College of Engineering

Morgantown, West Virginia
26506

September 27, 1979

West Virginia University

Mr. William Gammill
Acting Assistant Director for Operating
Reactor Projects
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Re: License R-58, Docket No. 50-129

Dear Mr. Gammill:

In conformance with 10CFR50 and Regulatory Guide 1.86, West Virginia University requests the following:

1. That NRC authorize the University to dismantle the AGN-211P (Serial No. 103) Reactor according to the Dismantling Plan presented below.

2. That NRC authorize the University to temporarily store the reactor fuel and graphite reflector elements, control and safety rods, rod drive assembly, air monitor, water demineralizer, ion chamber and BF_3 detectors, steel core and rod drive assembly structural supports including the core grid plate, and the control console at the reactor site.

3. That NRC authorize the University to dispose of all reactor hardware other than that cited in Item 2. without further restriction. This would primarily include the graphite thermal column, steel water tank, and concrete shielding blocks.

4. That NRC authorize removal of any and all restrictions on future University uses for disposition of the reactor high-bay area room.

5. That prior to expiration of the current Possession Only license on June 19, 1980, NRC authorize one of the following:

   a. Shipment of all components cited in Item 2. to a suitably licensed party.

   b. Shipment of fuel to Oak Ridge and disposal of all other components in Item 2. without further restriction.

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6. That the referenced NRC license be terminated upon completion of Items 1. through 5.

Justification

The AGN-211P reactor at West Virginia University has not been operated since February 1971. In early 1972, it was decided to apply for a Possession Only type license from the Atomic Energy Commission with the ultimate objective being disposal and transfer of the reactor to an interested and suitably licensed party. A Possession Only license was granted via Amendment No. 6 to the referenced license on June 13, 1973. Through the years, the University has attempted without success to effect transfer of the reactor to Northwestern University, the University of Missouri, and North Texas State University. At this time, only North Texas State University remains a viable client; however, they have yet to secure the necessary permits to possess and construct the reactor.

West Virginia University now has a rapidly expanding fossil fuel based energy research program funded by numerous Federal and State supported research grants and contracts. Space for research facilities is at a premium, and the AGN-211P Reactor high-bay area is desperately needed to accommodate research activities. We are at the stage where certain research activities may have to be reduced in scope or even cancelled if proper laboratory facilities cannot be developed. In this context, the University requests that reactor dismantling, disposal, and license termination be approved in two major steps:

1. Immediate NRC authorization and approval be granted for Items 1. through 4. This would free the reactor room (high-bay area) for construction of urgently needed energy research facilities. Rationales and procedures to accomplish this will be noted below.

2. Upon completion of Items 1. through 4., either Item 5a. or 5b. be carried out prior to the June 19, 1980 license expiration date (Amendment No. 7 to referenced license), and that Item 6. be effected, i.e. license termination.

Details concerning each of the requested items now follow:

Item 1. - Dismantling Plan

The AGN-211P Reactor (Serial No. 103) in its original operating configuration consisted of a matrix array of 12 fuel elements and 30 graphite reflector elements standing vertically in a steel grid plate. This core matrix was situated at the bottom of a 10' deep water-filled rectangular steel tank, having 5' x 5' cross-sectional

dimensions and walls approximately 5/8" thick. Four control-safety rod boral-stainless steel blades were vertically inserted into spaces between fuel elements in the core. These rods were electromagnetically coupled to rod drive mechanisms, and were spring loaded to permit greater than "1g" acceleration into the core under scram conditions. A 1" diameter "glory hole" tube also penetrated the center of the core to permit access of various foil and sample materials to the region of maximum neutron flux. When operating, the reactor had a maximum licensed power of 75 watts.

Surrounding and abutting the steel tank is a 4' thick concrete block biological shield. The tank and shield blocks rest on a reinforced floor level concrete pad. There is an opening through one side of this shield to permit placement of a 5' thick graphite thermal column (approximately 170 ft^3 of graphite in all). This thermal column is in turn shielded on its outer face by an 18" thick moveable sliding concrete shield.

