70-622

PDR - return to D.C.

DEPARTMENT OF THE ARMY T. Grucci/seb/AUTOVON 284-9340

HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA. 22333

DRCSF-P/81-0012 23 April 1981

Director
Nuclear Material Safety and Safeguards
ATTN: Radioisotopes Licensing Branch
US Nuclear Regulatory Commission
Washington, DC 20555

RECEIVED APR 30 AM 9 58

Gentlemen:

Forwarded is US Army Armament Research and Development Command application for amendment to Special Nuclear Material License Number SNM-561.

This request is for additional plutonium-239, plutonium-238, and neptunium-237 as check sources and activation foils. In addition, there is a request for storage only of 1716 grams of uranium-235 in form of Material Test Reactor type fuel elements as sealed source of uranium/aluminum alloyclad in aluminum. Incl 1 to application is Army Armament Research and Development Command's response to this office's questions concerning security and criticality of uranium fuel rods in storage.

Please acknowledge receipt of correspondence on inclosed DA Form 209 Mail Reply Card.

Sincerely,

DARWIN N. TARAS
Chief, Health Physics
Safety Office

2 Incl
as

CF:
HQDA (DASG-PSP-E) WASH DC 20310
Director, DARCOM Field Safety Activity, Charlestown, IN 47111
Commander, US Army Armament Research and Development Command, ATTN: DRDAR-SF, Dover, NJ 07801

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8106010385

DEPARTMENT OF THE ARMY
US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

DRDAR-SF

20 January 1981

SUBJECT: Amendments to Nuclear Regulatory Commission (NRC) License SNM-561

Commander
US Army Materiel Development and Readiness Command
ATTN: DRCSF-E
5001 Eisenhower Avenue
Alexandria, VA 22333

1. It is requested that the ARRADCOM Dover Site NRC License SNM-561 be amended by adding to the license as follows:

a. Add 100 microcuries of Plutonium-239 (less than $2X10^{-3}$ grams).

b. Add 5 microcuries of Plutonium-238 (less than $1X10^{-6}$ grams).

c. Add 10 microcuries of Neptuniun (less than .015 grams).

d. See also para 4 below.

2. The material will be used in research and development work as well as in the health physics laboratory. The items are in the form of assorted calibration, neutron activation foils, or check sources to be used for equipment setup and for research studies. An amount beyond that which is currently on hand is requested so additional unspecified sources may be obtained for this work, as necessary in the future, without requesting further amendments. The overage is the minimal amount considered necessary, and the current inventory is noted at Inclosure 1.

3. The sources, some of which are on hand, have previously been carried on a DA authorization, since individually, each is an exempt quantity. Because this command possesses a valid special nuclear materials license and the total quantity of such materials on this installation could exceed the exempt quantity, this request is made to seek an amendment to SNM-561 to add the small amounts noted of these items to that license.

4. It is also requested that the SNM-561 License be amended to permit the storage only of U-235 for the CFX system for which a license application is being prepared by the IRT corporation of San Diego, CA on behalf of

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ARRADCOM, Dover Site. The request is for possession and storage of special nuclear material consisting of 1716 grams of Uranium-235, 93.17% enriched for a total of 1842 grams of uranium. The form is MTR (Material Test Reactor) type fuel elements: sealed source of uranium/aluminum alloyclad in aluminum.

5. This material is now being stored by the contractor at a cost to the government of $1,094 per month. However, the contractor has informed this command that he cannot retain the system or the U-235 until the license is approved. The new license application will not be able to be processed and approved in sufficient time before contractual arrangements and funds expire.

7. Since the storage site is a secure building located in the heart of a military installation, it is anticipated that there should be no problems with the storage of this material in this location until the license is approved for its installation, operation, and use.

8. This quantity of material is classified as being of moderate strategic significance. The protection described should be more than adequate for the protection of this material.

