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Docket No. 50-228

JUN 9 1965

Aerojet-General Nucleonics
P. O. Box 77
San Ramon, California 94583

Attention: Mr. H. W. Davis
Vice President and Assistant Secretary

Gentlemen:

Transmitted herewith is a copy of a Notice of Proposed Issuance of Facility License which is being submitted to the Office of the Federal Register for publication.

The proposed license would authorize Aerojet-General Nucleonics to possess and operate the pool-type nuclear reactor, known as the ACN Industrial Reactor, at a maximum thermal power level of 250 kilowatts at the ACN plant site near San Ramon, California.

Also enclosed is a copy of the AEC's related safety evaluation.

Sincerely yours,

Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Enclosures:

1. Federal Register Notice
2. AEC Safety Evaluation

OFFICE ▶	DRL	OGC	DRL	DRL		
SURNAME ▶	NDMason:bjy		Boyd/Case	REDoan		
DATE ▶	6/25/65		6/25/65	6/29		

UNITED STATES ATOMIC ENERGY COMMISSION

DOCKET NO. 50-228

AEROJET-GENERAL NUCLEONICS

NOTICE OF PROPOSED ISSUANCE OF FACILITY LICENSE

Notice is hereby given that unless a request for a hearing is filed with the U. S. Atomic Energy Commission ("the Commission") by Aerojet-General Nucleonics ("the licensee"), or a petition for leave to intervene is filed by any person whose interest may be affected, as provided by and in accordance with the Commission's "Rules of Practice," 10 CFR 2, within fifteen days after publication of this notice in the Federal Register, the Commission proposes to issue a facility license substantially in the form set forth below. The proposed license would authorize the licensee to possess and operate a pool-type nuclear reactor at a maximum thermal power level of 250 kilowatts at the AGN plant site near San Ramon, California. Construction of the reactor was authorized by Construction Permit No. CPRR-86 issued April 16, 1965.

Prior to issuance of the license the reactor will be inspected by representatives of the Commission to determine whether a finding can be made that the reactor has been constructed in accordance with the provisions of Construction Permit No. CPRR-86.

The Commission has found that:

1. The application complies with the requirements of the Atomic Energy Act of 1954, as amended, and the Commission's regulations set forth in Title 10, Chapter 1, CFR;
2. There is reasonable assurance that (i) the activities authorized by this license can be conducted at the designated location without endangering the health and safety of the public, and (ii) such

activities will be conducted in compliance with the rules and regulations of the Commission;

3. The licensee is technically and financially qualified to engage in the proposed activities in accordance with the Commission's regulations;
4. The issuance of this license will not be inimical to the common defense and security or to the health and safety of the public.

For further details with respect to this proposed license, see (1) the license application dated September 14, 1964, and supplements thereto dated December 23, 1964, February 19, 1965, and April 9, 1965, (2) a related safety evaluation prepared by the Research and Power Reactor Safety Branch of the Division of Reactor Licensing and (3) the Technical Specifications referred to as Appendix A to the proposed facility license, all of which are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C. A copy of item (2) above may be obtained at the Commission's Public Document Room, or upon request addressed to the Atomic Energy Commission, Washington, D. C. 20545, Attention: Director, Division of Reactor Licensing.

FOR THE ATOMIC ENERGY COMMISSION

Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Dated at Bethesda, Maryland
this 9th day of June, 1965.

AEROJET-GENERAL NUCLEONICS

DOCKET NO. 50-228

PROPOSED FACILITY LICENSE

1. This license applies to the pool-type nuclear reactor, known as the AGN Industrial Reactor (hereinafter "the reactor") which is owned by Aerojet-General Nucleonics (hereinafter "the licensee"), located at the AGN plant site near San Ramon, California and described in the application dated September 14, 1964, and supplements thereto dated December 23, 1964, February 19, 1965 and April 9, 1965 (hereinafter "the application").
2. Subject to the conditions and requirements incorporated herein, the Atomic Energy Commission (hereinafter "the Commission") hereby licenses Aerojet-General Nucleonics:
 - A. Pursuant to Section 104c of the Atomic Energy Act of 1954, as amended, (hereinafter "the Act") and Title 10, CFR, Chapter 1, Part 50, "Licensing of Production and Utilization Facilities," to possess, use and operate the reactor as a utilization facility at the designated location at the AGN plant site near San Ramon, California;
 - B. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 70, "Special Nuclear Material," to receive, possess and use up to 2.6 kilograms of contained uranium-235 in connection with operation of the reactor;
 - C. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 30, "Licensing of Byproduct Material," (1) to receive, possess and use a 2-curie americium-beryllium neutron source for reactor startup and (2) to possess, but not to separate, such byproduct material as may be produced by operation of the reactor.