The reactor facility proper is located in Rooms B-31 and G-31 in the basement of Hodges Hall on the Downtown Campus of West Virginia University. This room combination, constituting the reactor high-bay area, has a floor dimension of 25' x 20' and a height of 24'. There are three access doors to the high-bay area. Two of the doors which lead to hallways in Hodges Hall cannot be unlocked from the outside. Entrance can only be attained by entering Room B-30 (formerly the location of the reactor control console which is now stored in B-31) and then proceeding through a locked internal access door from Room B-30 to Room B-31. Access to the high-bay area is controlled by the University Radiation Safety Office, administered by Dr. Stephen T. Slack, University Radiation Safety Officer.

For reference purposes, an "overhead" view of the fuel-reflector element matrix configuration is presented in Figure 1., and a sketch of a typical reactor fuel element is shown in Figure 2. The fueled portion of the fuel element consists of a solid homogeneous mixture of 20% enriched UO_2 pellets fused in a polyethylene moderator. Total ^{235}U loading for the 12 fuel elements in the core is 800 grams. Each fuel element has 2 7/8" x 3" cross-sectional dimensions and an overall length of 30 1/4".

The history of activities at the AGN-211P Reactor site since the cessation of reactor operations in February 1971 is as follows. In February 1972, electrical power to safety and control rod drive motors was disconnected. A Possession Only license for the reactor was issued to West Virginia University on June 13, 1973 via Amendment No. 6 to License R-58, Docket No. 50-129---with an expiration date of June 19, 1979. On April 25, 1974, Mr. Don Burke (AEC-Atlanta) arrived unannounced at the University for an AGN-211P Reactor facility inspection. Through a lack of satisfactory communication channels at the University, we were unaware

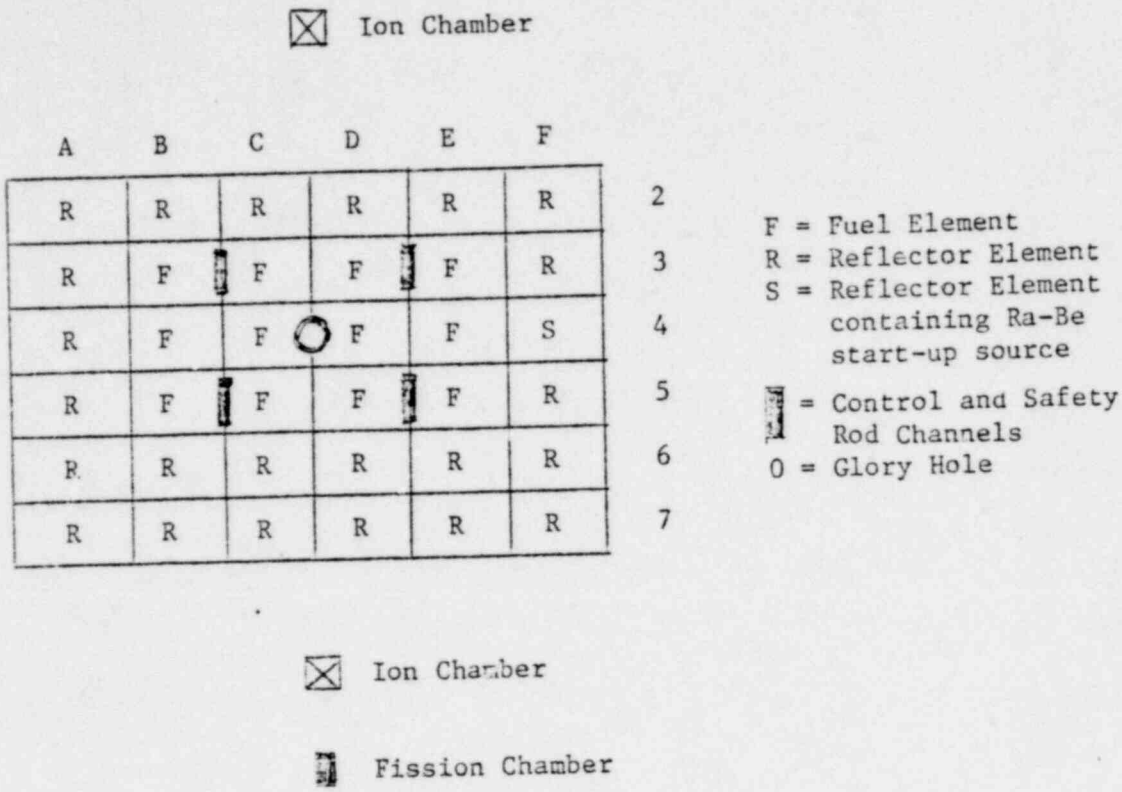

Figure 1. Overhead View of AGN-211P Reactor Fuel and Reflector Element Matrix Showing Location of Neutron-Power Level Detectors