FOR THE COMMANDER:

1 Incl

ROBERT A. WALTERSCHIED
Chief, Safety Office

DEPARTMENT OF THE ARMY
US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

REPLY TO ATTENTION OF:

DRDAR-SFD

16 April 1981

SUBJECT: Amendments to Nuclear Regulatory Commission License SNM-561-ARRADCOM

Commander
US Army Materiel Development and Readiness Command
ATTN: DRCSF-P/81-0012
5001 Eisenhower Avenue
Alexandria, VA 22333

1. This letter is provided to supply additional information on "91B exempt special nuclear material" as requested in basic letter and by fonecon with T. Grucci.

2. As noted in 1st Indorsement, paragraph 1.b. beginning on line 6, there will be no 91B material placed in the building with the U-235 system which is to be added to the subject license. It should also be noted that ARRADCOM, Dover Site, does not now have, has never had, and does not now intend to acquire any 91B material.

3. Point of contact for additional information or clarification is J. McCahill, AV 880-6821.

FOR THE COMMANDER:

1 Incl
as

ROBERT A. WALTERSCHIED
Chief, Safety Office

19033

Incl 1

HQ US Army Armament Research and Development Command, Dover, NJ 07801 13 Mar 81

TO: HQ US Army Materiel Development and Readiness Command, ATTN: DRCSF-P/81-0012, 5001 Eisenhower Avenue, Alexandria, VA 22333

b. Para 1.b. refers to criticality of the system. Inclosure 1 speaks to this issue and should adequately explain that the system cannot go critical. As described, any changes to the system lessens the chance for criticality. Therefore, an exemption from the criticality alarm requirement is requested as per Regulatory Guide 8.12, position 1. Since building 2030 is completely under the control of the RPO and staff, no one can enter without our people being present. Even though other radioisotopes are present, this precludes the possibility of any other neutron emitters, including any 91 B material, being placed in the building. It also precludes the possibility of any changes to the source configuration. The CFX system will be kept intact as it arrives from the company in the storage configuration until it is properly licensed and installed in the new facility now under construction.

c. Para 1.c. refers to entrance procedures and safety measures in regards to this system. This building has been and is in use as a radioisotope storage area under control and jurisdiction of the RPO. Only he and his staff are authorized

to gain access to the building. The staff has had training and experience in, on, and with nuclear reactors during shutdown and clean up operations. As such, all personnel are thoroughly familiar with and accustomed to this type of material and the safety measures and procedures in 10 CFR 19 and 20. Also, Army regulations which must be followed, are more stringent in this regard than NRC regulations. All personnel have been correctly entering this building with its alarm system as described without incident. It is expected that this procedure will continue upon the arrival of this one additional radioactive device.

2. POC for additional information or clarification relative to the foregoing is J. McCahill, autovon 880-6821.

FOR THE COMMANDER:

1 Incl
as

ROBERT A. WALTERSCHIED
Chief, Safety Office

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA. 22333

T. Grucci/seb/AUTOVON 284-9340

S: 16 March 81

DRCSF-P/81-0012

26 February 1981

SUBJECT: Amendments to Nuclear Regulatory Commission License SNM-561-- US Army Armament Research and Development Command

Commander
US Army Armament Research
and Development Command
ATTN: DRDAR-SF
Dover, NJ 07801

1. Subject application has been reviewed and the following comments are made:

a. Insure that a movement alarm system with emergency power capability is installed on the Uranium-235 fuel element container in such a manner that neither the container with fuel elements nor the fuel elements alone may be removed without detection IAW 10 CFR 73.45(c)(1).

b. IAW 10 CFR 70.24(a) insures that the Uranium-235 fuel elements and container will always be in a safe configuration while in storage to include a safe configuration with any neighboring neutron sources (Pu-Be),* and under no circumstances allow disassembly while in storage such that an accidential criticality may occur.

c. Insure that SOP is changed and properly posted at the entrance to the storage facility with instructions to entering personnel regarding the movement alarm system and the necessary safety measures described above IAW 10 CFR Parts 19 and 20.

