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February 15, 1962

Mr. A. A. Wells, Director
Division of International Affairs
US Atomic Energy Commission
Washington 25, D.C.

Dear Algie,

As requested, a closer investigation of the process, program and timing of our criticality experiments has been made. I have prepared a brief document concerning the Dijon criticality equipment and the suggested experimental program which would be conducted with the highly enriched uranium hexafluoride that we are requesting under our bilateral agreement. I am sending you herewith three copies of this document.

Very sincerely yours,

F. de Laage de Meux

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FRENCH CRITICALITY EXPERIMENTAL PROGRAM

The criticality experiments for which highly enriched uranium is requested by the CEA will be conducted at the criticality plant recently built at the Dijon site. The preparation of the facilities should be completed early next year for a possible beginning of the experiments in March 1963. The experimental program would cover basic research in the field of criticality and would last between eighteen months and three years.

The Dijon criticality plant

A criticality plant has been built in the Dijon Center and is now about completed.

The plant comprises two main buildings : the so-called "administrative building" and the technical building : communication from one to the other is possible exclusively through the dressing-rooms (see enclosed drafts).

The administrative building contains the offices and general services : electronics and physics laboratories, mechanical shop, stores, heaters, water purification.

The dressing-building contains

- on the first floor, the dressing-rooms themselves, a room for the control of irradiation and contamination of the personnel and a first-aid facility for injured or contaminated personnel;

- in the basement, the electricity generators, air compressors and inactive liquid storages;

- on the second floor, the air conditioning blowers.

The technical building is equipped with two experimental cells areas. The East area will be used exclusively for plutonium experiments and comprises two cells (Nº 9.02.1 and 9.02.2 on the draft), 30 ft wide, 40 ft long and 33 ft high. The West area will be reserved for enriched uranium experiments and comprises one big cell (Nº 9.02.3 and 4) which is 63 ft long, 40 ft wide and

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33 ft high. Each cell of the East area is provided with a smaller cell in which auxiliaries may be installed. The West cell is equipped with two such small cells.

The walls of the cells are made of 58" thick ordinary concrete and the ceilings have a minimum thickness of 28".

During the experiments, the cell openings are closed with concrete sliding doors.

Sectional casings can be built inside the cells with standard 7 x 7 ft plates ; the maximum size of such a casing would be 26 x 50 x 26 ft. These casings will be used as containments for the experimental equipments.

In front of each cell, there is a decontamination room which can be connected to the casing by means of a closed passageway.

The control rooms are adjacent to the cells on their southern side.

Space is provided between the cells for preparation and analysis laboratories.

The air fliters are on the second floor of the technical building.

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The construction of the plant is almost completed (see attached pictures). A laboratory for preparation and recycling of plutonium solutions is presently being equipped.

The first plutonium experiments will start next September. Their objective will be to study various containers (full or hollow cylinders, plates, etc...) with or without reflector and separately or as a group. Hollow cylinders will be studied first.

Experimental procedure

In order to maintain the hexafluoride in its initial form, it seems that the best way is to operate on liquid blends of UF_6 and HF. The variations of blending, pressure and temperature, which can be easily controlled, will allow to make the H/U_{235} ratio vary in a considerable scale of magnitude.

The consequence of such a process is that the experiments have to be conducted at a relatively high temperature (which may exceed 100°C) and at high pressure (which may exceed 10 atmos

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The experimental vessel, a sphere, or more probably a cylinder, will be made of an autoclave and will be equipped with a heating device (probably circulation of a hot gas in a double casing). This vessel will be placed in a tank in which hot water can be poured and maintained at a given temperature : this will consitute the reflector.

After introduction in the vessel of known quantities of UF_6 and HF, the temperature will be raised to a certain value. The composition of the liquid phase will be known by pressure and temperature measurements. It will be adjusted, if necessary, by decreasing the pressure.

The level of the water will then be risen in the reflector tank and a subcritical approach will be conducted by varying this level.

The safety of the experiment will be given by

- a mechanism for emptying rapidly the reflector tank,
- the fast communication between the vapor atmosphere of the vessel and a geometrically oversafe cold trap at low pressure,
- the lowering of a safety sleeve around the vessel.

Program and planning

A series of experiments should lead to the determination of critical masses of U_{235} in the H/U_{235} ratio range of 0 to 20 For densities in U_{235} varying from 1 to 3 gr/cm^3.

Then some values of critical masses for H/U ratio above 20 should be determined in order to compare these results with values already known and also to study the influence of the density in fissile material in a given H/U system.

Preparation

A first period of preparation, from the beginning of 1962 to March 1963, will be necessary to get the equipments and install them. This period will be divided into the following phases :

1) February-May 1962

Theoretical studies concerning the control and safety of the equipments.

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2) May-August 1962

Study and design of the equipment. The main components should be ordred before the 1st of August.

3) September 1962-January 1963

Assembling of the equipment. Connection of control and monitoring apparatus. Training of personnel.

4) January-March 1963

Preliminary tests, that is :

- pressure test
- safety and automation checking
- cleaning of all parts and tests under natural UF_6

Research program (March 1963-End of 1965)

Then, an experimental program would be conducted, which comprises four parts, as follows :

1) Criticality measurements with pure enriched UF_6 in order to estimate the critical mass at the given enrichment.

2) Introduction of HF and conduct of series of experiments at a temperature of 80°C and with

- H/U ratios of 0.1, 0.35 and 0.35
- pressures up to 800cm. Hg abs.

3) Introduction of HF and conduct of series of experiments at a temperature of 105°C and with

- H/U ratios between 0.1 and 1.5
- pressures up to 850 cm. Hg abs.

4) Study of mixtures of known quantities of UF_6 and HF leading to H/U ratios which have already been studied by other processes (H/U of the order of magnitude of 20). This would enable to check the results of the series of experiments.

Many chemical analysis and various purification will be needed all along the experiments, so that 18 months seem to be a reasonable estimate of the time required for the basic research program itself. However, it seems certain that some experiments

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will have to be repeated, and also that some others will be found interesting to conduct as the program develops. Also, the equipment will require maintenance and probably modifications. For these reasons, it is believed that this experimental program will last from two and a half to three years.

Washington, February 15, 1962

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