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3. This license shall be deemed to contain and be subject to the conditions specified in Section 50.54 of Part 50, Section 70.32 of Part 70 and Section 30.32 of Part 30 of the Commission's regulations, and to be subject to all applicable provisions of the Act and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified below:

A. Maximum Power Level

The licensee is authorized to operate the reactor at thermal power levels up to a maximum of 250 kilowatts.

B. Technical Specifications

The Technical Specifications contained in Appendix A to this license (hereinafter the "Technical Specifications") are hereby incorporated in this license. The licensee shall operate the reactor only in accordance with the Technical Specifications. No changes shall be made in the Technical Specifications unless authorized by the Commission as provided in 10 CFR 50.59.

C. Authorization of Changes, Tests, and Experiments

The licensee may (1) make changes in the reactor as described in the hazards summary report, (2) make changes in the procedures as described in the hazards summary report, and (3) conduct tests or experiments not described in the hazards summary report only in accordance with the provisions of Section 50.59 of the Commission's regulations.

D. Reports

In addition to reports otherwise required under this license and applicable regulations:

- 3 -

- (1) The licensee shall report in writing to the Commission within 10 days of its observed occurrence any incident or condition relating to the operation of the facility which prevented or could have prevented a nuclear system from performing its safety function as described in the Technical Specifications or in the hazards summary report.
- (2) The licensee shall report to the Commission in writing within 30 days of its observed occurrence any substantial variance disclosed by operation of the facility from performance specifications contained in the hazards summary report or the Technical Specifications.
- (3) The licensee shall report to the Commission in writing within 30 days of its occurrence any significant change in transient or accident analysis, as described in the hazards summary report.

E. Records

In addition to those otherwise required under this license and applicable regulations, the licensee shall keep the following records:

- (1) Reactor operating records, including power levels.
- (2) Records of in-pile irradiations.
- (3) Records showing radioactivity released or discharged into the air or water beyond the effective control of the licensee as measured at the point of such release or discharge.
- (4) Records of emergency reactor scrams, including reasons for emergency shutdowns.

4. This license is effective as of the date of issuance and shall expire at midnight April 16, 2005.

FOR THE ATOMIC ENERGY COMMISSION

R. L. Doan, Director
Division of Reactor Licensing

Date of Issuance:

SAFETY EVALUATION BY THE RESEARCH AND POWER REACTOR SAFETY BRANCH

DIVISION OF REACTOR LICENSING

IN THE MATTER OF

AEROJET-GENERAL NUCLEONICS

DOCKET NO. 50-228

PROPOSED OPERATING LICENSE

Introduction

Aerojet-General Nucleonics, by application dated September 14, 1964, requested authorization to construct and operate a 250-Kw research reactor at its plant site near San Ramon, California. On the basis of this application and amendments thereto dated December 23, 1964 and February 19, 1965, a Construction Permit was issued on April 16, 1965. Further information, dated April 9, 1965, on operational matters was submitted by Aerojet-General Nucleonics in further support of its application to operate the reactor. A proposed set of Technical Specifications was also included in the April 9, 1965 submittal.

Discussion

The reactor core, fueled with enriched uranium mixed with zirconium hydride and clad in aluminum, was described in detail in our Safety Evaluation dated March 23, 1965. The site, reactor facility, control system, experimental facilities and waste disposal were also discussed in our earlier evaluation. The applicant has since described his critical experiment and power calibration procedures which we believe to be adequate and acceptable. An evaluation of the instrumentation system follows below.

During normal operation there are a minimum of four channels of nuclear instrumentations connected to the automatic safety system as follows:

- Channel #1, proportional counter, period protection
- Channel #2, compensated ion chamber, period protection
- Channel #3, uncompensated ion chamber, level protection
- Channel #4, uncompensated ion chamber, level protection

During critical assembly, two additional proportional counters and one additional uncompensated ion chamber provide information for subcritical multiplication measurements.

During startup all four channels are operative. A low-level interlock within Channel #1 prevents startup unless an on-scale neutron level signal is present. Channel #1 safety functions, including the aforementioned interlock, are automatically bypassed by action of the Log N circuits of Channel #2 when reactor power reaches the intermediate level. This occurrence also activates a low level interlock within Channel #3 which will initiate a scram unless Channel #3 is sufficiently upscale.

