PROGRAM

MASTER

Astronuclear Laboratory
Westinghouse Electric Corporation

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INFORMATION CATEGORY

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Introduction:

A number of radiation tests have been planned to implement the WANL portion of the NERVA program. Test Plans describing these tests have been prepared and are presented as a part of this document. A listing of proposed tests has been previously presented as part of the Contract Year 1964 NERVA Technical Administration Document. In the interests of clarity the Test Plans presented herein were separated to conform with assigned project numbers. These are:

Project 1940 - Instrumentation Radiation Effects Program

Project 1950 - Component Radiation Effects Program

Project 1960 - Material Radiation Program

Each of the projects is handled individually in this compilation.

Projects 1900, 1920 and 1980 provide for management, technical and logistical support for the WANL Radiation Effects Program and are indirectly concerned with the attached Test Plans.

The Radiation Effects Program has been coordinated with the NERVA design and development effort. Project 1940 has been coordinated with Projects 2450 and 2460 Nuclear and Non-Nuclear Instrumentation Development Projects. Project 1950 was coordinated with Project 1520 Design and Development of Control Actuators, Project 8000 Reactor Mechanical Design and Project 8040 Mechanical Tests. Project 1960 is intimately connected with Project 2720 Source Term Studies and Project 8910 Material Evaluation, Application and Behavior.

PROJECT 1940

TEST PLANS

CALENDAR YEAR 1964

TEST PLAN

TEST NO. 20/WOOL

1. FACILITY: Ground Test Reactor (GTR)

a. Test Item Description	Neutron Detector-Preamplifier-Cable Systems
b. Test Date	January, 1964
c. Test Duration	20 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical Operating Parameters	System response vs. neutron and gamma irradiation
4. Components included	1 Source Range Fission Counter with preamplifier and associated cables.

1 Intermediate Range Fission Counter with preamplifier and associated cables.

1 Power Range gamma-compensated ionization chamber and associated cables. |
5. Parameters to be measured	Saturation characteristics; plateau characteristics and deadtime losses; neutron and gamma radiation intensities.
6. Use of data	To develop packaged neutron detector-preamplifier-cable systems for NERVA reactor control applications.
7. Pre- and Post-irradiation examination	Voltage breakdown; insulation resistance; capacitance.
e. Environmental Conditions	
1. Temperature	Approx. 80°F (ambient pool temperature)
2. Neutron exposure	Various exposures up to a maximum thermal flux of approx. 10^{12} n/cm ² sec.
3. Gamma exposure	Various exposures up to a maximum gamma dose rate of approx. 10^9 ergs/gram (C) - hr

TEST PLAN

TEST NO. 20/W001 Cont'd

f. Experimental Conditions

1. Operation procedure

Measure system behavior as a function of various parameters

2. Flow rates

Not applicable

3. Electrical oper. conditions

At required detector and preamplifier voltages

4. Internal pressure

Not applicable

g. Number of tests planned

One NRX-A test and one GTR test

h. Test Designer

WANL

TEST PLAN

TEST NO. 20/W002

1. FACILITY: NRX-A3
 - a. Test Item Description Neutron Detector-Preamplifier-Cable Systems
 - b. Test Date 1964
 - c. Test Duration Duration of NRX runs
 - d. Test Concepts
 1. Static or dynamic Dynamic
 2. Continuous or cyclic Continuous
 3. Critical oper. parameters System response as a function of radiation conditions encountered in Test Cell "A" water tank.
 4. Components included
 - 1 Source Range Fission Counter with preamplifier and associated cables.
 - 1 Intermediate Range Fission Counter with preamplifier and associated cables.
 - 1 Power Range gamma-compensated ionization chamber and associated cables.
 5. Parameters to be measured Transient response; linearity; saturation characteristics and dead-time losses; neutron and gamma radiation intensities.
 6. Use of data To develop packaged neutron detector-preamplifier-cable systems for NERVA reactor control applications.
 7. Pre and Post-irradiation examination Voltage breakdown; insulation resistance; capacitance.
 - e. Environmental Conditions
 1. Temperature Approx. 80°F (ambient water tank temperature)
 2. Neutron exposure Various exposures as a function of NRX power level
 3. Gamma exposure Various exposures as a function of NRX power level

TEST PLAN

TEST NO 20/W002

f. Experimental Conditions

1. Operation procedure	Measure system behavior as a function of NRX power level.
2. Flow rates	N. A.
3. Electrical oper. conditions	At required detector and preamplifier voltages.
4. Internal pressure	N. A.

g. Number of Tests Planned (Future) None

h. Test Designer WANL

1. FACILITY: (PBRF)

a. Test Item Description	Accelerometers
b. Test Date	November, 1963
c. Test Duration	10 days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Electrical output vs. vibration
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Voltage vs. g level
6. Use of data	To develop accelerometers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Ambient calibration by simulation testing with a sinusoidal vibration. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 1.9×10^{13} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Apply a sinusoidal vibration and measure output
2. Flow rates	55 gpm coolant water flow
3. Electrical oper. conditions	Oscilloscope and peak to peak meter readout
4. Internal Pressure	N.A.

g. Number of Tests Planned

Five in CY64

h. Test Designer

WANL

TEST PLAN

TEST NO. 23/W007

1. FACILITY: Ground Test Reactor (GTR)

a. Test Item Description	Accelerometers
b. Test Date	January, 1964
c. Test Duration	100 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical output vs. vibration
4. Components included	To be determined on the basis of prior test data.
5. Parameters to be measured	Voltage vs. g level
6. Use of data	To develop accelerometers for NERVA reactor diagnostic purposes.
7. Pre- and Post-Irradiation Examination	Ambient and cryogenic calibration by simulation testing with a sinusoidal vibration. Examination for radiation damage.
e. Environmental Conditions	
1. Temperature	LN ₂ (-320°F)
2. Neutron exposure	Fast (E > 0.1 MEV) = 3.1×10^{11} n/cm ² -sec
Integrated = 1.1×10^{17} n/cm ²
3. Gamma exposure	8×10^8 ergs/gm (C) -hr.
Integrated = 8×10^{10} ergs/gm (C)
f. Experimental Conditions	
1. Operation procedures	Apply a sinusoidal vibration and measure output as a function of frequency.
2. Flow rates	N. A.
3. Electrical oper. condition	Oscilloscope and peak-to-peak meter readout
4. Internal pressures	N. A.