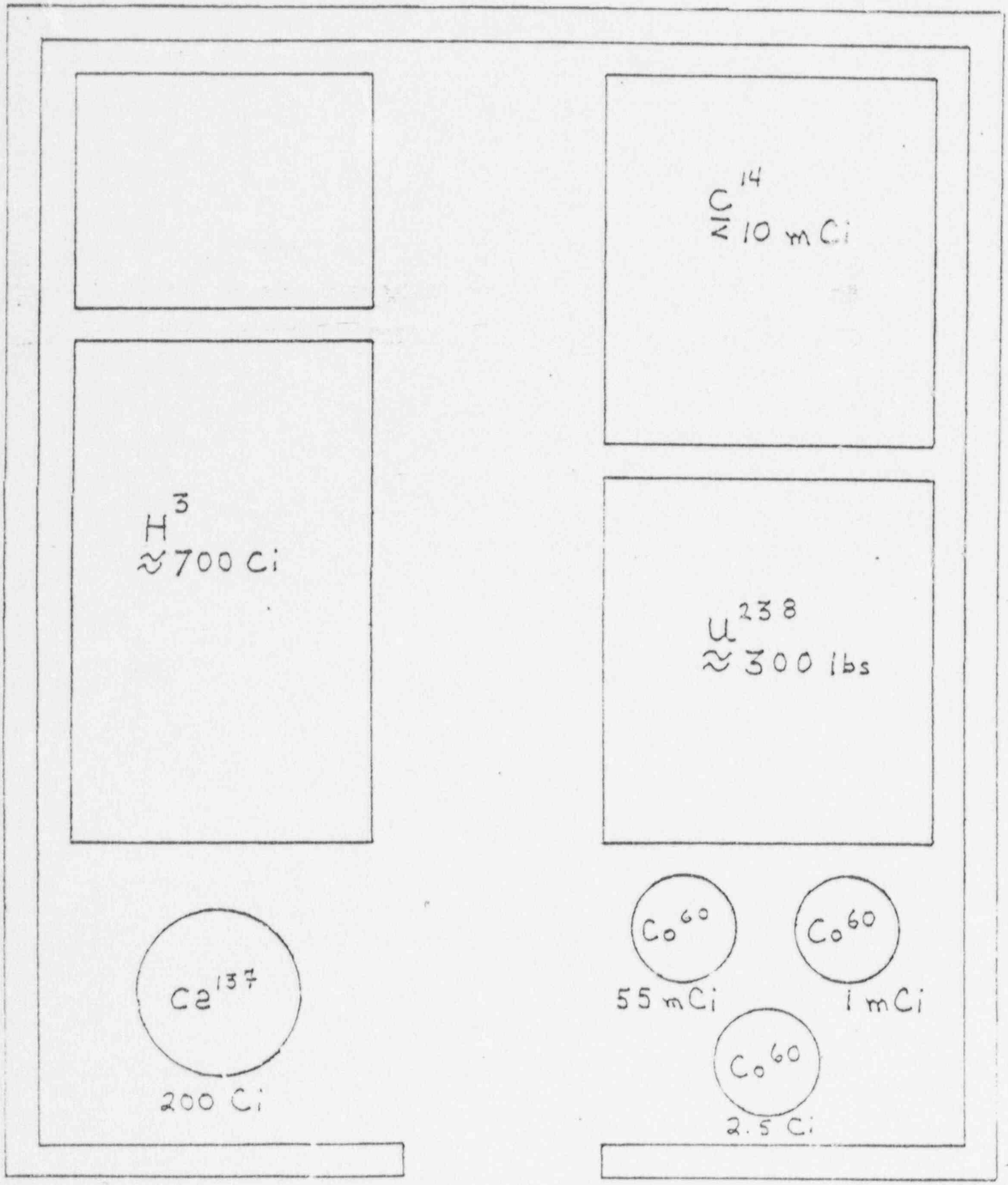
2. Upon receipt of your reply to comments, application will be forwarded to the Nuclear Regulatory Commission. Your reply is expected to reach this office by 16 March 1981.