- 2 -

The output of each nuclear safety channel is fed to a bistable trip circuit. Each trip circuit in turn controls an individual relay and deenergizes that relay when its scram set point is reached. The relay contacts are connected in series with the safety rod magnets and interrupt magnet current when any safety channel trips.

Three parallel-connected contacts at the manual scram switch are ganged and connected in series with a relay, one contact of which is connected in series with the magnets. Three additional contacts, individually operated, are connected in series with the respective magnets. This arrangement gives the operator the option of scrambling the rods simultaneously or one at a time.

All nuclear safety circuits including, and downstream of, the trip amplifiers are fail safe with respect to the loss of voltage. The downscale (low-level) interlocks within Channels #1 and #3 protect against such voltage loss upstream of their trip amplifiers. Further, each of the ion chamber power supplies for Channels 2, 3, and 4 is separately monitored, and a scram will occur if a voltage loss is detected at any one of them.

A scram can be initiated through the automatic safety system by two parameters not associated with the nuclear instrumentation; a scram will result if the pool water temperature rises above the set point or if an earthquake of magnitude IV on the modified Mercalli scale occurs.

The safety system has been designed such that no single failure can simultaneously disable both the automatic and manual scram circuits and we believe that both nuclear and process safety system instrumentation is sufficient and capable of providing safe operation through all proposed power ranges.

Technical Specifications

The applicant submitted a proposed set of Technical Specifications as noted above and has developed these, in conjunction with the staff, into a document which we believe to be sufficient to assure safe operation of the facility at thermal power levels up to 250 Kw.

Conclusion

Based on our evaluation of the application as outlined herein and as set forth in our evaluation dated March 23, 1965, we believe that the reactor may be operated as described without undue hazard to the health and safety of the public.

Original signed by:
Roger S. Boyd

Roger S. Boyd, Chief
Research & Power Reactor Safety Branch
Division of Reactor Licensing

Date: JUN 9 1965

APPENDIX A

TO LICENSE NO. R-98

TECHNICAL SPECIFICATIONS

FOR THE

AEROJET-GENERAL NUCLEONICS INDUSTRIAL REACTOR (AGNIR)

1.0 Site

The reactor and associated equipment is located within an exclusion area at the Aerojet-General Nucleonics plant on a tract near San Ramon, California.

A steel, locked perimeter fence shall surround the AGNIR facility, forming an exclusion area. The minimum distance from the center of the reactor pool to the boundary of the exclusion area fencing shall be 50 feet. The restricted area, as defined in 10 CFR 20, shall consist of the entire exclusion area.

The principal activities carried on within the exclusion area shall be those associated with the operation of the AGNIR reactor and the use of a hot cell and chemistry laboratory.

2.0 Containment

The reactor shall be housed in a steel building capable of meeting the following functional requirements: (1) all circulating fans and air conditioning systems shall have the capability to be shut off from a single control in the control room, (2) ventilation shall be achieved by gravity ventilators located on the roof of the building, and (3) a positive air pressure shall be maintained in the control room with respect to the reactor room.

3.0 Reactor Pool and Primary System

The minimum depth of water above the top of the active core shall be 16 ft. The maximum bulk water temperature shall be 130°F and the minimum 60°F.

The primary coolant shall be sampled at least once each month and the samples analyzed for pH and conductivity. Corrective action shall be taken to avoid exceeding a pH of 7.5 or a conductivity of 5 umho/cm.

The radioactive materials contained in the pool water shall be such that the radiation level one meter above the surface of the pool shall be less than 10 mr/hr and shall be checked periodically during operation.

4.0 Reactor Core

4.1 Fuel Elements

- (1) Type
- (2) Fuel alloy
- (3) Enrichment
- (4) Fuel loading

TRIGA pin
 8% uranium-92% zirconium hydride
 20 wt% U-235 nominal
 [REDACTED] gm U-235/pin, 3.3 kg maximum loading

- | | |
|-----------------------------------|---|
| (5) Cladding | 0.30 in. thick aluminum |
| (6) Fuel matrix diameter | █ in. |
| (7) Fuel matrix length | █ in. |
| (8) Graphite end-reflector length | 4.0 in. top and bottom |
| (9) Diameter of clad element | █ in. |
| (10) Total fuel element length | █ in. |
| (11) Burnable poison | two 0.05 in. thick samarium oxide wafers per pin. |

The reactor shall not contain in excess of 90 fuel elements. The core shall be loaded with not more than 3.30 kg of U-235. The maximum excess reactivity above cold, clean critical, without any experiments in place, shall be 3 dollars.