TEST PLAN

TEST NO. 23/0007 Cont'd

g. Number of Tests Planned

Five in CY64

h. Test Designer

WANL

TEST PLAN

23/W006
TEST NO. 23/W008

1. FACILITY: (PBRF)

a. Test Item Description	Accelerometers
b. Test Date	December, 1963, April, 1964
c. Test Duration	50 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Electrical output vs. vibration
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Voltage vs. g level
6. Use of data	To develop accelerometers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Ambient calibration by simulation testing with a sinusoidal vibration. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ²

3. Gamma exposure
8.1 x 10 ¹⁰ ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Apply a sinusoidal vibration and measure output
2. Flow rates	55 gpm coolant water flow
3. Electrical oper. conditions	Oscilloscope and peak to peak meter readout
4. Internal pressures	N.A.
g. Number of Tests Planned	Five in CY64
h. Test Designer	WANL

TEST PLAN

TEST NO. 23/W009

1. FACILITY: (PBRF)

a. Test Item Description	Accelerometers
b. Test Date	August, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Electrical output vs. g level
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Voltage vs. g level
6. Use of data	To develop accelerometers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Ambient and cryogenic calibration by simulation testing with a sinusoidal vibration. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	Cryogenic
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ²

3. Gamma exposure
8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Apply a sinusoidal vibration and measure output
2. Flow rates	To be determined
3. Electrical oper. conditions	Oscilloscope and peak to peak meter readout
4. Internal pressure	N.A.
g. Number of Tests Planned	Five in CY64
h. Test Designer	WANL

1. FACILITY: PBRF

a. Test Item Description	Resistance Thermometers
b. Test Date	November, 1963
c. Test Duration	10 days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical Oper. Parameters	Resistance vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Resistance and temperature
6. Use of data	To develop resistance thermometers for NERVA reactor diagnostic purposes
7. Pre-and Post-irradiation examination	Calibration at boiling water and ice-point temperatures. Examination for radiation damage
e. Environmental Conditions at Plum Brook	
1. Temperature	125° (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ²

3. Gamma Exposure
8.1×10^{10} ergs/gram(c)-hr
Integrated = 1.9×10^{-3} ergs/gram(c) |
f. Experimental Conditions	
1. Operation Procedure	Monitor resistance and temperatures of resistance thermometers attached to test fixture
2. Flow rates	55 gpm coolant water flow
3. Electrical Oper. Conditions	Voltage and current readout
4. Internal pressure	N.A.
g. Number of Tests Planned	Four in CY64
h. Test Designer	WANL

1. FACILITY: PBRF

a. Test Item Description	Resistance Thermometers
b. Test Date	January, May, 1964
c. Test Duration	50 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical Oper. Parameters	Resistance vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Resistance and temperature
6. Use of data	To develop resistance thermometers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation examination	Calibration at boiling water and ice point temperatures. Examination for radiation damage
e. Environmental Conditions at Plum Brook	
1. Temperature	125° (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram (c)-hr
Integrated = 1.9×10^{13} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Monitor resistance and temperatures of resistance thermometers attached to test fixture
2. Flow rates	55 gpm coolant water flow
3. Electrical Oper. Conditions	Voltage and current readout
4. Internal pressure	N.A.
g. Number of Tests Planned (Future)	PBRF: Aug., 1964
h. Test Designer	WANL

TEST PLAN

TEST NO. 23/W109

1. FACILITY: PBRF

a. Test Item Description	Resistance Thermometers
b. Test Date	August, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Resistance vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Resistance and temperature
6. Use of data	To develop resistance thermometers for NERVA reactor diagnostic purposes
7. Pre and Post-irradiation examination	Calibration at boiling water, ice-point, and cryogenic temperatures. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	Cryogenic
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec
	Integrated
	Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ²
3. Gamma exposure	8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c)
f. Experimental Conditions	
1. Operation procedure	Monitor resistance and temperatures of resistance thermometers attached to test fixture
2. Flow rates	To be determined
3. Electrical oper. conditions	Voltage and current readout
4. Internal pressure	N.A.
g. Number of Tests Planned (Future)	None in contract year 1964
h. Test Designer	WANI

1. FACILITY: (PBRF)

a. Test Item Description	Linear Displacement transducers
b. Test Date	November, 1963
c. Test Duration	10 days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical Oper. Parameters	Electrical output vs. displacement
4. Components Included	To be determined on the basis of prior test data
5. Parameters to be Measured	Voltage vs. displacement
6. Use of data	To develop linear displacement transducers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Calibration Checks at Ambient Temperatures. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 1.9×10^{13} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Apply a known displacement and measure output
2. Flow rates	55 gpm coolant water flow
3. Electrical Oper. Conditions	20 volts peak to peak, 3 KC carrier for LVDT; Oscilloscope Readout
4. Internal Pressures	160 to 300 psi Nitrogen Gas pressure for energizing test fixture

TEST PLAN

TEST NO. 23/W205 Cont'd

g. Number of Tests Planned (Future)

Four in CY64

h. Test Designer

WANL

TEST PLAN

TEST NO. 23/W206

1. FACILITY: Ground Test Reactor (GTR)

a. Test Item Description	Linear Displacement Transducers
b. Test Date	January, 1963
c. Test Duration	100 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical output vs. linear displacement
4. Components included	To be determined on the basis of prior test data.
5. Parameters to be measured	Voltage vs. displacement
6. Use of data	To develop linear motion displacement transducers for NERVA diagnostic purposes.
7. Pre- and Post-Irradiation examination	Calibration checks at ambient and LN ₂ temperatures. Examination for radiation damage.
e. Environmental Conditions	
1. Temperature	LN ₂ (-320°F)
2. Neutron exposure	Fast = 3.1×10^{11} n/cm ² sec (E > 0.1 MEV)
Integrated = 8×10^{10} ergs/gm (C)
3. Gamma exposure	8×10^8 ergs/gm (C) - hr
Integrated = 8×10^{10} ergs/gm (C)
f. Experimental Conditions	
1. Operation procedure	Apply known displacement and measure output.
2. Flow rates	N. A.
3. Electrical oper. conditions	20 volts peak-to-peak, 3 KC carrier for displacement transducers; oscilloscope readout.
4. Internal pressure	N. A.

TEST PLAN

TEST NO. 23/W206 Cont'd

g. Number of Tests Planned (Future)

Three at Plum Brook

h. Test Designer

WANI

1. FACILITY: PBRF

- a. Test Item Description Linear Displacement transducers
- b. Test Date February, May, 1964
- c. Test Duration 50 Hours
- d. Test Concepts
 - 1. Static or dynamic Dynamic
 - 2. Continuous or cyclic Cyclic
 - 3. Critical Oper. Parameters Electrical output vs. displacement
 - 4. Components Included To be determined on the basis of prior test data
 - 5. Parameters to be Measured Voltage vs. displacement
 - 6. Use of data To develop linear displacement transducers for NERVA reactor diagnostic purposes
 - 7. Pre- and Post-irradiation Examination Calibration Checks at Ambient Temperatures. Examination for radiation damage
- e. Environmental Conditions
 - 1. Temperature 125°F (Ambient Water Temperature)
 - 2. Neutron exposure
 - Fast = 3×10^{13} n/cm²sec
 - Thermal = 1.3×10^{14} n/cm²sec
 - Integrated
 - Fast = 5.4×10^{18} n/cm²
 - Thermal = 2.3×10^{19} n/cm²
 - 3. Gamma exposure
 - 8.1×10^{10} ergs/gram(c)-hr
 - Integrated = 4×10^{12} ergs/gram(c)
- f. Experimental Conditions
 - 1. Operation procedure Apply a known displacement and measure output
 - 2. Flow rates 55 gpm coolant water flow
 - 3. Electrical Oper. Conditions 20 volts peak to peak, 3 KC carrier for LVDT; Oscilloscope Readout
 - 4. Internal pressures 160 to 300 psi Nitrogen Gas pressure for energizing test fixture
- g. Number of Tests Planned (Future) PBRF: September, 1964
- h. Test Designer WANI

