MUC-LAO-41

[redacted]

(44-7-464) A

A-670

File ______________ (N - 1729 V)

Those Eligible
To Read the
Attached

R.B.

Date 7-26-44

Subject NOTES ON MEETING OF WEDNESDAY, JULY 26, 1944

Copy 6 Weinberg

By Ohlinger

To

DECLASSIFIED

Instructions Of 2id-403.5

PSR 7-7-82 m Day

Before reading this document, sign and date below

Name	Date	Name	Date
		Noe	
1944			

M[redacted]
This [redacted] of [redacted]
pages and [redacted]
No. 6 of 18 copies, Series A

[redacted]

NOTES ON MEETING OF

AMW

WEDNESDAY, JULY 26, 1944

(CF-44-7-464)

209 - Eck

Those present: Allison, Szilard, Wigner, Morrison, Franck, Hogness, Brugmann, Creutz, Vernon, Young, Ohlinger

Besides the use of the chain reaction for the production of power and for the production of isotopes, a third very important use mentioned in the outline presented at one of the early discussions was a small machine for the production of radiation with a very high level of intensity.

Mr. Morrison, the speaker at this meeting, explained a pile of the latter type, that is, a radiation source for experimental purposes in contrast to the military use of the product. There is no pile now operating with a flux as high as Hanford which can be used for experimental purposes. While such a unit might seem expensive at first (the cost would be about $150,000 to $200,000), it would give an important tool for study at a cost not too much more than a cyclotron and with a much better source. The flux in the pile proposed by Mr. Morrison would be about five times that in the W pile.

The principle of the pile proposed by Mr. Morrison is a slow chain reaction in 49, using a homogeneous mixture of 49 and a moderator with a central core. Water as a moderator would not be very useful because of its rapid decomposition under the intense radiation to be obtained. Therefore, it is suggested that beryllium or beryllium oxide or some similar material be used as a moderator with the 49 probably in the form of the oxide. Cooling would be obtained by radiation from the surface of the pile proper with the heat removed by cooling coils in the reflector around the pile. With beryllium oxide as the moderator and 2 - 3 kg of 49 in the form of the oxide as the active metal, the temperature drops across the pile would be about 1000° C.

The general arrangement of such a pile would be as indicated diagrammatically in the sketch attached.

The core of the pile would be a beryllium metal (or perhaps BeO or graphite) bottle into which could be poured pellets of beryllium and plutonium oxide as needed. Surrounding this to form the pile proper would be a cube 80 cm on a side composed of closely fitted beryllium oxide blocks with small depressions at regular intervals into which would be placed small compressed bricks of the plutonium oxide (pure beryllium blocks and pure 49 could be used in place of the oxide). Surrounding the cubical pile would be a 2" thick graphite crucible contained within a shell of bismuth-lead eutectic covering all sides of the pile and crucible except the top. Embedded in this bismuth-lead shell would be cooling coils to carry away the heat irradiated from the central mass. Around this shell would be an additional lead or bismuth-lead eutectic reflector in which would be embedded rods of thorium cooled by conduction. The purpose of these rods would be the production of isotopes in order to get back at least a portion of the original investment. These would probably be removed after say a year or two by allowing the reflector to heat until molten or plastic after which the rods could be lifted out.

The control element cannot be located directly in the pile because of the high operating temperature, the flux, etc., yet the pile must have a good control. Mr. Morrison's proposal for such a control would be a bismuth-lead tank of constantly running water with a variable liquid level control for maintaining any quantity of constantly changing water adjacent to one face of the pile. Immediately outside of this tank would be a thick section of absorbing material such as iron. The control would be by absorption and somewhat small, but this is all that is necessary for such a sluggish machine.

The pile and cooled reflector with its control tank on one side could be surrounded by a thermal shield if required and would then be embedded in a heavy concrete shielding block not less than 17 m. across. The top of this concrete shield would be left with a large hole filled with a removable shielding section in which would be embedded a plugged thimble for irradiating specimens close to the pile. Through sides of the concrete block would extend numerous small ports for irradiation of material by fast neutrons and gamma rays and one larger opening for a thermal column. Just inside the thermal shield would be a continuous steel shell to form a gas seal around the pile and reflector. Helium would be admitted to this shell to fill its voids entirely and would be sucked out slowly at slightly below atmospheric pressure to discourage leaks from the shell into the surrounding room. In this design, no attempt would be made to protect the inner pile from the helium and hence the helium would carry with it some gaseous fission products. These would be trapped out in the suction line (say in a gel) for bottling for use by the rest of the laboratory.

In actual operation, pellets of beryllium and plutonium oxide (the beryllium pellets are added to dilute the 49 to any desired consistency) are dropped into the center bottle until the critical size is passed and the pile is operating with a large period, say two minutes. By the addition of further pellets of either or both materials, the period could then be speeded up or slowed down as desired with the ultimate control by the water curtain on one side of the pile. To obtain one megawatt per day about 1 gm. per day of 49 would be used and so, once the pile is operating, about 10 gms. per month would keep the machine going. This means dropping in say one tablet per day to replace the material burned up.

The excess reproduction factor would be around 5 times that of Zinn's machine. The total leakage flux would be around 10^{12} or 10^{13} measured as surface flux at the face of the thermal column. At the thimble, the flux would be about five times this value. Mr. Morrison felt that the design was eminently stable and that no nuclear catastrophe was possible.

