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August 8, 1951

REPORT ON ADDITIONAL PRODUCTION CAPACITY OF HANFORD WORKS

COPY 1 OF 1

EXPECTED LIFE OF PILES

Item 23 of HDC 2261

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The useful life of a pile is determined by when the operational difficulties become so serious that it becomes uneconomical to operate the pile further. The economic aspects which would shut down a pile vary according to the national urgency with respect to the need for plutonium. This report does not evaluate this aspect, but will attempt to indicate which features of pile operation will become critical as operation continues.

Future operating difficulties will most likely include radiological hazards, loss of reactivity, and operational failures. Radiological hazards will become increasingly serious as the shield is distorted or as the working areas are contaminated excessively because of further difficulty with ruptured slugs or other causes. Both of these effects may be alleviated by working directly in the areas affected, since they comprise the exterior portions of the pile and are accessible. It is believed, therefore, that radiological hazards will not limit future pile operations to any great extent.

Loss of reactivity may result principally from graphite burnout or water leaks within the pile. Graphite burnout is a recognized possible effect and steps are currently being taken to prevent it from becoming excessive. Water leaks generally occur at positions in the cooling tubes which may be repaired by tube replacement or by reflanging the Van Stones. These factors, or other factors that would contribute to loss of reactivity, are not considered serious in limiting pile life.

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Expected operational failures may include such items as the sticking of vertical or horizontal rods, thermocouple failures, ruptured slugs (to the extent of making process tubes unusable), and loading problems caused by tube distortion. The graphite distortion is directly responsible for control rod difficulties and for loading problems.

Vertical and horizontal control rod operational difficulties can be alleviated by re-boring channels in the graphite, by jointing the rods, by reducing the rod size, or by replacing distorted trackways. For this reason, it is not believed that control rod difficulties will contribute much toward the limiting of pile life.

Loading problems, on the other hand, involve difficulties in replacing gunbarrels and tube distortion such as bowing, crimping, shearing, or sticking. These latter results of graphite distortion are considered to be the most serious possible limitations to future pile operations. Although graphite expansion has improved since the addition of carbon dioxide, there is reason to believe that the annealing caused by higher temperatures with carbon dioxide will eventually cease and an expansion begin again, particularly in the fringe regions. Some evidence for this is available now and indicates that the corner fringe region in the old piles at the top of the stacking is expanding at the rate of about 0.3 inches per year at a position 11 feet in from the face. On the basis of these and other associated data, the most serious aspect of graphite growth appears to be process tube distortions which may ultimately prevent passage of eight-inch dummies or four-inch slugs.

It is impossible to predict future pile life in other than a qualitative fashion; since the limiting distortion conditions and future damage rates are unknown. Any quantitative estimate must be based on a series of assumptions derived from opinion and the interpretation of present data. The assumptions necessary to draw up the table below include the following:

1. At F Pile, gunbarrels have reached their limit of distortion at the top of the pile.
2. Distortion will first become critical due to the breaking of gunbarrel entry blocks and the subsequent shearing action on process tubes. (HW-16075)
3. A slope of $3/4$ inch per foot at the gunbarrel entry block represents sufficient strain to break the block at the point of entry.
4. Annealing will continue to hold the distortion of graphite 9 feet in from the pile face to a negligible rate for 100,000 MWD, followed by expansion rates of increasing magnitude until a rate of 0.4 inch/100,000 MWD is reached after an additional 200,000 MWD.

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<u>Future Output MWD/Pile</u>	<u>Years @ 500 MW</u>	<u>Remarks</u>
250,000	1.4	Gunbarrel entry blocks begin to break and shear process tubes at the F Pile.
330,000	1.8	Same at the D Pile.
470,000	2.6	Same at the B Pile.
500,000	2.8	Over 5 percent of the tubes at the F Pile require special boring and fittings.
660,000	3.6	Same at the D Pile.
940,000	5.2	Same at the B Pile.
1,000,000	5.5	Serious shield distortions, tube crimping, and safety rod sticking. H and DR piles begin expansion with tube block undercuts filled.

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