TEST PLAN

TEST NO. 23/W209

1. FACILITY: (PBRF)

a. Test Item Description	Linear Displacement Transducers
b. Test Date	September, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical output vs. displacement
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Voltage vs. displacement
6. Use of data	To develop linear displacement transducers for NERVA reactor diagnostic purposes
7. Pre and Post-irradiation examination	Calibration checks at ambient and cryogenic temperatures. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	Cryogenic
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Apply known displacement and measure output
2. Flow rates	To be determined
3. Electrical oper. conditions	20 volts peak to peak, 3 KC carrier for LVDT; oscilloscope readout
4. Internal pressure	160 to 300 psi helium gas pressure for energizing test fixture
g. Number of Tests Planned (Future)	None in contract year 1964
h. Test Designer	WANL

1. FACILITY: (PBRF)

a. Test Item Description	Cooper-Constantan and Chromel-Alumel Thermocouples
b. Test Date	November, 1963
c. Test Duration	10 Days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical Oper. Parameters	Thermocouple output vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Temperature
6. Use of data	To develop thermocouples for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Calibration at boiling water and ice-point. Post-irradiation check for damage
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 1.9×10^{13} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Measure output of thermocouples mounted on test fixture
2. Flow rates	55 gpm coolant water flow
3. Electrical oper. conditions	Strip chart recorder output
4. Internal pressures	N.A.
g. Number of Tests Planned (Future)	Four in CY64
h. Test Designer	WANL

1. FACILITY: (PBRF)

- a. Test Item Description Cooper-Constantan and Chromel-Alumel Thermocouples
- b. Test Date January, May, 1964
- c. Test Duration 50 hours
- d. Test Concepts
 - 1. Static or dynamic Dynamic
 - 2. Continuous or cyclic Continuous
 - 3. Critical Oper. Parameters Thermocouple output vs. time and temperature
 - 4. Components included To be determined on the basis of prior test data
 - 5. Parameters to be measured Temperature
 - 6. Use of data To develop thermocouples for NERVA reactor diagnostic purposes
 - 7. Pre- and Post-irradiation Examination Calibration at boiling water and ice-point temperatures. Post-irradiation check for damage
- e. Environmental Conditions
 - 1. Temperature 125°F (ambient water temperature)
 - 2. Neutron exposure
 - Fast = 3×10^{13} n/cm²sec
 - Thermal = 1.3×10^{14} n/cm²sec
 - Integrated
 - Fast = 5.4×10^{18} n/cm²
 - Thermal = 2.3×10^{19} n/cm²
 - 3. Gamma exposure
 - 8.1×10^{10} ergs/gram(c)-hr
 - Integrated = 4×10^{12} ergs/gram(c)
- f. Experimental Conditions
 - 1. Operation procedure Measure output of thermocouples mounted on test fixture
 - 2. Flow rates 55 gpm coolant water flow
 - 3. Electrical oper. conditions Strip chart recorder output
 - 4. Internal pressures N.A.
- g. Number of Tests Planned (Future) PBRF: August, 1964
- h. Test Designer WANL

1. FACILITY: (PBRF)

a. Test Item Description	Tungsten/Tungsten-26% Rhenium Thermocouples
b. Test Date	May, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Thermocouple output vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Temperature
6. Use of data	To be develop thermocouples for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	High temperature calibration. Examination for radiation damage.
e. Environmental Conditions	
1. Temperature	4500°R
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Obtain desired temperature by gamma heating and measure thermocouple output
2. Flow rates	N.A.
3. Electrical oper. conditions	Strip chart recorder readout
4. Internal pressure	N.A.
g. Number of Tests Planned (Future)	None in contract year 1964
h. Test Designer	WANI

1. FACILITY: (PBRF)

a. Test Item Description	Copper-Constantan and Chromel-Alumel Thermocouples
b. Test Date	August, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Thermocouple output vs. time and temperature
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Temperature
6. Use of data	To develop thermocouples for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Calibration of thermocouples at boiling water, ice-point and cryogenic temperatures. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	Cryogenic
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec
	Integrated
	Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ²
3. Gamma exposure	8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c)
f. Experimental Conditions	
1. Operation procedure	Measure output of thermocouples mounted on test fixture
2. Flow rates	To be determined
3. Electrical oper. conditions	Strip Chart recorder output
4. Internal pressure	N.A.
g. Number of Tests Planned (Future)	None in contract year 1964
h. Test Designer	WANL

1. FACILITY: (PBRF)

a. Test Item Description	Strain Gages
b. Test Date	November, 1963
c. Test Duration	10 days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical Oper. Parameters	Strain gage output vs. strain
4. Components Included	To be determined on the basis of prior test data
5. Parameters to be Measured	Strain
6. Use of data	To develop strain gages for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Calibration of strain gages at ambient temperatures. Examination for radiation damage
e. Environmental Conditions at Plum Brook	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec Thermal = 1.3×10^{14} n/cm ² sec Integrated Fast = 2.6×10^{19} n/cm ² Thermal = 1.1×10^{20} n/cm ² 3. Gamma exposure 8.1×10^{10} ergs/gram(c)-hr Integrated = 1.9×10^{13} ergs/gram(c)
f. Experimental Conditions	
1. Operation procedure	Apply known strain and measure gage output
2. Flow rates	55 gpm coolant water flow
3. Electrical Oper. Conditions	Bridge network readout
4. Internal pressures	160-250 psi gas pressure for actuating bellows on test fixture
g. Number of Tests Planned (Future)	GTR: One Test PBRF Three Tests
h. Test Designer	WANI

TEST PLAN

TEST NO. 23/W407

1. FACILITY: Ground Test Reactor (GTR)

a. Test Item Description	Strain gages
b. Test Data	January, 1964
c. Test Duration	100 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical Oper. Parameters	Strain gage output vs. strain
4. Components Included	To be determined on the basis of prior test data.
5. Parameters to be Measured	Strain
6. Use of Data	To develop strain gages for NERVA reactor diagnostic purposes.
7. Pre- and Post-Irradiation Examination	Calibration of strain gages at ambient and LN ₂ temperatures. Examination for radiation damage.
e. Environmental Conditions at GTR	
1. Temperature	LN ₂ (-320°F)
2. Neutron Exposure	Fast = 3.1×10^{11} n/cm ² sec (E > 0.1 MEV)
Integrated = 1.1×10^{17} n/cm ²
3. Gamma Exposure	8×10^8 ergs/gm (C) -hr.
Integrated = 8×10^{10} ergs/gm (C)
f. Experimental Conditions	
1. Operation procedure	Apply known strain and measure gage output.
2. Flow rates	N. A.
3. Electrical Oper. Condition	Bridge network readout
4. Internal pressures	N. A.
g. No. of Tests Planned (Future)	Three tests at Plum Brook
h. Test Designer	WANL