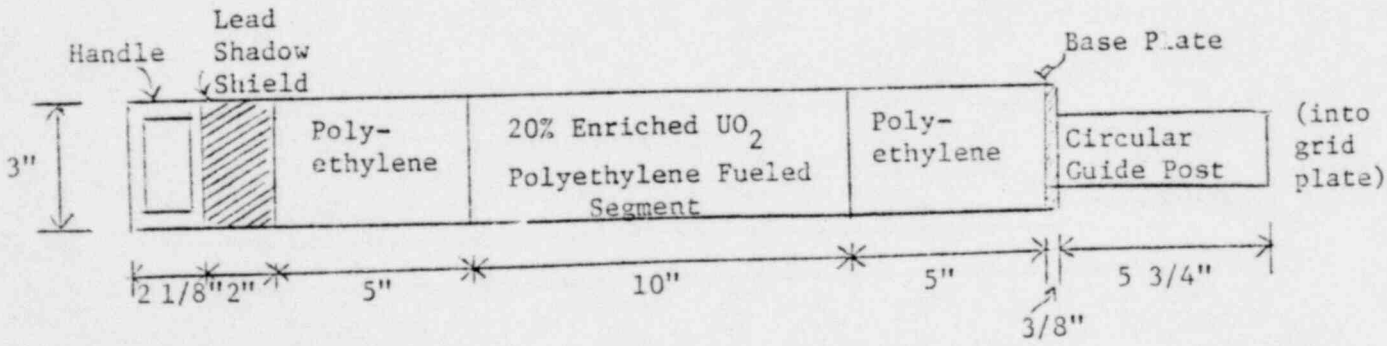

Figure 2. Side View of AGN-211P Reactor Fuel Element

that the Possession Only license had been granted; and, in fact, were cited for several items of non-compliance. The foremost item of non-compliance was that steps to absolutely guarantee subcriticality and inoperability of the reactor had not been taken. Basically, we had not been aware that official permission had been given under the Possession Only license to remove fuel and/or reflector elements to put the core in a subcritical configuration.

On April 25, 1975, fuel elements D-4 and E-4 were removed from the core in Mr. Burke's presence (Refer to Figure 1. for element identification). These were wipe tested and survey monitored. At-surface survey meter readings on the fuel elements were 4.0 mR/hr.* and wipe tests showed surface contamination to be less than 1000dpm/100 cm^2. Fuel elements D-4 and E-4 were doubly-wrapped and sealed in 4 mil thick polyethylene sheet and stored in a locked 1/4" thick steel box located in the high-bay area next to the concrete block shield. (Access to the storage box is controlled by the University Radiation Safety Office.) In addition to removing the fuel elements, all mechanical linkages between the rod drive motors and the control and safety rods were removed. Calculations assured us that the reactor was less than 0.25% $\Delta k/k$ subcritical with the fuel elements removed. In fact, the removal of one fuel element was sufficient to assure subcriticality with all rods out of the core.

On July 19, 1978, element F-4, which is a graphite reflector element containing the neutron start-up neutron source, was removed from the reactor. It was vertically braced in the center of a 55 gallon covered plastic drum which was filled with water, and stored in Room 132 of Hodges Hall. Calculations indicated and neutron survey meter readings verified that the maximum neutron dose rate at the outer perimeter of the drum was 10 mrem/hr. Room 132 was formerly a radioisotopes storage vault utilized by the Department of Physics. Its inner floor dimensions are 8' x 10' with a ceiling height of 10'. The walls are 2' thick high density concrete. Access to the vault, again controlled solely by the Radiation Safety Office, is through a 2 1/8" thick solid oak door with a 1/4" thick lead plate running through its middle. The door is key locked, and can also be bolt locked and secured using a heavy duty Master lock or its equivalent. It should be noted that the isotopes vault is not presently being used for radioactive materials storage, other than the neutron start-up source which is presently located in it.