The bath coefficient shall be negative at all operating temperatures. The prompt temperature coefficient shall be negative and have a minimum absolute value of 0.5 cents/°F.

The coolant void coefficient of reactivity shall have a minimum average negative value across the active core of 30 cents/1% void. Maximum in-core operating void shall be 10% of the coolant core volume.

The burnable poison shall have a maximum total reactivity worth of 2.25 dollars and shall be contained within the fuel cladding.

4.2 Reflector Elements

- | | |
|---|--------------------------|
| (1) Cladding | 0.030 in. thick aluminum |
| (2) Over-all reflector element dimensions | Same as fuel element |

4.3 Control Elements

- | | |
|--|------------------------------------|
| (1) Guide material | aluminum |
| (2) Poison | boron carbide, powdered |
| (3) Containment material | aluminum |
| (4) Type | 1 safety, 1 shim, and 1 regulating |
| (5) Over-all length | 20 in. |
| (6) Outside diameter and cladding thickness: | |
| Shim and Safety | 1.25 in. x 0.065 in. |
| Regulating | 0.875 in. x 0.058 in. |
| (7) Minimum guide tube clearance | 0.062 in. |

The reactor shall be subcritical by a minimum margin of 0.50 dollars when the maximum worth rod is fully withdrawn from the core.

The maximum rate of reactivity addition for the control rods shall be 11 cents/second. There shall be a minimum of three operable control elements.

The total time for insertion of the control rods following receipt of a scram signal by the safety system shall be a maximum of 600 milliseconds.

4.4 Control Element Drives

(1) Vertical travel	15 in.
(2) Drive speed	19 in/minute, maximum
(3) Drive type	rack and pinion
(4) Position indication	Helipot to servo-driven register
(5) Drive to element connection	electromagnet
(6) Position accuracy	± 0.02 inches

4.5 Neutron Source

(1) Type	americium-beryllium
(2) Unit source size	4×10^6 n/sec
(3) Source holder	aluminum dummy element

5.0 Reactor Safety Systems

The reactor safety system shall include sensing devices and associated circuits which automatically actuate visual and audible alarms and, when certain pre-set limits are exceeded, scram the reactor. The systems shall be fail-safe (de-energizing shall cause a scram). Table 1 describes the minimum requirements of the safety system. The nuclear, process and radiation monitoring instrumentation shall provide the functions and have the set point ranges and associated annunciations listed in Table 2 of these specifications.

The safety system shall be designed such that no single component failure or circuit fault shall simultaneously disable both the automatic and manual scram circuits.

A minimum of two channels of the nuclear instrumentation listed in Table 1 shall be on scale, providing meaningful information, through all power levels. Reactor sequences, interlocks and safety circuits shall remain operative while fuel is in the core except that one channel may be removed for maintenance purposes when the reactor is shut down.

Interlocks shall prevent safety rod withdrawal unless all of the following conditions exist: (a) The master switch is in the ON position; (b) The safety system has been reset (a scram condition does not appear on the annunciator); (c) All four nuclear instruments channels are in the OPERATE mode; (d) The startup channel count rate is greater than 2 cps. It shall not be possible to withdraw more than the safety rod until it has reached the upper limit interlock, at which time either the shim or regulating rod may be moved, but only one at a time.

During a critical experiment, subcritical multiplication plots shall be obtained from at least three instrumentation channels. These channels may be used in addition to the normal operating instrumentation in Table 1.

Process instrumentation with readout in the control room shall be provided to permit continuous indication of pool water temperature and conductivity. In addition,

alarms shall be provided to indicate high water radioactivity, low water flow, low pool water and improper location of the crane bridge. Scrams shall result from high pool water temperature and seismic shock parameters.

A fixed gamma monitor employing Geiger tube detectors shall be located on the wall connecting the control room and reactor room. This monitor shall serve as both an area radiation monitor and an accidental criticality alarm and will annunciate in the control room and guard station and actuate a siren within the building on high radiation level. The monitor shall have a minimum range of 0 to 20 mr/hr.

During reactor operation, a gas sample shall be continuously withdrawn from the roof vent above the reactor and pumped through a shielded gas chamber. The gas chamber shall be monitored by a beta-gamma detector which shall have a continuous readout in the control room. An annunciator shall indicate when the gas exceeds normal background levels.