1. FACILITY: (PBRF)

- a. Test Item Description Strain Gages
- b. Test Date January, May, 1964
- c. Test Duration 50 Hours
- d. Test Concepts
 - 1. Static or dynamic Dynamic
 - 2. Continuous or cyclic Cyclic
 - 3. Critical Oper. Parameters Strain gage output vs. strain
 - 4. Components Included To be determined on the basis of prior test data
 - 5. Parameters to be Measured Strain
 - 6. Use of data To develop strain gages for NERVA reactor diagnostic purposes
 - 7. Pre- and Post-irradiation Examination Calibration of strain gages at ambient temperatures. Examination for radiation damage
- e. Environmental Conditions at Plum Brook
 - 1. Temperature 125°F (ambient water temperature)
 - 2. Neutron exposure
 - Fast = 3×10^{13} n/cm²sec
 - Thermal = 1.3×10^{14} n/cm²sec
 - Integrated
 - Fast = 5.4×10^{18} n/cm²
 - Thermal = 2.3×10^{19} n/cm²
 - 3. Gamma exposure
 - 8.1×10^{10} ergs/gram(c)-hr
 - Integrated = 4×10^{12} ergs/gram(c)
- f. Experimental Conditions
 - 1. Operation procedure Apply known strain and measure gage output
 - 2. Flow rates 55 gpm coolant water flow
 - 3. Electrical Oper. Conditions Bridge network readout
 - 4. Internal pressures 160-250 psi gas pressure for actuating bellows on test fixture
- g. Number of Tests Planned (Future) PBRF: September, 1964
- h. Test Designer WANL

1. FACILITY: (PBRF)

a. Test Item Description	Strain Gages
b. Test Date	September, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Strain gage output vs. strain
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Strain
6. Use of data	To develop strain gages for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Calibration of strain gages at ambient and cryogenic temperatures. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	Cryogenic
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ²

3. Gamma exposure
8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	All known strain and measure gage output
2. Flow rates	To be determined
3. Electrical oper. conditions	Bridge network readout
4. Internal pressure	160-250 psi gas pressure for actuating bellows on test fixture
g. Number of Tests Planned (Future)	None in contract year 1964
h. Test Designer	WANI

1. FACILITY: (PBRF)

a. Test Item Description	Pressure Transducers
b. Test Date	November, 1963, December, 1963
c. Test Duration	10 days
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical Output vs. Pressure
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Electrical output vs. pressure
6. Use of data	To develop pressure transducers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Ambient calibration. Examination for radiation damage.
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 2.6×10^{19} n/cm ²
Thermal = 1.1×10^{20} n/cm ² |
f. Experimental Conditions	
1. Operation procedure	Measure output as a function of pressure
2. Flow Rates	55 gpm coolant water flow
3. Electrical oper. conditions	Digital voltmeter readout
4. Internal pressure	0-750 psia
0-125 psid
g. Number of Tests Planned (Future)	Three Tests in CY64
h. Test Designer	WANL

TEST PLAN

TEST NO. 23/W507

1. FACILITY: Ground Test Reactor (GTR)

a. Test Item Description	Pressure Transducers
b. Test Date	January, 1964
c. Test Duration	100 Hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical output vs. pressure
4. Components included	To be determined on the basis of prior test data.
5. Parameters to be measured	Electrical output vs. pressure
6. Use of data	To obtain pressure transducers for NERVA reactor diagnostic purposes
7. Pre- and Post-Irradiation Examination	Calibration tests of pressure vs. output within range of transducers at ambient and LN ₂ temperatures. Examination for radiation damage.
e. Environmental Conditions	
1. Temperature	LN ₂ (-320°F)
2. Neutron exposure	Fast (E > 0.1 MEV) = 3.1×10^{11} n/cm ² - sec.
Integrated = 1.1×10^{17} n/cm ²
3. Gamma exposure	8×10^8 ergs/gm (C) - hr.
Integrated = 8×10^{10} ergs/gm (C)
f. Experimental Conditions	
1. Operation procedure	Apply pressures within range of transducers and measure output under vibration conditions.
2. Flow rates	Not applicable
3. Electrical oper. condition	Digital voltmeter readout.
4. Internal pressures	0-750 psia
0-125 psid

TEST PLAN

TEST NO. 23/W507 Cont'd

g. Number of Tests Planned (Future)

Three tests at Plum Brook

h. Test Designer

WANL

1. FACILITY: (PBRF)

a. Test Item Description	Pressure Transducers
b. Test Date	April, 1964
c. Test Duration	50 hours
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Cyclic
3. Critical oper. parameters	Electrical Output vs. Pressure
4. Components included	To be determined on the basis of prior test data
5. Parameters to be measured	Electrical output vs. pressure
6. Use of data	To develop pressure transducers for NERVA reactor diagnostic purposes
7. Pre- and Post-irradiation Examination	Ambient calibration. Examination for radiation damage
e. Environmental Conditions	
1. Temperature	125°F (ambient water temperature)
2. Neutron exposure	Fast = 3×10^{13} n/cm ² sec
Thermal = 1.3×10^{14} n/cm ² sec

Integrated
Fast = 5.4×10^{18} n/cm ²
Thermal = 2.3×10^{19} n/cm ² |
| 3. Gamma exposure | 8.1×10^{10} ergs/gram(c)-hr
Integrated = 4×10^{12} ergs/gram(c) |
f. Experimental Conditions	
1. Operation procedure	Measure output as a function of pressure
2. Flow Rates	55 gpm coolant water flow
3. Electrical oper. conditions	Digital voltmeter readout
4. Internal pressure	0-750 psia
0-125 psid
g. Number of Tests Planned (Future)	PBRF: Aug., 1964
h. Test Designer	WANL

TEST PLAN

TEST NO. 23/W509

1. FACILITY: (PBRF)
 - a. Test Item Description Pressure Transducers
 - b. Test Date August, 1964
 - c. Test Duration 50 hours
 - d. Test Concepts
 1. Static or dynamic Dynamic
 2. Continuous or cyclic Cyclic
 3. Critical oper. parameters Electrical output vs. pressure
 4. Components included To be determined on the basis of prior test data
 5. Parameters to be measured Electrical output vs. pressure
 6. Use of data To develop pressure transducers for NERVA reactor diagnostic purposes.
 7. Pre- and Post-irradiation examination Ambient and cryogenic calibration. Examination for radiation damage.
 - e. Environmental Conditions
 1. Temperature Cryogenic
 2. Neutron exposure
$$\text{Fast} = 3 \times 10^{13} \text{ n/cm}^2\text{sec}$$
$$\text{Thermal} = 1.3 \times 10^{14} \text{ n/cm}^2\text{sec}$$

