Distribution
Document Room
Formal
Supplemental
DRL Reading
R&PRSB Reading
Originator: NDMason
bcc: H. J. McAlduff, OROO
E. G. Case
H. Shapar
L. Kornblith (2)
E. E. Hall
D. C. Clark
E. Tremmel
N. Stoner
R. Huard
G. Page, encl. only
D. Skovholt, encl. only

JUL 2 1965

Docket No. 50-228

Aerojet-General Nucleonics
A Division of Aerojet-General Corporation
P. O. Box 77
San Ramon, California 94583

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

Gentlemen:

The Atomic Energy Commission has issued Facility License No. R-98 to Aerojet-General Corporation authorizing operation of its pool-type nuclear reactor known as the AGN Industrial Reactor at a maximum thermal power level of 250 kilowatts at the AGN plant site near San Ramon, California. Enclosed are copies of the license and a related notice which has been submitted to the Office of the Federal Register for publication.

Also enclosed are two copies of Amendment No. 4 to Indemnity Agreement No. B-2. One copy of the amendment to the indemnity agreement should be signed by you and returned to this office at your earliest convenience.

Sincerely yours,
Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Enclosures:
1. License No. R-98
2. Federal Register Notice
3. Amendment No. 4 to Indemnity Agreement No. B-2

OFFICE ▶	DRL	OGC	RR SLR	SLR	DRL	DRL
SURNAME ▶	NDMason:bjy		RHuard	ERPrice	Boyd/Case	RLDoan
DATE ▶	6/29/65	6/30/65		7/1/65	7/1	7/2

UNITED STATES ATOMIC ENERGY COMMISSION

DOCKET NO. 50-228

AEROJET-GENERAL CORPORATION

NOTICE OF ISSUANCE OF FACILITY LICENSE

Please take notice that no request for a formal hearing having been filed following publication of the notice of proposed action in the Federal Register, the Atomic Energy Commission has issued Facility License No. R-98 to Aerojet-General Corporation, authorizing operation of the pool-type nuclear reactor, known as the AGN Industrial Reactor, at a maximum thermal power level of 250 kilowatts at the AGN plant site near San Ramon, California.

The license, as issued, is substantially as set forth in the Notice of Proposed Issuance of Facility License published in the Federal Register on June 12, 1965, 30 FR 7674, except that Subparagraph 2.B has been changed to authorize the licensee to receive, possess and use up to 5.0 kilograms instead of 2.6 kilograms of contained uranium-235 in connection with operation of the reactor and the name of the licensee has been changed from Aerojet-General Nucleonics to Aerojet-General Corporation, as requested in the amendment to the license application dated June 21, 1965.

FOR THE ATOMIC ENERGY COMMISSION

Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Dated at Bethesda, Maryland
this 2nd day of July, 1965.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AEROJET-GENERAL CORPORATION

DOCKET NO. 50-228

FACILITY LICENSE

License No. R-98

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 Corporation (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, April 9, 1965, and June 21, 1965 (hereinafter "the application").

2. Subject to the conditions and requirements incorporated herein, the Atomic Energy Commission (hereinafter "the Commission") hereby licenses Aerojet-General Corporation:

   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 5.0 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.

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:

(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

Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Attachment:
Appendix A, Technical Specifications

Date of Issuance: JUL 2 1965

JUL 2 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	TRIGA pin
(2)	Fuel alloy	8% uranium-92% zirconium hydride
(3)	Enrichment	20 wt% U-235 nominal
(4)	Fuel loading	[redacted] gm U-235/pin, 3.3 kg maximum loading

(5)	Cladding	0.30 in. thick aluminum
(6)	Fuel matrix diameter	[redacted] in.
(7)	Fuel matrix length	[redacted] in.
(8)	Graphite end-reflector length	4.0 in. top and bottom
(9)	Diameter of clad element	[redacted] in.
(10)	Total fuel element length	[redacted] 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. CO_2 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 in^2.

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 CO_2 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 appartus, 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.

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	4×10^{-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	4.4×10^{-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	4.4×10^{-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	$\geq$ 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°F	
Low Pool Water Level	1		$\leq$ 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	$\geq$ 500 volts	
Low Source Level; Ch. 1	1	$\geq$ 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		$\leq$ 10 mr/hr
Water Radioactivity	1		$\leq$ 20 mr/hr
Demineralizer Water Flow	1		$\geq$ 4 gpm
Building Gas Effluent Monitor	1		$\leq$ 2 mr/hr
Master Key Switch	1	Not on "ON" position	
Manual Scram Button	1	Button Depressed	

REDACTED FOR PUBLIC RELEASE

CONCURRENCE COPY

REDACTED FOR PUBLIC RELEASE

DOCKET NOS. 70-891
50-32
50-228

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AMENDMENT TO INDEMNITY AGREEMENT NO. B-2

AMENDMENT NO. 4

Effective JUL 2 1965, Indemnity Agreement No. B-2 between Aerojet-General Nucleonics and the Atomic Energy Commission dated May 17, 1962, as amended, is hereby further amended as follows:

Delete the name "Aerojet-General Nucleonics" wherever it appears in the agreement, as amended, and substitute in lieu thereof the name "Aerojet-General Corporation".

