



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

January 15, 1985

*Hearings  
House Comm.  
Rep. Lloyd*

The Honorable Marilyn Lloyd, Chairman  
Subcommittee on Energy Research and Production  
Committee on Science and Technology  
United States House of Representatives  
Washington, D.C. 20515

Dear Madam Chairman:

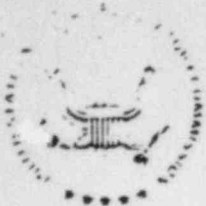
By letter dated December 17, 1984 the Commission forwarded responses to 28 of the 34 questions for the record of the hearing on Conversion of Research and Test Reactors to Low Enriched Uranium (LEU) Fuel. Responses to the remaining six questions are enclosed.

Since this hearing was conducted jointly by the Subcommittees on Energy Development and Applications and Energy Research and Production, we are also forwarding these responses to Chairman Fuqua.

Sincerely,

*Edward Fay*  
Carlton Kammerer, Director  
Office of Congressional Affairs

Enclosure:  
As stated



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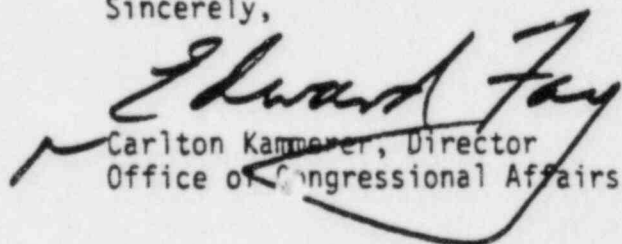
The Honorable Don Fuqua, Chairman  
Committee on Science and Technology  
United States House of Representatives  
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Dear Mr. Chairman:

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QUESTION 1A. Has the Department of State asked the NRC to promulgate a rule requiring conversion from HEU to LEU fuel? If not, why is NRC proposing to take action based, in large part, on foreign policy considerations?

ANSWER.

No. The proposed rule was issued as a follow-on to NRC's 1982 policy statement, which expressed NRC's plan to encourage that action be taken to eliminate U.S.-supplied inventories of HEU to the maximum degree possible, and to encourage further conversion efforts by foreign operators by taking appropriate regulatory steps to support similar conversion efforts by U.S. reactor operators.

While the Department of State did not ask NRC to promulgate this rule, the policy statement setting forth NRC's intention was fully coordinated with State and concurred in by State, on behalf of the Executive Branch, prior to issuance. State advised NRC, at that time, that the statement would be very useful in implementing the procedures under which U.S.-supplied inventories of HEU can be eliminated to the maximum degree possible. State also expressed the view that there should be a coherent policy respecting the use of HEU fuels in both foreign and domestic research reactors. With regard to the international implications of the proposed rule, the State Department has stated that it could have some "marginal effect" on future negotiations with foreign reactor operators on the need and timing for converting their own reactors.

In commenting on the proposed rule, State advised NRC that the criterion in the proposed rule for converting "unique purpose" reactors should be changed to exempt existing non-power lifetime core reactors, which were built before current concerns about HEU use surfaced. State noted that: (1) there are no significant nonproliferation benefits associated with conversion of lifetime core reactors since they do not add to HEU commerce, and (2) the suggested exemption would bring the domestic conversion program criteria in line with those for foreign research reactors.

QUESTION 1B. Please identify the domestic and foreign research reactors that (1) have converted to LEU fuel, (2) can now be converted to LEU fuel but haven't done so, and (3) cannot convert to LEU fuel because the technology has not been demonstrated.

ANSWER.

Based on information provided by the reduced enrichment for research and test reactors (RERTR) program at Argonne National Laboratory, it is technically feasible to convert a large fraction of non-power reactors from HEU to LEU fuel at the present time. However, the current limitations on fuel density could require major changes in fuel geometry and potential performance loss for many of the facilities. If the fuel development efforts, currently underway within the RERTR program, are successful over the next five years, the technical feasibility of converting almost all non-power reactors should be demonstrated. Furthermore, the need for changes in fuel configuration would be minimized while optimizing performance.

The Ford Nuclear Reactor at the University of Michigan and the OSIRIS (France) reactors have been fully converted to LEU fuels. Others, such as the University of Maryland and Pennsylvania State University, converted several years ago from plate-type HEU fuel to LEU TRIGA. A listing (provided by Argonne) of facilities now in the process of being converted to or testing prototype LEU fuel includes the following:

- |     |        |             |
|-----|--------|-------------|
| 1.  | RA-3   | Argentina   |
| 2.  | IEA-R1 | Brazil      |
| 3.  | JRR-4  | Japan       |
| 4.  | PRR-1  | Philippines |
| 5.  | JEN-1  | Spain       |
| 6.  | TRIGA  | Korea       |
| 7.  | TRIGA  | Mexico      |
| 8.  | TRIGA  | Austria     |
| 9.  | TRIGA  | Yugoslavia  |
| 10. | RP-0   | Peru        |
| 11. | ASTRA  | Austria     |
| 12. | FRM    | Germany     |