Integrated

$$\text{Fast} = 5.4 \times 10^{18} \text{ n/cm}^2$$
$$\text{Thermal} = 2.3 \times 10^{19} \text{ n/cm}^2$$
 3. Gamma exposure
$$8.1 \times 10^{10} \text{ ergs/gram(c)-hr}$$
$$\text{Integrated} = 4 \times 10^{12} \text{ ergs/gram(c)}$$
 - f. Experimental Conditions
 1. Operation procedure Measure output as a function of pressure
 2. Flow rates To be determined
 3. Electrical oper. conditions Digital voltmeter readout
 4. Internal pressure 0-750 psia
0-125 psid
 - g. Number of Tests Planned (Future) None in contract year 1964
 - h. Test Designer WANL

PROJECT 1950

TEST PLANS

CALENDAR YEAR 1964

TEST PLAN

TEST NO. 14/W003

1. FACILITY: GTR
 - a. Test Item Description Control Actuator Components
 - b. Test Date January, 1964
 - c. Test Duration 100 hours
 - d. Test Concepts
 1. Static or dynamic Dynamic
 2. Continuous or cyclic Continuous
 3. Critical oper. parameters Temperature and integrated neutron
 4. Components included Potentiometer, servo valve, bearings (2 types)
 5. Parameters to be measured Electrical characteristics of potentiometers, valve pressures, bearing integrity and performance, etc., at elevated temperatures
 6. Use of data To design and develop actuator components which are resistant to radiation damage
 7. Pre and post-irradiation examination Dynamic operation of components to measure parameters (voltage, pressure, etc.) and determine changes due to irradiation. Post-irradiation disassembly and inspection to evaluate anomalies.
 - e. Environmental Conditions
 1. Temperature +350°F
 2. Neutron exposure 1×10^{17} nvt fast
 3. Gamma exposure Not specified
 - f. Experimental Conditions
 1. Operation procedure Simulate operating conditions encountered in service (input-output voltages, temperature rise, gas pressures, etc.)
 2. Flow rates 10 lbs. He/hr.
 3. Electrical oper. conditions Regulate DC input voltages to potentiometer and monitor output voltage
 4. Internal pressure 200 psig He

g. Number of Tests Planned

5 radiation tests with varying ambients
and first and second generation components
are planned in the 1964 program

h. Test Designer

WANL

TEST PLAN

TEST NO. 14/W004

1. FACILITY: GTR
 - a. Test Item Description Complete Control Actuator and Load
 - b. Test Date February, 1964
 - c. Test Duration 100 hours
 - d. Test Concepts
 1. Static or dynamic Dynamic
 2. Continuous or cyclic Continuous
 3. Critical oper. parameters Internal heat generation under varying loads and coolant flows
 4. Components included Complete actuator and simulated load
 5. Parameters to be measured Operation of actuator
 6. Use of data Evaluate actuator performance and to aid in improved designs
 7. Pre and post-irradiation examination Determination of condition of components before and after exposure (distortion, dimensional changes, Bode plots, etc.)
 - e. Environmental Conditions
 1. Temperature Varying
 2. Neutron exposure 1×10^{17} nvt fast
 3. Gamma exposure Not specified
 - f. Experimental Conditions
 1. Operation procedure Simulate actuator operation under load conditions
 2. Flow rates
 3. Electrical oper. conditions Normal actuation requirements
 4. Internal pressure Not specified
 - g. Number of Tests Planned 5 radiation tests with varying ambients and first and second generation components are planned in the 1964 program
 - h. Test Designer WANL

TEST PLAN

TEST NO. 14/WO05

1. FACILITY	GTR
a. Test Item Description	Control Actuator Components
b. Test Date	April, 1964
c. Test Duration	100 hours (Test stopped if component fails)
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Vibration, temperature and flux
4. Components included	Servo valve (2nd generation), potentiometer (2nd generation), metal piston seals, syncro or variable reluctance transducer (2nd generation test)
5. Parameters to be measured	Operation of components in flux, vibration and temperature
6. Use of data	Evaluate effect of conditions on components
7. Pre and post-irradiation examination	Determination of effect of conditions on components with radiation the determined variable
e. Environmental Conditions	
1. Temperature	+350°F
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Simulate operation of components during test
2. Flow rates	Not specified
3. Electrical oper. conditions	Normal actuation requirements
4. Internal pressure	Not specified
g. Number of Tests Planned	5 radiation tests with varying ambients and first and second generation components are planned in the 1964 program
h. Test Designer	WANL

TEST PLAN

TEST NO. 14/W006

1. FACILITY: GTR
 - a. Test Item Description Control Actuator Components
 - b. Test Date July, 1964
 - c. Test Duration 100 hours (Test stopped if component fails)
 - d. Test Concepts
 1. Static or Dynamic Dynamic
 2. Continuous or Cyclic Continuous
 3. Critical Oper. Parameters Temperature, neutron flux and vacuum
 4. Components Included Servo valve (2nd generation), potentiometer (2nd generation), synchro or variable reluctance transducer (2nd generation)
 5. Parameters to be Measured Operation in flux, temp. and vacuum field
 6. Use of Data Evaluate effect of conditions on components
 7. Pre- and Post-Irradiation Examination Determination of operating characteristics of components before and after irradiation
 - e. Environmental Conditions
 1. Temperature 140°R
 2. Neutron Exposure 1×10^{17} nvt fast
 3. Gamma Exposure Not specified
 - f. Experimental Conditions
 1. Operation Procedure Simulate operation of components during test
 2. Flow Rates Not specified
 3. Electrical Oper. Conditions Normal actuation requirements
 4. Internal Pressure 10^{-6} Torr.
 - g. Number of Tests Planned 5 radiation tests with varying ambients and first and second generation components are planned in the 1964 program
 - h. Test Designer WANL

TEST PLAN

TEST NO. 14/1007

I. FACILITY: PBRF

a. Test Item Description	Control Actuator Components
b. Test Date	July, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Dose rate (fast neutrons)
4. Components included	Servo valve (2nd generation), potentiometer (2nd generation), piston seals (SP type)
5. Parameters to be measured	Operation in flux field
6. Use of data	Determine effects of flux rate on components
7. Pre and post-irradiation examination	Determination of operating characteristics before and after irradiation
e. Environmental Conditions	
1. Temperature	Not controlled
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Simulate operation of components during test
2. Flow rates	Not specified
3. Electrical oper. conditions	Normal actuation requirements
4. Internal pressure	Not specified
g. Number of Tests Planned	5 radiation tests with varying ambients and first and second generation components are planned in the 1964 program
h. Test Designer	WANL

TEST PLAN

TEST NO. 15/W001

1. FACILITY: GTR
 - a. Test Item Description Control Drum Assembly
 - b. Test Date May, 1964
 - c. Test Duration 150 hours
 - d. Test Concepts
 1. Static or dynamic Dynamic
 2. Continuous or cyclic Continuous
 3. Critical oper. parameters LN_2 Temperature and nvt
 4. Components included Control drum assembly
 5. Parameters to be measured Temperature and flux
 6. Use of data Determine embrittlement and distortion of parts and change in properties
 7. Pre and post-irradiation examination Determine impact and other mechanical properties and particularly dimensions of Boral plate
 - e. Environmental Conditions
 1. Temperature $\sim 140^\circ R$ ambient
 2. Neutron exposure 5.4×10^{17} thermal nvt
 3. Gamma exposure Not specified
 - f. Experimental Conditions
 1. Operation procedure Irradiate test component in environment specified
 2. Flow rates To maintain temperature
 3. Electrical oper. conditions Not specified
 4. Internal pressure Not specified
 - g. Number of Tests Planned One
 - h. Test Designer WANL