Delete Item 3 of the Attachment to the indemnity agreement in its entirety and substitute the following therefor:

Item 3 - License number or numbers

R-10, R-29, R-32, R-34, R-35, R-39, R-42, R-44, R-45, R-50, SNM-863, and R-98.

Item 4 of the Attachment to the indemnity agreement is amended by adding the following:

Item 4 - Location

With respect to License No. R-98

"The Nuclear Test Laboratory Building excluding the Laboratory Area, Hot Cell, Hot Cell Service Area, Hot Cell Operating Area and the Hot Change Room on the licensee's plant site located about one-half mile east of San Ramon, California."

FOR THE UNITED STATES ATOMIC ENERGY COMMISSION

Original signed by
Eber Price

____
Eber R. Price, Director
Division of State and Licensee Relations

DISTRIBUTION:
Public Document Room
Formal
Supplemental
bcc: Roger Huard, DSLR
Paul Travelstead, OC
Joseph Scinto, OGC
Compliance

Accepted ____________________, 1965

By ______________________________

CONCURRENCES:

DSLR	OGC	DSLR
LPRHuard:bsp		ERPrice
6/ 29/65	/ /65	/ /65

REDACTED FOR PUBLIC RELEASE

REDACTED FOR PUBLIC RELEASE

JUL 2 1965

Docket No. 50-228

Aerojet-General Nucleonics
A Division of Aerojet-General Corporation
P. O. Box 77
San Ramon, California 94583

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

Gentlemen:

The Atomic Energy Commission has issued Facility License No. R-98 to Aerojet-General Corporation authorizing operation of its pool-type nuclear reactor known as the AGN Industrial Reactor at a maximum thermal power level of 250 kilowatts at the AGN plant site near San Ramon, California. Enclosed are copies of the license and a related notice which has been submitted to the Office of the Federal Register for publication.

Also enclosed are two copies of Amendment No. 4 to Indemnity Agreement No. B-2. One copy of the amendment to the indemnity agreement should be signed by you and returned to this office at your earliest convenience.

Sincerely yours,

Original Signed By
R.L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Enclosures:
1. License No. R-98
2. Federal Register Notice
3. Amendment No. 4 to Indemnity Agreement No. B-2

REDACTED FOR PUBLIC RELEASE

UNITED STATES ATOMIC ENERGY COMMISSION

DOCKET NO. 50-228

AEROJET-GENERAL CORPORATION

NOTICE OF ISSUANCE OF FACILITY LICENSE

Please take notice that no request for a formal hearing having been filed following publication of the notice of proposed action in the Federal Register, the Atomic Energy Commission has issued Facility License No. R-98 to Aerojet-General Corporation, authorizing operation of the pool-type nuclear reactor, known as the AGN Industrial Reactor, at a maximum thermal power level of 250 kilowatts at the AGN plant site near San Ramon, California.

The license, as issued, is substantially as set forth in the Notice of Proposed Issuance of Facility License published in the Federal Register on June 12, 1965, 30 FR 7674, except that Subparagraph 2.B has been changed to authorize the licensee to receive, possess and use up to 5.0 kilograms instead of 2.6 kilograms of contained uranium-235 in connection with operation of the reactor and the name of the licensee has been changed from Aerojet-General Nucleonics to Aerojet-General Corporation, as requested in the amendment to the license application dated June 21, 1965.

FOR THE ATOMIC ENERGY COMMISSION

R. L. Doan

R. L. Doan, Director
Division of Reactor Licensing

Dated at Bethesda, Maryland
this 2nd day of July, 1965.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AEROJET-GENERAL CORPORATION

DOCKET NO. 50-228

FACILITY LICENSE

License No. R-98

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 Corporation (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, April 9, 1965, and June 21, 1965 (hereinafter "the application").

2. Subject to the conditions and requirements incorporated herein, the Atomic Energy Commission (hereinafter "the Commission") hereby licenses Aerojet-General Corporation:

   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 5.0 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.

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:

(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

R. L. Doan, Director
Division of Reactor Licensing

Attachment:
Appendix A, Technical Specifications

Date of Issuance: JUL 2 1965

JUL 2 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	TRIGA pin
(2)	Fuel alloy	8% uranium-92% zirconium hydride
(3)	Enrichment	20 wt% U-235 nominal
(4)	Fuel loading	[redacted] gm U-235/pin, 3.3 kg maximum loading

(5)	Cladding	0.30 in. thick aluminum
(6)	Fuel matrix diameter	[redacted] in.
(7)	Fuel matrix length	[redacted] in.
(8)	Graphite end-reflector length	4.0 in. top and bottom
(9)	Diameter of clad element	[redacted] in.
(10)	Total fuel element length	[redacted] 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. CO_2 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 in^2.

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 CO_2 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 appartus, 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.

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.