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*Although it is difficult assess accurately, a conservative estimate would be that the reactor sporadically operated at 75 watts power for 100 hours per year over a 12-year period. Translating this to a continuous operation of the order of one watt per year for 12 years, followed by a shutdown period of 8.5 years, gives a present ^{235}U activity of 55 μCi/gm. This is approximately 20 times higher than the natural radioactivity of ^{235}U.

On July 25 and 27, 1979 the remaining ten fuel elements were removed from the core, wipe tested, and stored in two 55 gallon sealed steel drums in the reactor high-bay area. We interpreted this to be permissible under Conditions 2.C.(3) and 2.C.(4) of Amendment No. 6 of the referenced license which read:

> Condition 2.C.(3) "The reactor shall be changed by removal of fuel element(s) and, if required, graphite reflectors such that the reactor is at least 0.25% $\Delta k/k$ subcritical with all control rods fully withdrawn from the core."
>
> Condition 2.C.(4) "Fuel element(s) removed from the core shall be stored in a locked enclosure within the facility and the key for this enclosure shall be under the control of the person responsible for administration of the reactor."

Removal of two fuel elements had guaranteed 0.25% $\Delta k/k$ subcriticality with all rods removed. Removal of all fuel elements resulted in a $k_{eff} = 0$ core. There appeared to be no prohibition of this if the elements were stored at the reactor site.

Fuel elements C-3, C-5, D-5, E-3, and E-5 were labeled and stored in one drum; and fuel elements B-3, B-4, B-5, C-4, and D-3 were labeled and stored in the other. Each element was wipe tested, doubly wrapped in 4 mil polyethylene sheet (which was sealed with reinforced tape), and vertically placed in a 3/4" plywood matrix structure especially built to properly space and support the elements in the drums. The drum lids were modified so that they could be secured with steel bands and locked with heavy duty Yale padlocks. Keys to these locks are possessed by Dr. G. Lansing Blackshaw, Acting Reactor Director and Dr. Stephen Slack, University Radiation Safety Officer. Wipe tests of all removed fuel elements indicated removeable contamination of well under 1000dpm/100 cm^2. Radiation surveys at the outside surface of the drums presently show maximum readings of 2mR/hr.

In order to remove fuel elements B-3, B-5, E-3, and E-5, it was necessary to remove the control rods from the core. The control rod blades slide in channels attached to these elements and removal of these elements was not possible without taking out the control rods. Six fuel elements had already been extracted when the first of these elements, E-3, was removed--so the possibility of criticality was non-existent. The control blades and rod couplings to the rod drive mechanism housing were wipe tested and showed no evidence of radioactive contamination. In conjunction with removal of the control rods, the rod drive mechanism housing also had to be decoupled from the steel superstructure. At present the control blades and rod couplings are stored in the high-bay areas, whereas the rod drive mechanism housing is covered for dust protection purposes and stored in the radioisotopes storage vault. We have interpreted the storage vault (Room 132) and the high-bay area

(Rooms B-31 and G-31) in Hodges Hall to be included in the definition of the "reactor site."

To summarize, the present status of the ACN-211P Reactor is this: All fuel has been removed and is in on-site locked storage with access controlled by the Acting Reactor Director and/or the University Radiation Safety Officer. The control rods and rod drive mechanism are also stored at the reactor site, as well as the reflector element containing the neutron start-up source. The remaining 29 graphite elements are still located in the grid, under water, in the steel tank. Wipe tests have demonstrated removeable contamination of less than 1000dpm/100 cm^2 on all fuel elements. No other components show any evidence of contamination.

At this stage the University requests that disassembly of the remaining in-place reactor hardware be authorized. Wipe tests of these components (with the exception of the graphite reactor elements), radiation surveys, and monthly air and water sampling clearly indicate that there is no contamination present. Air samples indicate no measurable activity above background, which ranges from 1.0×10^{-8} µCi/l to 8.0×10^{-8} µCi/l for the Morgantown, West Virginia area---dependent upon the date the sample was taken. Water in the reactor tank has consistently shown a lack of detectable extraneous activity during the past five years, measuring the order of 10^{-5} µCi/cc, again dependent on instrument background. Reactor pool water measurements have been totally consistent with tap water samples run as blanks for comparison purposes.