A fission product water monitor shall be attached to the process water cleanup system loop adjacent to the demineralizer and shall provide continuous indication in the control room. High radiation levels within the demineralizer or pool water shall annunciate an audible alarm on the reactor console. The range of the monitor shall be from 0.1 to 100 mr/hr.

Portable survey instruments for measuring beta-gamma dose rates in the range of 0.01 mr/hr to 50 r/hr shall be available at the facility. Portable instruments for measuring fast and thermal neutron dose rates from 0.1 mrem/hr to 1.0 rem/hr shall also be available. Radiation detector packets containing a series of threshold detectors shall be placed at several locations within the reactor building for post-accident radiation analyses.

6.0 Experimental Facilities

6.1 Large-Component Irradiation Box

A large-component irradiation box shall have a maximum volume of 8 cu. ft. and accept components not larger than a cube 2 ft. on a side. The box shall encompass approximately an 120° arc of the core and shall be designed so that it can be placed no closer than 5 cm to the outer row of active fuel elements.

The box shall be secured by bolts to a platform to prevent uncontrolled movement of the box. The platform shall be positioned remotely relative to the reactor core by means of a drive nut and lead screw. Positive mechanical stops shall prevent moving the experiment box into the active reactor core. CO₂ shall be used for purging and to maintain a slight positive pressure in the box relative to the pool water pressure.

To remove or install the experiment box, the platform shall be moved two or more feet away from the reactor core. The box shall then be lowered onto the platform and bolted in place with remote handling equipment. The voided box shall be purged of air prior to exposure to neutrons.

6.2 Other Irradiation Facilities

The central 7 fuel elements of the reactor may be removed from the core and a central irradiation facility installed provided the cross-sectional area of the facility does not exceed 16 in².

Two triangular exposure facilities are available which shall allow the insertion of circular experiments to a maximum of 2.35 in. diameter or triangular experiments to a maximum of 3.0 in. on a side.

A dry glory hole facility can be located in any reactor core position. The glory hole shall accept capsules to a maximum of 1.35 in. in diameter. The glory hole shall be purged with CO₂ and an internal shield plug inserted during reactor operation.

Irradiation capsules in the shape of dummy fuel elements shall have a maximum inner void volume of 34 cu. in. in the active fuel region.

6.3 Experiment Limitations

An "experiment" as used in this section shall be construed to mean any apparatus, device, or material installed in or near the core which is not a component of the core. Experiments shall be evaluated in the most reactive credible condition.

The documentation of experiments, which shall be reviewed and approved prior to insertion in the reactor, shall include at least: (1) the purpose of the experiment, (2) a description of the experiment, and (3) an analysis of the possible hazards associated with the performance of the experiment.

The value of the reactivity worth of any single independent experiment shall not exceed 2 dollars. If such experiments are connected or otherwise related so that their combined reactivity could be added to the core simultaneously, their combined reactivity shall not exceed 2 dollars.

The reactivity worth of any single independent experiment not rigidly fixed in place shall not exceed 1 dollar. If such experiments are connected or otherwise related so that their combined reactivity could be added to the core simultaneously, their combined reactivity worth shall not exceed 1 dollar.

No experiment shall be installed in the reactor in such a manner that it could shadow the nuclear instrumentation system monitors.

No experiment shall be installed in the reactor in such a manner that a failure could interfere with the insertion of a reactor control element.

No experiment shall be performed involving materials which could (1) credibly contaminate the reactor pool causing corrosive action on the reactor components or experiments, (2) cause excessive production of airborne radioactivity, or (3) produce a violent chemical reaction.

Experiments shall not be performed involving equipment whose failure could credibly result in fuel element damage. Explosive materials such as gunpowder, dynamite, TNT or nitroglycerine shall not be irradiated in the reactor facility.

The amount of special nuclear material contained in an experiment shall be limited to 5 grams in the form of solid samples.

Experiments having moving parts shall be designed to have reactivity insertion rates less than 10 cents/sec except that moving parts worth less than 5 cents may be oscillated at higher frequencies.

7.0 General Operating Limitations

Reactor operation shall be permitted only when two or more personnel are in the reactor building, at least one of whom is a licensed Operator.

The reactor shall not be operated wherever there are significant defects in fuel elements, control rods or control circuitry.

Upon occurrence of abnormal operation of the reactor, including its controls, safety systems and auxiliary systems, action shall be taken immediately to secure the safety of the facility and determine the cause of the abnormal behavior.