DARWIN N. TARAS
Chief, Health Physics
Safety Office

* including any 91B exempt special nuclear materials.

BLDG 3030 APPOX: 12'X20'

RADIATION STORAGE (LONG TERM)



3. PURPOSE

3.1 SYSTEM

The special nuclear material requested by this license application is for use in a CFX Model 103, a subcritical assembly designed and constructed by IRT Corporation of San Diego, California.

The CFX is a subcritical assembly of enriched uranium surrounding a ^{252}Cf neutron source. The subcritical assembly serves as a multiplying medium to enhance the effect of the spontaneously fissioning ^{252}Cf source. The system is designed such that the effective multiplication constant (k_{eff}) is 0.990. This is the maximum k_{eff} possible; thus, the multiplier can never become a critical assembly. An assembly with this value of k_{eff} has a fission source multiplication of 100. The CFX has a thermal flux multiplication of about 28 relative to the flux from an unmultiplied ^{252}Cf source in a hydrogenous moderator. It is polyethylene moderated and reflected. The fuel is enriched uranium aluminum alloy fully clad with aluminum, a type proven in many low-power reactors over the past 20 years. The system is optimally moderated with a hydrogen-to-uranium-atom ratio so that any change in the geometric arrangement of the fuel will result in a less reactive system, and fully reflected so that reactivity changes by additional reflections are precluded. The system has a positive expansion coefficient and hence a negative temperature coefficient of reactivity. The assembly incorporates aluminum-encased cadmium plates as safety rods to provide for system shutdown, and is equipped with a backup safety system similar to that of a reactor. In addition to providing system shutdown by means of the safety rods, provision is made to remotely remove the source from the core, thus further reducing the flux level.

The system provides for activation analysis operations and neutron radiography operations. A complete description of the system and its operating characteristics is given in Section 6.

3.2 GENERAL PROGRAM

The system will be used as a tool for research and development in the area of nondestructive testing and inspection of armaments. General areas of interest include radiographic real time imaging, image enhancement, film evaluation, image transfer techniques, and investigation of neutron filter systems for special purpose radiography.

This program would be under the direction of the Quality Assurance Directorate which is responsible for assuring the quality of armaments. This device would be an adjunct to the other inspection systems used by this organization. These include a ^{252}Cf based neutron radiography system, a photon scattering gauge utilizing ^{60}Co, and a 300 keV x-ray system.

These inspection programs involve the use of radioactive materials and/or radiation producing machines and therefore come under the control of the U.S. Army Material Development and Readiness Command (DARCOM), which has recently assumed responsibility for radiation protection. Army regulations provide a system of controls from DARCOM down to local activities within the Army organization.

3.3 LOCATION OF ACTIVITIES

These programs will be carried out at the U.S. Army Armament Research and Development Command at its experimental facilities located at Picatinny Arsenal near Dover, New Jersey.

3.4 DURATION OF THE PROGRAM

This experimental program is expected to be ongoing for many years. This license is requested to be for a minimum of five (5) years.

3.5 EXEMPTIONS

Because of the nature of this device ARRADCOM specifically requests exemption from the requirements of 10 CFR 70.24.

9. SAFETY ANALYSIS

9.1 CRITICALITY

9.1.1 Installation and Fuel Loading

The fuel loading of the CFX at the ARRADCOM facility will be governed by the experimental data taken when the assembly was initially loaded at IRT Corporation. Calculations have been performed which parameterize the core, but the experimental values derived from measurements on the actual assembly determined the exact fuel loading necessary to reach a k_{eff} of 0.990. The following items were determined experimentally during the initial approach.

1. Reactivity worth of the fuel
2. Temperature expansion coefficient
3. Reactivity effect of hydrogen change in the flux trap
4. Safety rod worth
5. Reflector worth
6. Effect of materials in the activation analysis port.