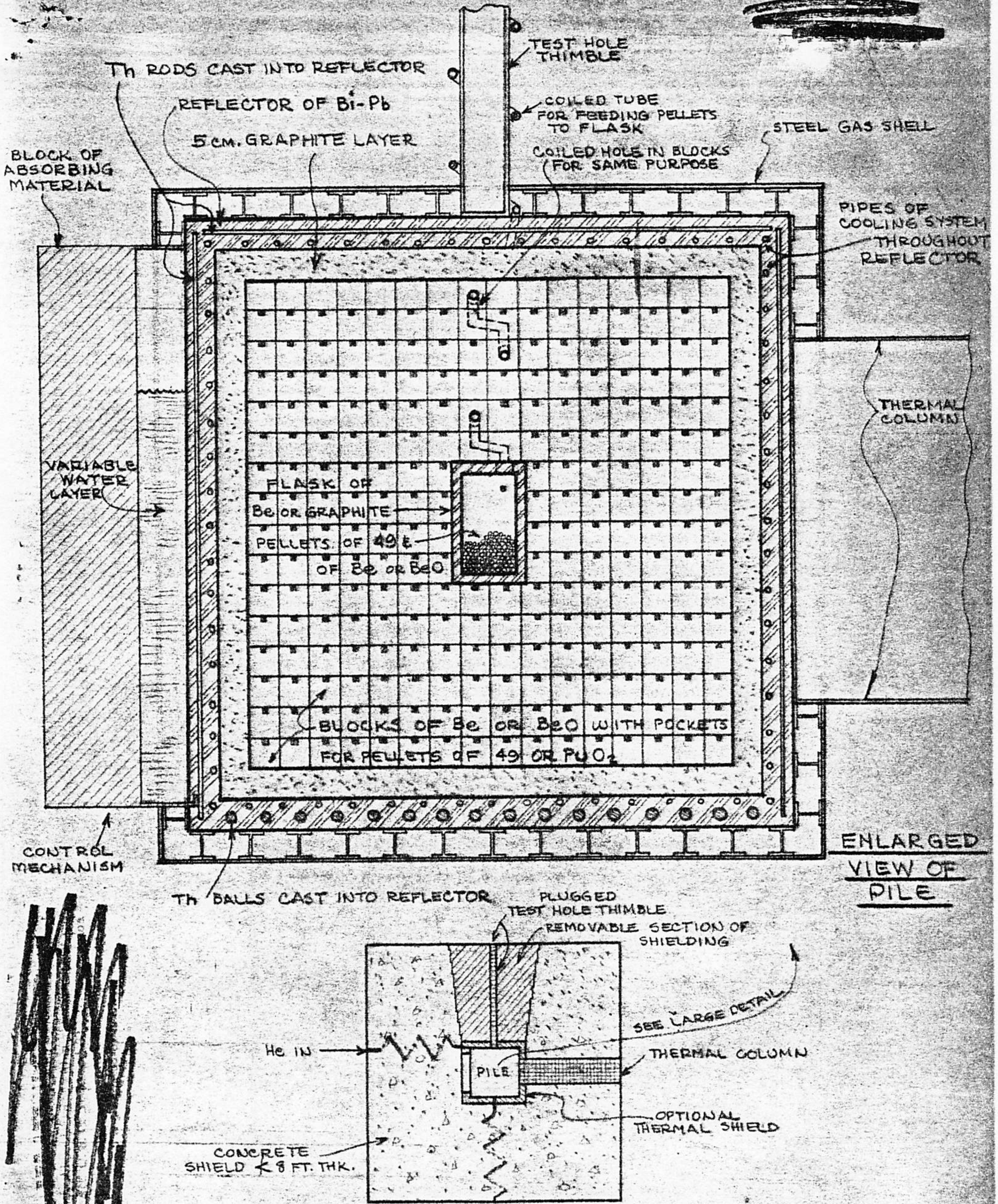
Mr. Allison commended the design on the basis of its having few moving parts.

Mr. Wigner feared that the beryllium might reduce the oxide leaving pure 49 which melts at 625° and therefore it would be preferable to either use oxides for both the moderator and the active metal or else the pure metals. The latter gives a smaller unit but does not give off any gaseous fission products for other uses in the laboratory, whereas oxides will provide these products.

Mr. Hogness suggested the use of thorium as the alloying element at the center. This has a high melting point and produces some fast fission.

Mr. Wigner compared Mr. Morrison's high temperature operating pile with one using water at high pressure and felt that one could realize a factor of only say 2 or 3 in favor of the former. However, Mr. Morrison explained that he was suggesting this type of pile only for its advantage of having high temperature operation and that other types were probably as good or better. Mr. Wigner still felt somewhat disturbed by the combination of high temperature with high flux.

In answer to the question, Mr. Morrison explained that the specific activity in the P-9 pile at Argonne was rather low and that the pile he had designed had the advantage of not depending upon neutron capture to obtain high specific activity. He felt it was better to get out the gaseous fission products carrier free as occurs in this type pile. Likewise with the use of high temperature metal, it is probable that many corrosion problems will be avoided. Mr. Allison reiterated his favorable reaction to high temperature operation and reported that he had approved a program for studying the bismuth-lead alloys for this purpose. This included the solubility of iron in these alloys, wetting of ferrous metals, etc. Since there are only four main materials suitable for pile tubes--iron, beryllium, aluminum, and stainless steel--the action of bismuth-lead and pure bismuth on these materials [redacted] investigated.



OHLINGER
8-17-44

DIAGRAMMATIC SKETCH OF SHIELDED PILE