Since there are no fueled components left in the reactor, we request that disassembly be permitted in an order which makes logistical sense, given the physical environment of Rooms B-31 and G-31. This would be:

a. A sump pump to transfer reactor tank water to Hodges Hall storm drains. Approximately 1500 gallons of water will be discarded.

b. Remove the graphite reflector elements.

c. Remove the ion-chamber instrumentation from the reactor tank.

d. Remove the reactor air monitor and water demineralizer.

e. Remove all reactor steel structural supports and braces attached to the reactor tank.

f. Remove the moveable concrete thermal column shield.

g. Remove the thermal column graphite.

h. Remove the steel reactor tank.

i. Remove the concrete shield blocks.

All work will be carried out under the combined supervision of the Acting Reactor Director and the Radiation Safety Office. Air monitoring and wipe tests of all components will be performed on a continuous basis. To date, the monitoring of all individuals involved with reactor fuel removal has shown that no personnel radiation exposure occurred; and checks of gloves, rags, etc. used in fuel and components handling has indicated that they are free of radioactive contamination. If evidence of contamination exists (although none is expected), all parts, components, etc. will be decontaminated to acceptable levels before they are transferred to storage or sent to disposal.

Items 2. and 3. - Storage and Disposal

In order to permit research usage of Rooms B-31 and G-31 in Hodges Hall and to allow North Texas State University sufficient time to acquire the necessary permits to possess and reconstruct the AGN-211P Reactor, it is requested that West Virginia University be allowed to store the usable and potentially transferrable components of the reactor in Room 132 Hodges Hall (the previously noted isotopes storage vault), and dispose of the non-usable components. At present the usable components are deemed to be the fuel and reflector elements, control and safety rods, rod drive assembly and housing, air monitor, water demineralizer, ion chamber and BF_3 detectors, the structural steel components, the fuel-reflector element grid plate, and the control console and cables. Disposable components are the graphite thermal column, steel water tank, and concrete shielding materials--all of which would be scrapped.

The fuel storage drums containing five fuel elements each will be placed in opposite corners on the floor of the isotopes storage vault. The metal box containing the other two fuel elements will be located in one of the other vault corners. With this arrangement, criticality would be impossible. Shelves presently exist in the room to hold the graphite reflector elements. The door to the vault will be both key-locked and bolt-locked, with the bolt lock secured with a padlock. Only the Acting Reactor Director and the Radiation Safety Officer will have keys to the vault.

A radiation hazard warning sign will be posted on the door to the storage vault. Appropriate radioactive materials tags will be placed on the fuel storage containers and the barrel holding the neutron start-up source located within the vault. An alarm system will be installed at the vault site to detect unauthorized entry.

Output from this system will be directly coupled to West Virginia University Security Police headquarters so that unauthorized intrusion into the vault would be immediately discovered. Authorized entry to Room 132 by either the Acting Director or the Radiation Safety Officer and his staff members would be preceded by a telephone call to Security Police headquarters for notification and identification purposes. A quarterly radiation and environmental survey of the vault will be performed, and results logged and reported according to the provisions of Section C.3. of Regulatory Guide 1.86.

Item 4. - Unrestricted Use of Room B-31 and G-31 Hodges Hall (High-Bay Area)

Upon storage and disposal of all reactor hardware, the high-bay area will be thoroughly wipe tested and surveyed for sources of contamination. Responsibility for this will be vested in the University Radition Safety Office, where equipment exists for this type of monitoring. Rooms B-31 and G-31 are expected to be free of contamination, as past surveys have indicated. If the final radiation survey results support this, a report will be sent to NRC as specified in Section 4 of Regulatory Guide 1.86, with a request that Rooms B-31 and G-31 be made immediately available for unrestricted use. It should be noted that the arrangement of all research equipment to be installed will be such that access to the rooms by NRC inspectors will be possible.