All fuel-handling operations at the installation site which include initial unpackaging of fuel, initial inventory, and fuel loading will be done by IRT personnel. Once loaded, there is no need for any operation requiring the manipulation of fuel plates.

The fuel will be loaded at ARRADCOM in precisely the same configuration as it was loaded at IRT, i.e., each fuel plate will be in the same location within the core. A map has been prepared designating fuel plate position. Since the configuration of the system is the same at ARRADCOM as at IRT, the fully loaded core will have the same reactivity as measured at IRT, and the loading operation can be performed in a single step. To determine that the system is as it was at IRT, flux measurements will be made in the thermal neutron activation analysis port with the safety rods at "full in" and at intermediate positions between "full in" and "full out" prior to total withdrawal of the rods. These measurements will be compared with measurements made at IRT to assure

that a k_{eff} of 0.990 will not be exceeded with the rods fully withdrawn. These flux measurements will be made with the same detectors and associated equipment as used at IRT. In addition to the comparison of flux measurements, power level information from the linear and logarithmic channels (these are also the same as used at IRT) will be compared to further establish that the system is identical. The safety rods will not be fully withdrawn until it has been determined that the neutron flux is the same as that measured at San Diego when the reactivity was 0.990.

The fuel plates are aluminum-clad, uranium-aluminum alloy, and contain approximately 10.3 grams of ^{235}U per plate. An individual lot of fuel will consist of up to 16 full plates, which therefore are critically safe by virtue of their mass. The plates are not brittle by nature, and therefore not subject to breakage if they are dropped. It is not credible that an accident could be associated with any fuel-handling operations. There are no additional plates available, so inadvertent criticality during the on-site fuel loading program is also not considered credible.

9.1.2 Operational

The CFX design is based on a requirement to preclude any credibility of inadvertent criticality after the system has been loaded to its design reactivity and put into routine operation as a neutron radiography and activation analysis facility. This requirement means that no operating functions, such as safety rod manipulation, can cause criticality, and that all credible spontaneous non-operating changes result only in negative reactivity changes. For operational and personnel protection purposes, the CFX design incorporates a number of safety characteristics which are:

1. Nuclear safety system to detect changes in power and reactivity.
2. Optimum moderation — the system is loaded with an H/U ratio at the minimum of the critical mass versus H/U, and any composition changes increase the ^{235}U mass required for criticality.
3. Negative temperature coefficient.
4. Limited volume for activation samples.
5. Firmly obstructed radiography port.
6. Highly reflected configuration.
7. Fully clad fuel of proven safety.

Our analysis of the CFX has shown that it is not possible for the system to become critical except by the addition of more fissile material. Recognizing this, we have designed access to the system such that a critical addition cannot be made other than through the activation analysis port. Administrative operational procedures at ARRADCOM limit any fissile materials in the activation analysis samples.

Figure 9-1 shows the calculated effect of starting up the system with a critical loading and the transient effects that follow. This assumes that the period trip malfunctions and that the overpower trip is set 25 percent above full power. The total integrated yield is negligible.