TEST PLAN

TEST NO. 15/W301

1. FACILITY: GTR
 - a. Test Item Description NRX Dome End Support Ring Section
 - b. Test Date December, 1963
 - c. Test Duration 150 hours
 - d. Test Concepts
 1. Static or dynamic Static
 2. Continuous or cyclic Continuous
 3. Critical oper. parameters Temperature and flux
 4. Components included Prestressed support ring section
 5. Parameters to be measured Ability to withstand stress and flux
 6. Use of data Determine ability of component to withstand combined NRX Temperature and integrated flux conditions
 7. Pre and post-irradiation examination Strength measurement with and without irradiation
 - e. Environmental Conditions
 1. Temperature ~140°R
 2. Neutron exposure $6 \times 10^{17} > 1$ MEV
 3. Gamma exposure Not specified
 - f. Experimental Conditions
 1. Operation procedure Static load part and place in temperature and flux conditions
 2. Flow rates Not specified
 3. Electrical oper. conditions Not specified
 4. Internal pressure Not specified
 - g. Number of Tests Planned One
 - h. Test Designer WANL

TEST PLAN

TEST NO. 15/W202

1. FACILITY: PBRF

a. Test Item Description	Fuel Module
b. Test Date	July, 1964
c. Test Duration	10 hours
d. Test Concepts	
1. Static or dynamic	Static
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Temperature and Burnup
4. Components included	NRX Fuel Element
5. Parameters to be measured	Resultant integrity after test stresses have been imposed
6. Use of data	Determine ability of fuel module to maintain mechanical integrity
7. Pre and post-irradiation examination	Detailed inspection of fuel module before and after irradiation
e. Environmental Conditions	
1. Temperature	4000 R. Max.
2. Neutron exposure	2.5×10^{18} nvt thermal
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Irradiate part in water cooled instrumented capsule
2. Flow rates	Not specified
3. Electrical oper. conditions	Not specified
4. Internal pressure	Not specified
g. Number of Tests Planned	One
h. Test Designer	WANL

1. FACILITY: (GTR)

a. Test Item Description	Prototype connector for instrumentation
b. Test Date	January, 1964
c. Test Duration	100 hours
d. Test Concepts	
1. Static or dynamic	Electronically dynamic, mechanically static
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Constant voltage applied to test circuits
4. Components included	Chromel-alumel and copper constantan thermocouples
5. Parameters to be measured	Output voltage from thermocouple. Voltage drop across wire loop connections.
6. Use of data	Evaluation of temperature difference across connector
7. Pre- and Post Irradiation Examination	Comparison of mating surfaces, conductivity, dielectric
e. Environmental Conditions	
1. Temperature	32°F to 320°F
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	1.8×10^{18} Mev/cm ²
f. Experimental Conditions	
1. Operation procedure	Check equipment against specified setup voltage
2. Flow rates	Not specified
3. Electrical oper. conditions	Control equipment against specified setup voltage
4. Internal pressure	Atmospheric
g. Number of Tests Planned	5 tests of connectors, harnesses for control actuators
h. Test Designer	WANL

TEST PLAN

TEST NO. 26/W002

1. FACILITY:	GTR
a. Test Item Description	Prototype connector for instrumentation for tungsten-tungsten rhenium thermocouple.
b. Test Date	January, 1964
c. Test Duration	100 hours
d. Test Concepts	
1. Static or Dynamic	Electrically dynamic-mechanically static
2. Continuous or Cyclic	Continuous
3. Critical Oper. Parameters	Constant voltage applied to test circuits.
4. Components Included	Tungsten-tungsten rhenium thermocouples
5. Parameters to be Measured	Output voltage from thermocouples. Voltage drop across wire loop circuits
6. Use of Data	Evaluation of temperature difference across connectors.
7. Pre- and Post-Irradiation Examination	Comparison of mating surfaces, conductivity dielectric.
e. Environmental Conditions	
1. Temperature	32°F to 320°F
2. Neutron Exposure	3.6×10^{17} nvt fast
3. Gamma Exposure	1.8×10^{18} Mev/cm ²
f. Experimental Conditions	
1. Operation Procedure	Check equipment against specified setup voltages.
2. Flow Rates	Not specified
3. Electrical Oper. Conditions	Constant voltage applied to closed wire circuits.
4. Internal Pressure	Atmospheric
g. Number of Test Planned	5 tests of connectors, harnesses for control actuators.
h. Test Designer	WANL

TEST PLAN

TEST NO. 26/W003

1. FACILITY: (PBRF)

a. Test Item Description	Prototype connector for instrumentation
b. Test Date	February, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Mechanically and electrically dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Frequency and amplitude of vibration
4. Components included	Vibration equipment
5. Parameters to be measured	Freq. and amplitude of vibration, noise from connector
6. Use of data	Evaluation of connector joints
7. Pre- and Post-irradiation examination	Mechanical condition of pins, dielectric strength and conductivity
e. Environmental Conditions	
1. Temperature	32°F to 320°F
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	1.8×10^{18} Mev/cm ²
f. Experimental Conditions	
1. Operation procedure	Calibrate vibration and measuring gear
2. Flow rates	Not specified
3. Electrical oper. conditions	Constant voltage
4. Internal pressure	Atmospheric
g. Number of Tests Planned	5 tests of connectors, harnesses for control actuators
h. Test Designer	WANL

TEST PLAN

TEST NO. 26/W004

1. FACILITY: (PBRF)

a. Test Item Description	Cable for cable harness
b. Test Date	April, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Electrically dynamic, mechanically static
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Voltage applied to test circuits
4. Components included	
5. Parameters to be measured	Leakage, noise
6. Use of data	Evaluation of cable
7. Pre- and Post-Irradiation Examination	Insulation, shield, dielectric condition
e. Environmental Conditions	
1. Temperature	32°F to 320°F
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	1.8×10^{18} Mev/cm ²
f. Experimental Conditions	
1. Operation procedure	Calibrate measuring gear, establish operating levels
2. Flow rates	Not specified
3. Electrical oper. conditions	Constant voltage amplitude
4. Internal pressure	Atmospheric
g. Number of Tests Planned	5 tests of connectors, harnesses for control actuators
h. Test Designer	WANL

TEST PLAN

TEST NO. 26/W005

1. FACILITY: (PBRF)

a. Test Item Description	Cable for cable harness
b. Test Date	September, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Mechanically and electrically dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Voltage applied to test circuits, frequency and amplitude of vibration
4. Components included	Vibration Equipment
5. Parameters to be measured	Vibration amplitude and frequency, leakage, and noise
6. Use of data	Cable evaluation
7. Pre- and post-irradiation examination	Insulation condition, dielectric, shield
e. Environmental Conditions	
1. Temperature	32°F to 320°F
2. Neutron exposure	1×10^{17} nvt fast
3. Gamma exposure	1.8×10^{18} Mev/cm ²
f. Experimental Conditions	
1. Operation procedure	Calibrate measuring gear, establish operating levels
2. Flow rates	Not specified
3. Electrical oper. conditions	Constant voltage amplitude
4. Internal pressure	Atmospheric
g. Number of Tests Planned	5 tests of connectors, harnesses for control actuators
h. Test Designer	WANL