8.0 Fuel Storage and Transfer

The fuel storage pits located in the floor of the reactor room shall accommodate a maximum of 19 fuel elements ($\sim$ 700 gm U-235) in storage racks dry or flooded with water. The fuel storage pits shall be secured with a lock and chain except during fuel transfer operations.

A storage rack located on the wall of the reactor pool tank 6 ft. above the reactor floor shall accommodate a maximum of 21 elements. All of these storage facilities shall be so designed that for all conditions of moderation k_{eff} shall not exceed a value of 0.8.

A fuel handling tool shall be used in transferring fuel elements of low radioactivity between the storage pits and the reactor; a shielded fuel transfer cask shall be used for the transfer of highly radioactive fuel elements. The fuel handling tool shall remain in locked cabinet under the cognizance of the Reactor Supervisor when not authorized for use.

All fuel transfers in the reactor tank shall be conducted by a minimum staff of three men, and shall include a licensed Senior Operator and a licensed Operator. The staff members shall monitor the operation using appropriate radiation monitoring instrumentation. Fuel transfers outside the reactor tank but within the facility shall be supervised by a licensed Operator.

Not more than one fuel element shall be allowed in the facility which is not in storage or in the core lattice.

9.0 Surveillance Requirements

Any maintenance shall be performed with at least three of the four nuclear safety channels listed in Table 1 energized.

The electronic control and the process control system shall be checked for proper operation and calibration before each extended reactor operation, or at least once per day for short-term reactor operations. If maintenance or recalibration is required, it shall be performed before reactor startup proceeds.

Routine maintenance on all control and process system components shall be performed in accordance with written schedules and with written procedures.

The radiation monitoring instrumentation shall be checked for operability and proper set point each week. This procedure shall include tests of all associated alarms as applicable.

All instrument channels and radiation monitoring sensors shall be calibrated according to vendors instruction manuals at least four times per year at approximately ninety day intervals.

A test of the control elements shall be performed at least four times a year at approximately ninety day intervals. This test shall include verifying that the total scram time and rod drive rates are within the specified limits.

All fuel and control elements shall be visually inspected for evidence of pitting and corrosion once each two years and at least thirty fuel elements inspected on the odd year.

TABLE 1

NUCLEAR INSTRUMENTATION

Channel (No.)	Detector	Minimum Sensitivity	Information	Minimum Range	Information to Logic Element (Scram)
Startup (1)	BF ₃ Proportional Counter	4.5 counts/sec per n/cm ² -sec	Neutron flux, period	source level to approx. 10 watts	Period scram; (a) low count rate scram
Log N (2)	Compensated ion chamber	4 x 10 ⁻¹⁴ amp/n/cm ² -sec	Power level, period	10 ⁻² watts to 120% full power	Period scram
Linear Level Safety (3)	Uncompensated ion chamber	4.4 x 10 ⁻¹⁴ amp/n/cm ² -sec	Power level	10 ⁻¹ watts to 120% full power	High and low level ^(b) scrams
Linear Level Safety (4)	Uncompensated ion chamber	4.4 x 10 ⁻¹⁴ amp/n/cm ² -sec	Power level	10 ⁻¹ watts to 120% full power	High level scram

(a) Scrams on Channel 1 are by-passed when signal on Channel 2 ~~exceeds a fixed setting~~ similarly the high voltage is removed from the detector and the detector is shorted.

(b) Low level scram is bypassed on Channel 3 when Channel 2 is below a fixed setting.

TABLE 2
SAFETY SYSTEM FUNCTIONS

Sensor or Trip Device	No. of Switches or Sensors	Annunciator and Scram Set Point	Annunciator and Alarm Set Point
Short Period; Chs. 1, 2	2	≥ 3 sec.	
High Neutron Flux Level; Chs. 3, 4	2	$\leq 98\%$ of full scale and not greater than 120% full power	
High Temperature of Coolant Water	1	$\leq 130^{\circ}\text{F}$	
Low Pool Water Level	1		≤ 1 ft max decrease
Seismic Disturbance	1	IV on modified Mercalli Scale max.	
Bridge Crane Location	1		When located off storage position
Low Neutron Detector Voltage; Chs. 2, 3, 4	3	≥ 500 volts	
Low Source Level; Ch. 1	1	≥ 2 cps	
Loss of Instrument Power; Ch. 2, 3, 4	2	x	
Low Neutron Flux; Ch. 3	1	$\geq 5\%$ of full scale	
Area Radiation Monitor	1		≤ 10 mr/hr
Water Radioactivity	1		≤ 20 mr/hr
Demineralizer Water Flow	1		≥ 4 gpm
Building Gas Effluent Monitor	1		≤ 2 mr/hr
Master Key Switch	1	Not on "ON" position	
Manual Scram Button	1	Button Depressed	