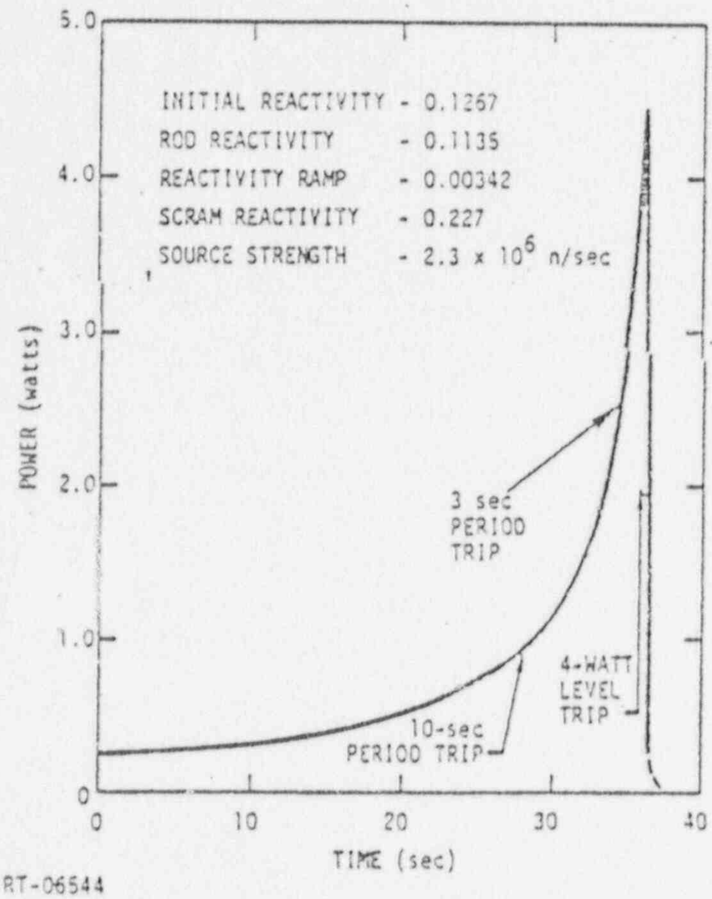


Figure 9-1. Transient power for a critical loading

Figure 9-2 is another accident scenario involving the rapid addition of plutonium into an operating system. Even with enough plutonium to cause the system to be critical the accident is negligible. Again the period trip would have caused a faster

shut down of the system. The maximum k_{eff} reached was 0.9972. The power spike is approximately twice the normal operating power and the time span is about 200 milliseconds until it is reduced to below the normal power.