TEST PLAN

TEST NO. 40/W005

1. FACILITY:	GTR
a. Test Item Description	Control Drum Bearing
b. Test Date	February, 1964
c. Test Duration	100 hours
d. Test Concepts	
1. Static or Dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Vacuum and neutron flux
4. Components included	Bearing
5. Parameters to be measured	Rolling friction
6. Use of data	Determine ability of component to function in NRX-A Reactors
7. Pre and post-irradiation examination	Determine friction before irradiation, friction and visual inspection after irradiation
e. Environmental Conditions	
1. Temperature	Ambient
2. Neutron exposure	$6.5 \times 10^{16} > 1 \text{ MEV}$
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Measure bearing behavior in flux and vacuum
2. Flow rates	None
3. Electrical oper. conditions	Not specified
4. Internal pressure	10^{-6} Torr.
g. Number of Tests Planned	Three Bearing Tests
h. Test Designer	WANL

TEST PLAN

TEST NO. 40/W006

1. FACILITY: (PBRF)

a. Test Item Description	Control Drum Bearing
b. Test Date	February, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Temperature and neutron flux
4. Components included	Bearing
5. Parameters to be measured	Rolling friction
6. Use of data	Determine ability of bearing to operate in NRX-A reactors
7. Pre- and Post-irradiation examination	Determine friction before irradiation and friction plus visual inspection after irradiation
e. Environmental Conditions	
1. Temperature	150°F
2. Neutron exposure	1×10^{17} 1 Mev
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Measure behavior of bearing in flux and temperature conditions of test
2. Flow rates	Static
3. Electrical oper. conditions	Not specified
4. Internal pressure	Not specified
g. Number of Tests Planned	Three Bearing Tests
h. Test Designer	WANL

TEST PLAN

TEST NO. 40/W007

1. FACILITY: (PBRF)

a. Test Item Description	Control Drum Bearing
b. Test Date	September, 1964
c. Test Duration	1 hour
d. Test Concepts	
1. Static or dynamic	Dynamic
2. Continuous or cyclic	Continuous
3. Critical oper. parameters	Temperature and Neutron flux
4. Components included	Bearing
5. Parameters to be measured	Rolling Friction
6. Use of data	Determine ability of bearing to operate in NRX-A reactors
7. Pre- and Post-irradiation Examination	Friction determinations before and after irradiation. Visual inspections before and after irradiation
e. Environmental Conditions	
1. Temperature	100°R
2. Neutron exposure	1×10^{17} 1 Mev
3. Gamma exposure	Not specified
f. Experimental Conditions	
1. Operation procedure	Measure bearing behavior in flux and temperature
2. Flow rates	Not specified
3. Electrical oper. conditions	Not specified
4. Internal pressure	Not specified
g. Number of Tests Planned	Three Bearing Tests
h. Test Designer	WANL

TEST PLAN

TEST NO. 37/W401

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile Specimens of Selected Structural Materials

b. Test Date

March, 1964

c. Test Duration

200 hours (liquid nitrogen level maintained between reactor runs)

d. Test Concepts

(1) Static or Dynamic

Both - Some test specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux - and temperature (IN_2)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be measured

Tensile strength and temperature

(6) Use of Data

Design of components for NERVA

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

PROJECT 1960

TEST PLANS

CALENDAR YEAR 1964

TEST PLAN

TEST NO. 37/W401

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile Specimens of Selected Structural Materials

b. Test Date

March, 1964

c. Test Duration

200 hours (liquid nitrogen level maintained between reactor runs)

d. Test Concepts

(1) Static or Dynamic

Both - Some test specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux - and temperature (IN_2)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be measured

Tensile strength and temperature

(6) Use of Data

Design of components for NERVA

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

e. Environmental Conditions

(1) Temperature	Cryogenic (LN_2 - 320°F)
(2) Neutron Exposure	10^{18} nvt, $E > 1$ Mev
(3) Gamma Exposure	Not Applicable

f. Experimental Conditions

(1) Operation Procedure	Tensile specimens will be loaded into either AGC or NASA load cells and racks which will be lowered into cryogenic dewars in the reactor pallet positions and tested to failure in liquid nitrogen immediately at termination of the irradiation.
(2) Flow Rates	Natural convection of boiling liquid nitrogen
(3) Electrical Operating Conditions	None required except for tensile apparatus
(4) Internal Pressure	None

g. Number of Tests Planned Five tests during CY64

h. Test Designer WANL*

*Tests to be run in conjunction with Aerojet tests

TEST PLAN

TEST NO. 37/W402

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile Specimens of Various Materials

b. Test Date

May, 1964

c. Test Duration

100 hrs. (highest flux possible)

d. Test Concepts

(1) Static or Dynamic

Both - some tensile specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the tensile specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux and temperature (LN₂)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be Measured

Tensile strength and temperature

(6) Use of Data

Design of NERVA components

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

e. Environmental Conditions

(1) Temperature

Cryogenic - -320°F

(2) Neutron Exposure	10^{18} nvt, $E > 1$ mev
(3) Gamma Exposure	Not applicable
f. Experimental Conditions	
(1) Operation Procedure	Tensile specimens will be loaded into either AGC or NASA load cells which will be lowered into cryogenic dewars in the reactor pallet positions and tested to failure immediately at termination of the irradiation.
(2) Flow Rates	Natural convection of boiling liquid nitrogen
(3) Electrical Operating Conditions	None required except for tensile apparatus
(4) Internal Pressure	None
g. Number of Tests Planned	Five tests are planned for CY64
h. Test Designer	WANL

TEST PLAN

TEST NO. 37/W403

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile Specimens of Selected Structural Materials

b. Test Date

June, 1964

c. Test Duration

200 hours (liquid nitrogen level maintained between reactor runs)

d. Test Concepts

(1) Static or Dynamic

Both - Some tensile specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux - and temperature (LN₂)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be Measured

Tensile strength and temperature

(6) Use of Data

Design of components for NERVA

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

e. Environmental Conditions

(1) Temperature	Cryogenic ($\text{LN}_2 - 320^\circ\text{F}$)
(2) Neutron Exposure	10^{18} nvt, $E > 1$ Mev
(3) Gamma Exposure	Not Applicable

f. Experimental Conditions

(1) Operation Procedure	Tensile specimens will be loaded into either AGC or NASA load cells and racks which will be lowered into cryogenic dewars in the reactor pallet positions and tested on failure in liquid nitrogen immediately at termination of the irradiation.
(2) Flow Rates	Natural convection of boiling liquid nitrogen
(3) Electrical Operating Conditions	None required except for tensile apparatus
(4) Internal Pressure	None

g. Number of Tests Planned

Five tests during CY64

h. Test Designer

WANL

TEST PLAN

TEST NO. 37/W404

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile specimens of various materials

b. Test Date

August, 1964

c. Test Duration

100 hrs. (highest flux possible)

d. Test Concepts

(1) Static or Dynamic

Both - some tensile specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the tensile specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux and temperature (LN₂)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be Measured