Other reactors in the process of a two-step conversion from HEU to 45% enriched HEU and then to 20% LEU fuels are:

- |    |         |              |
|----|---------|--------------|
| 1. | SAFARI  | South Africa |
| 2. | LAREINA | Chile        |
| 3. | JRR-2   | Japan        |
| 4. | JMTR    | Japan        |
| 5. | SAPHIR  | Switzerland  |
| 6. | KUCA    | Japan        |
| 7. | JMTRC   | Japan        |

Other reactors for which technical feasibility studies have yet to be completed are:

- |    |              |                 |
|----|--------------|-----------------|
| 1. | HFR Petten   | The Netherlands |
| 2. | HFR Grenoble | France          |
| 3. | BR-2         | Belgium         |
| 4. | R-2          | Sweden          |

Technical constraints may prevent conversion of some of these reactors to LEU fuel if current performance requirements are to be maintained.

Conversion of almost all of NRC's domestic licensees, is, or is expected to be technically feasible if the RERTR program is successful over the next five years. A report prepared for the NRC by an LEU Study Group indicated that from 3-5 facilities could be converted with today's fuel technology without significant change in core thermohydraulics. The Report also identified the University of Missouri-Columbia and the Massachusetts Institute of Technology as the only university facilities in which conversion may not be feasible without loss of core performance. High density LEU fuels are under development which could replace HEU fuels in facilities such as the Union Carbide and National Bureau of Standards reactors. However, detailed conversion studies would be required to determine whether or not such a fuel replacement would have a significant impact on the missions of these or other non-university facilities.

Conversions of approximately 40 foreign low power (less than 1 MW) facilities, generally not included in the RERTR program conversion plans, are believed to be technically feasible.

Of the larger DOE facilities, the Oak Ridge reactor will be used as the facility to test a full core of high density LEU fuel. As Mr. Kane indicated in his testimony, initiation of conversion studies for the larger DOE facilities will be based on the progress made in demonstrating the feasibility of high density LEU fuels. The NRC is not aware of any plans to convert the lower power (less than 1 MW) DOE facilities.



QUESTION 4.

Do you agree with Dr. Zebroski's comment that "reactors with lifetime cores, which nominally have much less than a kilogram [of HEU] on site, may be reasonably found to be exempt from [conversion]"?

ANSWER.

Research reactors with lifetime cores that use HEU fuel typically have more than one kilogram of HEU in the core (see also the answer to Question Number 6). The recently proposed rule published in the Federal Register would require conversion by reactor licensees with lifetime cores. The NRC is studying the appropriateness of this requirement in light of public comments (also, see the answer to Question Number 7).

QUESTION: 16. Has there ever been either a successful or unsuccessful attempt to divert HEU fuel from a domestic research and test reactor?

ANSWER.

To our knowledge there has not been either a successful or confirmed unsuccessful attempt to divert HEU fuel from an NRC licensed research and test reactor. There is a case where 20 grams of HEU was missing but later was found at the facility following police questioning.

We are aware of an individual breaking into a university reactor site. The individual was subsequently arrested and convicted of breaking and entering. We are also aware of another report of an intrusion into a building housing a university reactor.

QUESTION 23. The proposed rule defines LEU fuel as fuel in which the weight percent of Uranium-235 is less than 20 percent. What is the practical lower limit of LEU fuel before one begins to get a significant increase in plutonium production?

ANSWER.

There is no specifically defined limit of enrichment below which plutonium production becomes significant. Consideration of plutonium production depends on a number of variables including power level, operating cycle, as well as fuel enrichment.

The production of plutonium will be relatively higher in lower enrichment fuel. For example, a 20 MWth research reactor using 10 to 20% enriched uranium would generate about 0.5 kg. of plutonium per year. In contrast, a 20 MWth research reactor fueled by natural uranium would produce about 5 kg. of plutonium per year. A practical lower limit for plutonium production has not been established. However, it should be noted that HEU is directly usable for weapons purposes, while plutonium obtained from spent reactor fuel would require chemical processing of the reactor fuel to extract plutonium.



QUESTION 31. What has the Department of State told you about their position on this issue?

ANSWER.

In the issue of license amendments, the Department of State has commented that, based on its international experience with RERTR participants, the U.S. will need to be sensitive to licensing and funding issues associated with proposals to convert non-power reactors. We plan to take these factors into account in our review of the proposed rule.

On the issue of conversion in general, please see answer to Question 1A.

QUESTION 32. What has DOE told you about the availability of LEU fuel for all domestic research and test reactors?

ANSWER.

DOE has indicated that they are encouraging the medium power research reactors that refuel on a regular basis to consider conversion to the use of LEU fuel as HEU fuel is expended. Attempts are underway to develop a standard fuel plate which meets the needs of the affected facilities. DOE's Oak Ridge reactor will be used to test a full core of high density silicide fuel; however, as Mr. Kane of DOE indicated in his testimony, initiation of conversion studies for DOE facilities will be based on progress made in demonstrating the feasibility of high density LEU fuels.