Docket No. 50-228

JUN 9 1965

Aerojet-General Nucleonics
P. O. Box 77
San Ramon, California 94583

Attention: Mr. H. W. Davis
Vice President and Assistant Secretary

Gentlemen:

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Sincerely yours,

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R.L. Doan

R. L. Doan, Director
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2. There is reasonable assurance that (i) the activities authorized by this license can be conducted at the designated location without endangering the health and safety of the public, and (ii) such

activities will be conducted in compliance with the rules and regulations of the Commission;

3. The licensee is technically and financially qualified to engage in the proposed activities in accordance with the Commission's regulations;
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FOR THE ATOMIC ENERGY COMMISSION



R. L. Doan, Director
Division of Reactor Licensing

Dated at Bethesda, Maryland
this 9th day of June, 1965.

AEROJET-GENERAL NUCLEONICS

DOCKET NO. 50-228

PROPOSED FACILITY LICENSE

1. This license applies to the pool-type nuclear reactor, known as the AGN Industrial Reactor (hereinafter "the reactor") which is owned by Aerojet-General Nucleonics (hereinafter "the licensee"), located at the AGN plant site near San Ramon, California and described in the application dated September 14, 1964, and supplements thereto dated December 23, 1964, February 19, 1965 and April 9, 1965 (hereinafter "the application").
2. Subject to the conditions and requirements incorporated herein, the Atomic Energy Commission (hereinafter "the Commission") hereby licenses Aerojet-General Nucleonics:
 - A. Pursuant to Section 104c of the Atomic Energy Act of 1954, as amended, (hereinafter "the Act") and Title 10, CFR, Chapter 1, Part 50, "Licensing of Production and Utilization Facilities," to possess, use and operate the reactor as a utilization facility at the designated location at the AGN plant site near San Ramon, California;
 - B. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 70, "Special Nuclear Material," to receive, possess and use up to 2.6 kilograms of contained uranium-235 in connection with operation of the reactor;
 - C. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 30, "Licensing of Byproduct Material," (1) to receive, possess and use a 2-curie americium-beryllium neutron source for reactor startup and (2) to possess, but not to separate, such byproduct material as may be produced by operation of the reactor.

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3. This license shall be deemed to contain and be subject to the conditions specified in Section 50.54 of Part 50, Section 70.32 of Part 70 and Section 30.32 of Part 30 of the Commission's regulations, and to be subject to all applicable provisions of the Act and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified below:

A. Maximum Power Level

The licensee is authorized to operate the reactor at thermal power levels up to a maximum of 250 kilowatts.

B. Technical Specifications

The Technical Specifications contained in Appendix A to this license (hereinafter the "Technical Specifications") are hereby incorporated in this license. The licensee shall operate the reactor only in accordance with the Technical Specifications. No changes shall be made in the Technical Specifications unless authorized by the Commission as provided in 10 CFR 50.59.

C. Authorization of Changes, Tests, and Experiments

The licensee may (1) make changes in the reactor as described in the hazards summary report, (2) make changes in the procedures as described in the hazards summary report, and (3) conduct tests or experiments not described in the hazards summary report only in accordance with the provisions of Section 50.59 of the Commission's regulations.

D. Reports

In addition to reports otherwise required under this license and applicable regulations:

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- (1) The licensee shall report in writing to the Commission within 10 days of its observed occurrence any incident or condition relating to the operation of the facility which prevented or could have prevented a nuclear system from performing its safety function as described in the Technical Specifications or in the hazards summary report.
- (2) The licensee shall report to the Commission in writing within 30 days of its observed occurrence any substantial variance disclosed by operation of the facility from performance specifications contained in the hazards summary report or the Technical Specifications.
- (3) The licensee shall report to the Commission in writing within 30 days of its occurrence any significant change in transient or accident analysis, as described in the hazards summary report.

E. Records

In addition to those otherwise required under this license and applicable regulations, the licensee shall keep the following records:

- (1) Reactor operating records, including power levels.
- (2) Records of in-pile irradiations.
- (3) Records showing radioactivity released or discharged into the air or water beyond the effective control of the licensee as measured at the point of such release or discharge.
- (4) Records of emergency reactor scrams, including reasons for emergency shutdowns.