Tensile strength and temperature

(6) Use of Data

Design of NERVA components

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

e. Environmental Conditions

(1) Temperature

Cryogenic - -320°F

(2) Neutron Exposure	10^{18} nvt, $E > 1$ mev
(3) Gamma Exposure	Not applicable
f. Experimental Conditions	
(1) Operation Procedures	Tensile specimens will be loaded into either AGC or NASA load cells which will be lowered into cryogenic dewars in the reactor pallet positions and tested to failure immediately at termination of the irradiation.
(2) Flow Rates	Natural convection of boiling liquid nitrogen
(3) Electrical Operating Conditions	None required except for tensile apparatus
(4) Internal Pressure	None
g. Number of Tests Planned	Five tests planned for CY64
h. Test Designer	WANL

TEST PLAN

TEST NO. 37/W405

1. FACILITY

Ground Test Reactor (GTR)

a. Test Item Description

Tensile Specimens of Selected Structural Materials

b. Test Date

September, 1964

c. Test Duration

200 hours (liquid nitrogen level maintained between reactor runs)

d. Test Concepts

(1) Static or Dynamic

Both - Some tensile specimens will be tested to failure (at cryogenic temperature) immediately at shutdown of the reactor; other specimens will be removed from the cryostat after irradiation, examined, and tested after various annealing treatments.

(2) Continuous or Cyclic

Continuous - the specimens will be irradiated to a predetermined exposure.

(3) Critical Operating Parameters

Neutron flux - and temperature (IN_2)

(4) Components Included

Tensile specimens and thermocouples

(5) Parameters to be Measured

Tensile strength and temperature

(6) Use of Data

Design of components for NERVA

(7) Pre- and Post-Irradiation Examination

Pre-irradiation examination: Prior to the irradiation test, control specimens will be loaded to failure in the same equipment to be used on irradiated specimens. After the irradiation and the tests on irradiated specimens, an additional quantity of control tests will be performed on the same equipment. Both irradiated and control specimens will be examined for total elongation. Selected metallographic examinations will be performed. Specimens irradiated in special rack will be examined for dimensional changes, given various annealing treatments, tested, and examined for total elongation. Selected metallographic examinations will be performed on these specimens also.

e. Environmental Conditions

(1) Temperature	Cryogenic (LN_2 - 320°F)
(2) Neutron Exposure	10^{18} nvt, $E > 1$ Mev
(3) Gamma Exposure	Not Applicable

f. Experimental Conditions

(1) Operation Procedure	Tensile specimens will be loaded into either AGC or NASA load cells and racks which will be lowered into cryogenic dewars in the reactor pallet positions and tested on failure in liquid nitrogen immediately at termination of the irradiation.
(2) Flow Rates	Natural convection of boiling liquid nitrogen
(3) Electrical Operating Conditions	None required except for tensile apparatus
(4) Internal Pressure	None

g. Number of Tests Planned

Five tests during CY64

h. Test Designer

WANL

1. FACILITY: (GETR) or (PBRF)

a. Test Item Description

NERVA fuel material, to produce fission product inventory for re-entry heating diffusion studies

b. Test Date

October 1, 1963 through September 30, 1964

c. Test Duration

15-120 minutes each

d. Test Concepts

1. Static or dynamic

Static - a sealed capsule will be irradiated with a flow of coolant water over the external surface.

2. Continuous or cyclic

Continuous - the capsules will be inserted and remain for 15 to 120 minutes until a predetermined integrated flux (nvt) is obtained and then removed from the flux region.

3. Critical Operation Parameters

a. Constant flux over the capsule length

b. Temperature of the fuel material in the center of the capsule

4. Components Included

Basic capsule, fuel material, flux monitor wires, temperature monitor wires, and thermocouple(s). (Ref: Dwg. 976D016, Rev. A)

5. Parameters to be measured

a. Temperature during irradiation

b. Neutron flux values

6. Use of data

To provide fission product release rates during re-entry heating diffusion studies

7. Pre- and Post-irradiation Examination

Pre-irradiation measurements include: weight, length, and diameter. Post-irradiation determinations include weight, length, diameter and gamma flux measurements. Other studies funded by NE 2720 will include determinations of the rate and amount of fission product diffusion in both plasmajet and laboratory oxidation test equipment which simulate fuel material re-entry conditions

e. Environmental Conditions

1. Temperature

1000°-2000°C

TEST PLAN

TEST NO. 39/W101 Cont'd

2. Neutron Exposure	$10^{15} - 10^{17}$ nvt thermal
3. Gamma Exposure	N.A.
f. Experimental Conditions	
1. Operational Procedure	The capsule will be inserted to a predetermined position according to the calibration of the trail cable, and oscillated over short time to verify position at flux peak. It will remain there for a prescribed time, be withdrawn to a position out of the flux region until it can be transferred to a storage facility. The capsule is then held until sufficient cooling time has lapsed to meet ICC shipping requirements in a 4" walled lead container
2. Flow rates	The flow of water on the external capsule surface will range from 5 to 10 gpm
3. Electrical Operation Conditions	None
4. Internal Pressure	200 psig (at operating conditions)
g. Number of Tests Planned	16 capsules or nearly 1-1/2 capsules per month
h. Test Designer	WANL

TEST PLAN

TEST NO. 39/W102

1. FACILITY: (WREC)

- a. Test Item Description
Low level irradiation of NERVA fuel to produce a fission product inventory for controlled temperature release experiments
- b. Test Date
October 1, 1963 through September 30, 1964
- c. Test Duration
Three hours in the WREC facility at 100 watts
- d. Test Concepts
 - 1. Static or dynamic
Static
 - 2. Continuous or cyclic
Continuous
 - 3. Critical operating parameters
None
 - 4. Components included
Irradiation capsules
 - 5. Parameters to be measured
None
 - 6. Use of data
Fission product inventory
 - 7. Pre- and Post-irradiation examinations
Pre-irradiation measurements include weight, length, and diameter. Post-irradiation measurements include weight, length, and diameter. Other studies funded by NE 2720 will include fission product diffusion studies under controlled conditions of temperature and environment
- e. Environmental Conditions
 - 1. Temperature
N.A.
 - 2. Neutron exposure
Approximately 10^{14} nvt
 - 3. Gamma exposure
N.A.
- f. Experimental Conditions
 - 1. Operation procedure
Capsule is inserted into irradiation tube and remains until facility is shutdown
 - 2. Flow rates
No flow
 - 3. Electrical operating conditions
None
 - 4. Internal pressures
None
- g. Number of Tests Planned
Two capsules per week are planned during the test period or about 106 capsules

h. Test Designer

WANL