A-84-019
57-7

[redacted]

1 - A. H. Compton
2 - C. H. Greenewalt
3 - E. Fermi
4 - H. L. Anderson

[redacted]

VERIFIED UNCLASSIFIED
JA BROWN OS-6 TSM 12/1/93

RECEIVED
NOV 19 1998
OSTI

August 24, 1943

TO: A. H. COMPTON

FROM: H. L. ANDERSON

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

PUBLICLY RELEASABLE
OS-6 JB 12/1/93

REPORT FOR WEEK ENDING AUGUST 21, 1943

The early part of the week was devoted to a more comprehensive review and analysis of the shield problem but this has not been completed. It is planned, subsequently, to treat other phases of the W design in a similar way.

The week was climaxed by Fermi's visit to Wilmington Friday and Saturday. The whole plan for the Hanford pile in its present form was gone over with Greenewalt, Worthington, Babcock, and Wahl. The general features of the design seem well defined. It is a reasonably well balanced design and at this stage relatively few details are still undecided.

Water Cooling

The water cooling system seems essentially frozen. This includes all pumps, reservoirs, filters, refrigeration, piping, orifices, and holdup basin. Instrumentation on the water; pressure gauges on the inlet end of each tube, thermocouples and sampling tubes on the exit end. Safety measures in the water system; steam turbine and electric pump combination in event of electric power failure, fly wheels on pumps, high tanks, and safety rod release by mercoids on the pressure gauges operating on abnormally high or low pressure.

Shield

The shield blocks for the metal and exit water ends, which will be an imposing machining task made more difficult by the need to use wrought pipe rather than drawn tubing due to procurement limitations. The method of using loose doughnuts between the water pipe and the shield block to provide the necessary flexibility between shield and graphite is really an elegant one and satisfactory arrangements for fabrication appear to have been completed.

The dummy slugs; aluminum jacketed lead spirals with a double twist have been ordered. Minor alterations in their design may be made after actual specimens appear for test.

The method of constructing the shield was considered generally satisfactory; but the plan to make the top of the shield self-supporting

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

[redacted]

2197 0228

CLASSIFICATION CANCELLED
PER DOC REVIEW J

was rather frowned upon as being rather awkward and some attempt should be made to have the top shield rest on the graphite.

Slug Movements

The present charging mechanism seems satisfactory and has the advantage that it can be used to strip a whole tube if desired. Obviously, since this device is an attachment, it may be replaced by an improved mechanism at any time.

Several methods are still under consideration for slug discharge. The simplest, that of dropping the slugs, awaits the development of a suitable mat upon which the slugs can fall without damage. Dropping the slugs down a tube with one end under water, deceleration by hydraulic resistance, is a second line of defense but the design is still rather awkward. Finally, lowering the slugs by means of an elevator is certainly workable although slow and elaborate. The concrete design will permit any of these to be employed.

The slug storage basin and monorail transportation of the slug baskets seems satisfactory. The plan for transfer of the slug baskets to the casket car may undergo considerable and laudable simplification by loading the car directly under water.

Control Rods

The design of the control rods is nearly crystallized in most details except for their automatic regulation. It would seem desirable to minimize the number of elements whose failure would necessitate pile shut down. The Overbeck electronic derivative control appears more elaborate than an on-off type of photocell control now being developed at Argonne. If the latter should prove satisfactory, it should be incorporated in the Hanford design.

Protection from radioactivity of the rods is provided by arranging a concrete enclosed space into which they may be drawn and left until the radiation from them is considered safe.

The control and shim rods are water cooled cadmium aluminum sandwiches. The control rods are two speed electric motor driven; the shim rods have a hydraulic motor drive and stand by tank for shut down due to power failure. The safety rods are boron steel crosses with a magnetic clutch release and hydraulic deceleration at the end of their travel. They can fall into the pile in 1 1/2 seconds.

Helium Circulation

Certain features of the helium circulation system are still vague. No clear decision has been reached whether the helium should be very

2 1 9 7 0 2 2 9

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 19

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

pure and at higher than atmospheric pressure inside the shell--or less pure and at lower than atmospheric pressure. The final decision will depend on what arrangements can be made in the matter of helium purification.

If the leakage out of the pile is small enough and arrangement could be made to obtain sufficiently pure helium so that with reasonable ventilation excessive gas radioactivity will not be encountered in the pile room, the necessity for a helium purification plant on the premises could be avoided and a somewhat more reliable indication of water leaks achieved using the higher pressure system.

Leakage of helium through the concrete base of the pile might prove excessive if the present plan is followed. A thin copper sheet across the bottom of the structure would complete an all metal enclosure and reduce the gas leakage.

Pessimism

The greatest doubts about the success of the design center around slug removal and tube failure. It is an essential weakness that there are so many tubes and such a small water annulus. The effects of radiation on the structure of the graphite (Wigner effect) and on the corrosion of the aluminum are the chief uncertainties. It is clear that a rupture of a tube exposing water to hot graphite might liberate a dangerous amount of steam. The study of these effects are badly in need of some experimental work, the most promising possibility for which would seem to be a P-9 plant which can develop W radiation intensities.

The cooling of the slugs is the most serious problem for which no satisfactory solution exists at present. The swelling of the jackets may make slug removal difficult, reduce the area of good thermal contact, and restrict the water annulus so that overheating and boiling may take place.

Four-ribbed rather than two-ribbed aluminum tubes would seem preferable if it is considered desirable to increase the chance of having the slug stick in order to decrease the chance that it make contact with the sides of the tube and cause boiling.

A further difficulty in the coating problem is the hot spot which appears at the center of ends of the slug. One proposal is to extrude the slugs with a hole down the axis. The maximum temperature in the slug would be considerably less and if these slugs were used only in the center of the pile, a flattening of heat distribution would result which would permit higher total power output.

Much of the concern about tube failure and slug sticking would be relieved if it were really possible to remove the tubes from the

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

2197 0230

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

pile. To achieve this without dangerously increasing the thermal resistance to the graphite will require an overall precision in construction on such a large structure rather outstanding in engineering accomplishment. Many of these questions will be better understood when the W mock-up is constructed and tried (early October) at Clinton.

As a last ditch safeguard, a proposal is being considered which contemplates a displacement of the pile which would prevent the safety rods from entering. In this case, a cadmium solution could be ready to be forced into the safety rod holes. A double thimble would minimize the chance of leak into the pile and to prevent boiling the solution should be circulated.

Optimism

Under favorable circumstances the output of the pile might be twice its rating of 250 gms./day. This assumes winter conditions, inlet water 5°, outlet water 65°, some excess k available to flatten heat distribution and some adjustment of orifice sizes to equalize exit water temperatures. With a lucky break on the corrosion making possible higher outlet temperatures and by using all the pumping capacity (45,000 gallons per minute), it is possible to visualize peak outputs of 1000 gms. per day.

H. L. Anderson

2197 0231

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973