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4. This license is effective as of the date of issuance and shall expire at midnight April 16, 2005.

FOR THE ATOMIC ENERGY COMMISSION

R. L. Doan, Director
Division of Reactor Licensing

Date of Issuance:

SAFETY EVALUATION BY THE RESEARCH AND POWER REACTOR SAFETY BRANCH

DIVISION OF REACTOR LICENSING

IN THE MATTER OF

AEROJET-GENERAL NUCLEONICS

DOCKET NO. 50-228

PROPOSED OPERATING LICENSE

Introduction

Aerojet-General Nucleonics, by application dated September 14, 1964, requested authorization to construct and operate a 250-Kw research reactor at its plant site near San Ramon, California. On the basis of this application and amendments thereto dated December 23, 1964 and February 19, 1965, a Construction Permit was issued on April 16, 1965. Further information, dated April 9, 1965, on operational matters was submitted by Aerojet-General Nucleonics in further support of its application to operate the reactor. A proposed set of Technical Specifications was also included in the April 9, 1965 submittal.

Discussion

The reactor core, fueled with enriched uranium mixed with zirconium hydride and clad in aluminum, was described in detail in our Safety Evaluation dated March 23, 1965. The site, reactor facility, control system, experimental facilities and waste disposal were also discussed in our earlier evaluation. The applicant has since described his critical experiment and power calibration procedures which we believe to be adequate and acceptable. An evaluation of the instrumentation system follows below.

During normal operation there are a minimum of four channels of nuclear instrumentations connected to the automatic safety system as follows:

- Channel #1, proportional counter, period protection
- Channel #2, compensated ion chamber, period protection
- Channel #3, uncompensated ion chamber, level protection
- Channel #4, uncompensated ion chamber, level protection

During critical assembly, two additional proportional counters and one additional uncompensated ion chamber provide information for subcritical multiplication measurements.

During startup all four channels are operative. A low-level interlock within Channel #1 prevents startup unless an on-scale neutron level signal is present. Channel #1 safety functions, including the aforementioned interlock, are automatically bypassed by action of the Log N circuits of Channel #2 when reactor power reaches the intermediate level. This occurrence also activates a low level interlock within Channel #3 which will initiate a scram unless Channel #3 is sufficiently upscale.

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The output of each nuclear safety channel is fed to a bistable trip circuit. Each trip circuit in turn controls an individual relay and deenergizes that relay when its scram set point is reached. The relay contacts are connected in series with the safety rod magnets and interrupt magnet current when any safety channel trips.

Three parallel-connected contacts at the manual scram switch are ganged and connected in series with a relay, one contact of which is connected in series with the magnets. Three additional contacts, individually operated, are connected in series with the respective magnets. This arrangement gives the operator the option of scrambling the rods simultaneously or one at a time.

All nuclear safety circuits including, and downstream of, the trip amplifiers are fail safe with respect to the loss of voltage. The downscale (low-level) interlocks within Channels #1 and #3 protect against such voltage loss upstream of their trip amplifiers. Further, each of the ion chamber power supplies for Channels 2, 3, and 4 is separately monitored, and a scram will occur if a voltage loss is detected at any one of them.

A scram can be initiated through the automatic safety system by two parameters not associated with the nuclear instrumentation; a scram will result if the pool water temperature rises above the set point or if an earthquake of magnitude IV on the modified Mercalli scale occurs.

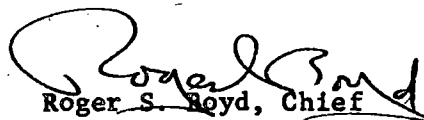
The safety system has been designed such that no single failure can simultaneously disable both the automatic and manual scram circuits and we believe that both nuclear and process safety system instrumentation is sufficient and capable of providing safe operation through all proposed power ranges.

Technical Specifications

The applicant submitted a proposed set of Technical Specifications as noted above and has developed these, in conjunction with the staff, into a document which we believe to be sufficient to assure safe operation of the facility at thermal power levels up to 250 Kw.

Conclusion

Based on our evaluation of the application as outlined herein and as set forth in our evaluation dated March 23, 1965, we believe that the reactor may be operated as described without undue hazard to the health and safety of the public.



Roger S. Boyd, Chief
Research & Power Reactor Safety Branch
Division of Reactor Licensing

Date: JUN 9 1965