Item 5. - Ultimate Disposal of the Usable Reactor Components

Two options are noted here. Item 5.a. provides for the contingency that North Texas State University may still procure the necessary authorization to acquire the reactor. If so, they or any other bona fide client (in terms of proper NRC authorization) will be sent the usable components of the AGN-211P Reactor. March 1, 1980 will be the deadline date for this option to be viable. If 5.a. proves unfeasible, then Item 5.b. provides that the fuel and neutron source bearing graphite reflector element will be shipped to Oak Ridge. Any reactor components usable for non-nuclear related activities will be retained by the University, and the remainder scrapped. In either 5.a. or 5.b. the fuel will be shipped in containers approved by NRC and DOT, and in accordance with the transportation regulations of these agencies.

Item 6. - Termination of Referenced License

Following completion of either of the two options in Item 5., a final radiation survey will be made of Room 132 Hodges, the radioisotopes storage vault . If contamination exists, it will be removed to the acceptable levels as noted in Table I of Regulatory Guide 1.86; however, none is expected to occur. A report will be made

to NRC, at which time approval will be sought to terminate License R-58, Docket No. 50-129. This will be done prior to the license expiration date of June 19, 1980.

Safety Evaluation of Reactor Dismantling and Disposal

Since AGN-211P Reactor fuel has already been removed from the reactor system and stored in three separate containers, there is no danger of criticality. No significant radiation hazards other than low-level radiation at the fuel storage container surfaces have been detected to date, nor are any anticipated. Dismantling, transfer to storage, and disposal of components will be performed under the supervision of qualified, trained individuals--the Acting Reactor Director and the University Radiation Safety Officer. Gloves and film badges will be worn by all personnel participating in the dismantling operations. As noted previously, radiation monitoring procedures will be continuously carried out. All electrical connections and services to the reactor system have long since been severed, so electrical hazards are non-existent. Normal safety precautions associated with the movement of heavy materials, e. g. concrete shielding blocks, will be observed. Ultimately, all nuclear materials associated with the reactor will be removed from the University. There is some chance that certain non-contaminated components may be retained for non-nuclear use. These might include control console instrumentation, electrical cables and connectors, control rod drive motors, electromagnetic couplers, etc. This would depend upon whether an institution is found that can accept the reactor.

Environmental Impact Appraisal of Reactor Dismantling and Disposal

No changes in Hodges Hall building structure, electrical s[illegible] water lines, or sewer lines will be associated with dismant[illegible] operations. It has been noted that adequate reactor fuel component storage facilities already exist. An alarm system will have to be installed in the storage vault, Room 132 Hodges Hall. Evidence to date indicates that no radioactive contamination of the high-bay area, storage vault, or non-fuel components is to be expected. If hardware contamination does exist, it will be reduced to acceptable levels. Shipment of fuel materials will be in accordance with NRC and DOT regulations.

West Virginia University has not had use for the AGN-211P Reactor since early 1971. Future use is out of the question, and the space currently occupied by the reactor is urgently needed for energy-related activities. Dismantling and disposal costs will be borne by the University. In the event that usable components, including the fuel, can be transferred to another institutions, the costs

associated with packaging and shipment will be paid by that institution.

In brief, no significant environmental impact is anticipated.

We believe that all our activities undertaken with respect to reactor fuel and control-safety rod removal have been permissible under conditions and interpretations of License R-58, Docket No. 59-129. Expeditious NRC approval of Items 1. through 4. in this request will greatly help the University obtain laboratory facilities space which is immediately needed to properly conduct research work under existing grants and contracts. If further information is required, or you wish to discuss technical or regulatory aspects of this request, please contact Dr. G. Lansing Blackshaw, College of Engineering, West Virginia University, Morgantown, West Virginia 26506: Phone (304) 293-4821.

West Virginia University certifies that this request has been prepared in conformity with Title 10, Code of Federal Regulations, Parts 20, 50, and 70, where applicable, and NRC Regulatory Guide 1.86, where applicable. The licensee also solemnly affirms that all information contained herein is true and correct to the best of our knowledge and belief.

West Virginia University, Licensee
Morgantown, West Virginia

G. Lansing Blackshaw

G. Lansing Blackshaw
Assistant Dean of Engineering
Acting Reactor Director

Ray Koppelman

Ray Koppelman
Vice President - Energy Studies,
Graduate Programs, and Research
Chairman, University Radiological
Safety Committee

State of West Virginia

County of Monongalia

Subscribed and sworn to before me this 27th of September, 1979.

Olive F. Snyder

Notary Public

My Commission expires 11/18/86

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