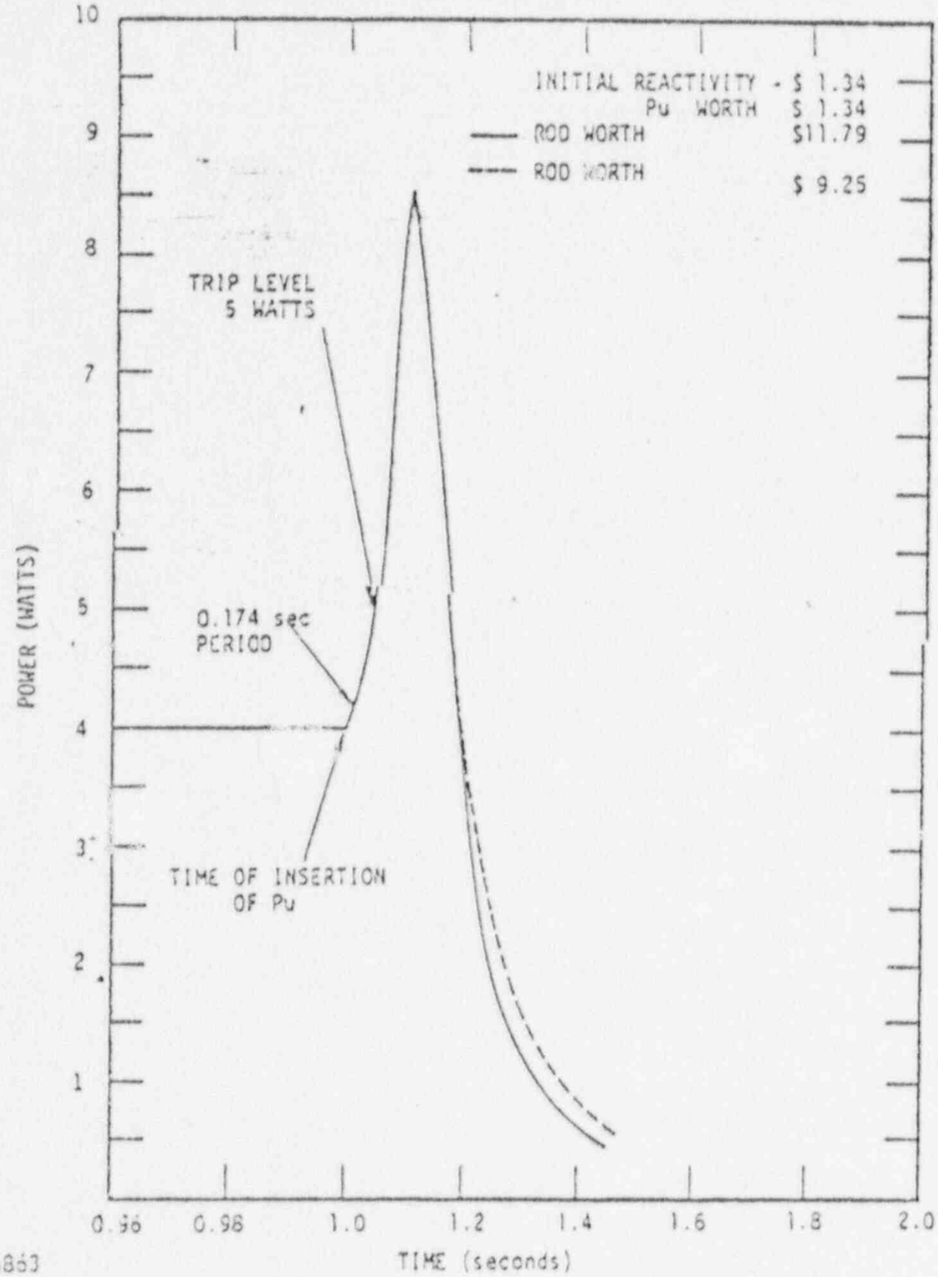


Figure 9-2. Calculated assembly power as a function of time after insertion of $1.34 worth of reactivity

6.1.1 Fuel Assembly

Figure 6-3 shows a horizontal cross section of the CFX fuel assembly and Figure 6-2 shows a partial vertical cross section of this same area. The fuel assembly consists of the flux trap with the activation analysis and radiography ports, the fuel region, the reflector, and safety rods.

6.1.1.1 Flux Trap. The control portion of the CFX fuel assembly contains the flux trap which is a small cube of high-density polyethylene. A central vertical hole provides access for a central irradiation tube to the center of the flux trap. Adjacent to the central penetration is a smaller hole which allows for insertion of the ^{252}Cf neutron source: there is a shaped horizontal penetration into the center of the flux trap which constitutes the inner portion of the radiography port.

6.1.1.2 Fuel Region. The fuel consists of MTR type fuel plates. Each plate has a 0.020-inch-thick core of uranium-aluminum alloy (93% enriched in ^{235}U) sandwiched between two 0.010-inch plates of aluminum. This type of fuel has been extensively used throughout the world at many low-power reactor facilities. The inherent safety of the plates has been proven over the past 20 years at burnups of up to 45%. The burnup over the anticipated lifetime of the CFX, even if operated continuously, is negligible.

Approximately 96% of the fuel is loaded in four rectangular boxes which are arranged as shown in Figure 6-3. The remaining fuel is loaded in a small region above and below the central flux trap. Fuel plates are separated by sheets of polyethylene such that the hydrogen-to-uranium ratio is ~425:1. This ratio was experimentally measured to be the optimum; consequently, any rearrangement of the fuel and polyethylene moderator is likely to result in a less-than-optimum ratio and a less reactive system.

Each of the four major fuel containers have a pressure plate at one end to insure that no voids exist between the fuel and the moderator plates.

The polyethylene in the moderator and flux trap will satisfactorily withstand the radiation doses accumulated for a period of at least ten years. Negligible radiation damage to the fuel will occur over this same period. Clad metallic fuel is used, since it provides for retention of fission products, particularly gaseous ones; hence, the system requires no special air monitoring or filtering.

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