REDACTED FOR PUBLIC RELEASE

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	$\geq$ 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	$\leq 130^{o}F$	
Low Pool Water Level	1		$\leq$ 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	$\geq$ 500 volts	
Low Source Level; Ch. 1	1	$\geq$ 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		$\leq$10 mr/hr
Water Radioactivity	1		$\leq$20 mr/hr
Demineralizer Water Flow	1		$\geq$4 gpm
Building Gas Effluent Monitor	1		$\leq$ 2 mr/hr
Master Key Switch	1	Not on "ON" position	
Manual Scram Button	1	Button Depressed	

REDACTED FOR PUBLIC RELEASE

REDACTED FOR PUBLIC RELEASE Formal

Docket Nos. 50-32
50-228
70-891

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AMENDMENT TO INDEMNITY AGREEMENT NO. B-2

AMENDMENT NO. 4

Effective JUL 2 1965, Indemnity Agreement No. B-2 between Aerojet-General Nucleonics and the Atomic Energy Commission dated May 17, 1962, as amended, is hereby further amended as follows:

Delete the name "Aerojet-General Nucleonics" wherever it appears in the agreement, as amended, and substitute in lieu thereof the name "Aerojet-General Corporation".

Delete Item 3 of the Attachment to the indemnity agreement in its entirety and substitute the following therefor:

Item 3 - License number or numbers

R-10, R-29, R-32, R-34, R-35, R-39, R-42, R-44, R-45, R-50, SNM-863, and R-98.

Item 4 of the Attachment to the indemnity agreement is amended by adding the following:

Item 4 - Location

With respect to License No. R-98

"The Nuclear Test Laboratory Building excluding the Laboratory Area, Hot Cell, Hot Cell Service Area, Hot Cell Operating Area and the Hot Change Room on the licensee's plant site located about one-half mile east of San Ramon, California."

FOR THE UNITED STATES ATOMIC ENERGY COMMISSION

Original signed by
Eber Price

Eber R. Price, Director
Division of State and Licensee Relations

Accepted ______________, 1965

By ______________________

REDACTED FOR PUBLIC RELEASE

REDACTED FOR PUBLIC RELEASE

Formal Docket Nos. 50-32
50-228
70-891

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AMENDMENT TO INDEMNITY AGREEMENT NO. B-2

AMENDMENT NO. 4

Effective JUL 2 1965, Indemnity Agreement No. B-2 between Aerojet-General Nucleonics and the Atomic Energy Commission dated May 17, 1962, as amended, is hereby further amended as follows:

Delete the name "Aerojet-General Nucleonics" wherever it appears in the agreement, as amended, and substitute in lieu thereof the name "Aerojet-General Corporation".

Delete Item 3 of the Attachment to the indemnity agreement in its entirety and substitute the following therefor:

Item 3 - License number or numbers

R-10, R-29, R-32, R-34, R-35, R-39, R-42, R-44, R-45, R-50, SNM-863, and R-98.

Item 4 of the Attachment to the indemnity agreement is amended by adding the following:

Item 4 - Location

With respect to License No. R-98

"The Nuclear Test Laboratory Building excluding the Laboratory Area, Hot Cell, Hot Cell Service Area, Hot Cell Operating Area and the Hot Change Room on the licensee's plant site located about one-half mile east of San Ramon, California."

FOR THE UNITED STATES ATOMIC ENERGY COMMISSION

Original signed by
Eber Price

Eber R. Price, Director
Division of State and Licensee Relations

Accepted ______________, 1965

By ______________________

REDACTED FOR PUBLIC RELEASE

[redacted] REDACTED FOR PUBLIC RELEASE

[redacted] Formal Docket No. 70-891
50-32
50-228

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AMENDMENT TO INDEMNITY AGREEMENT NO. B-2

AMENDMENT NO. 4

Effective JUL 2 1965, Indemnity Agreement No. B-2 between Aerojet-General Nucleonics and the Atomic Energy Commission dated May 17, 1962, as amended, is hereby further amended as follows:

Delete the name "Aerojet-General Nucleonics" wherever it appears in the agreement, as amended, and substitute in lieu thereof the name "Aerojet-General Corporation".

Delete Item 3 of the Attachment to the indemnity agreement in its entirety and substitute the following therefor:

Item 3 - License number or numbers

R-10, R-29, R-32, R-34, R-35, R-39, R-42, R-44, R-45, R-50, SNM-863, and R-98.

Item 4 of the Attachment to the indemnity agreement is amended by adding the following:

Item 4 - Location

With respect to License No. R-98

"The Nuclear Test Laboratory Building excluding the Laboratory Area, Hot Cell, Hot Cell Service Area, Hot Cell Operating Area and the Hot Change Room on the licensee's plant site located about one-half mile east of San Ramon, California."

FOR THE UNITED STATES ATOMIC ENERGY COMMISSION

Original signed by
Eber Price

Eber R. Price, Director
Division of State and Licensee Relations

Accepted ____________, 1965

By ____________________

REDACTED FOR PUBLIC RELEASE