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PITA IP-22, SUP III
DEMONSTRATION LOAD

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PITA IP-22, SUP III
DEMONSTRATION LOAD

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PITA IP-22, SUP III
DEMONSTRATION LOAD

OBJECTIVE

The purpose of this supplement is to authorize charging the complete central zone core of H Reactor with the modified E-N charge makeup, installed as a 102-tube "test core" in the fifth loading.

BASIS AND JUSTIFICATION

The potential economic and efficiency gains of a simplified charge pattern (a smaller average number of N pieces per tube and a minimum number of different charge types) were discussed in Supplement II to the parent PITA¹. Accordingly, a test block, consisting of 102 process channels in the center of the reactor, was included in the charging of the present (fifth) E-N core loading for the purpose of evaluation. Based on satisfactory preliminary confirmations of the calculated reactivity, front-to-rear flux distribution and other operating characteristics, extension to a full-scale core loading appears feasible. All resulting changes in pile reactivity and other operating variables will be minor and easily adjustable without significantly affecting operating efficiencies.

DISCUSSION

The fifth (present) E-N central zone core loading at H Reactor consists of two types of striped charge makeups. The majority of the central zone process channels (over 1050 tubes) contain the same basic charge as the fourth loading, consisting of five different types of charges of which two require three 4.2-inch pieces of Li-Al per tube and three require four 4.2-inch N pieces per tube. A 102-tube test block, geometrically centered in the reactor, completes the central core loading. The charge makeup of the test load is simplified in that each process channel contains three 5.0-inch Li-Al pieces and only two different types of charges are necessary. The advantages of extending the test block loading to the full central zone were presented in Supplement II of this PITA.

The purpose of the test block was threefold: (1) to evaluate the reactivity change, (2) to analyze the front-to-rear flux distribution, and (3) to ensure that no unmanageable changes in any operating variable were associated with the simplified charge. The originally calculated reactivity change between the two types of charge makeup was a full pile gain of 1.4 mk associated with the new, simplified charge. Reactivity evaluation of the test block, based on observed operating data, have been completed². The indicated full pile reactivity change is less than ± 3 mk.

The front-to-rear flux distribution was analyzed with the aid of operational spline traverses. The flux shape as indicated by the test block is acceptable. A typical set of traverse data, run at comparable locations inside and outside the test block, indicates that the test block flux is skewed one slug farther upstream, depeaked by about six per cent and the average calculated rupture potential reduced (as compared to the fourth core load).

Based on the favorable results of the test block evaluation, a full-size loading of the same charge makeup as is presently in the 102-tube test block (Table I) appears feasible.

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The N pieces will conform to the specifications written for the test block prototype target elements³ for all charges in the central zone.

One additional, minor change appears feasible. Considerable reactor flow may be gained if the solid Li-Al charges in the fringe are replaced with I&E Li-Al. No appreciable reactivity change will result, since the solid element is very little blacker (as pertains to neutron absorption) than the I&E element; some slight loss in conversion ratio may result due to reduced blackness to epithermal neutrons.

Thus, to facilitate this flow increase and accompanying production gains, replacement of the present fringe charge, containing 47 pieces of six-inch solid Li-Al, by any charge meeting the following requirements is authorized:

1. The total length of Li-Al in each fringe-poison tube will be greater than 260 inches and will be approximately centered with the rest of the reactor load (minimum Panellit operating pressure requirements must be met).
2. The Li-Al pieces may be solid or I&E of any length up to 12 inches.
3. The concentration of Li-6 in the Li-Al pieces will remain unchanged.
4. The Li-Al charge may be anchored by any standard slug presently approved for reactor use. (Any enriched material so used would be located such that its reactivity effect would be negligible. The tube charge will be considered as fissionable.)

The use of enrichment metal to anchor the I&E Li-Al, if an anchor is required, may be economically desirable, when compared to the alternative of the special design and manufacturing effort required to obtain some other suitable heavy I&E piece (e.g., I&E lead-cadmium). Shortening the Li-Al length to 260 inches will put the enriched anchor pieces in a low flux so that some product will be realized, partially compensating the associated small tritium loss; however, the reactor multiplication will be negligibly affected.

CONTROL CHARGES

Determination of the enriched uranium conversion ratio of preceding E-N blocks was accomplished by analyzing both the full block in the first core and selected groups of charges (special pickup groups) in both cores. Analysis to determine the improvement in the conversion ratio of the sixth block, if performed, will require the use of one or both of these methods. The use of a special pickup group would involve no more than 24 E-N charges. Selection of the method will depend upon the separations scheduling feasibility for obtaining meaningful data.

Charging

The charge type for each tube is specified in Figure 1. Some slight modification in the core E-ring boundary, consistent with operating and nuclear safety requirements, may be made in the normal manner upon recommendation of the H Pile Physicist.

Goal Exposure

Adjustments to the goal exposure of the various charges will be made through normal Manufacturing and Research and Engineering Channels.

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Reactor

The irradiation of the E-N load will be continued at H Reactor.

Tube Power Recommendations

Tube power limits will be recommended through normal Manufacturing and Research and Engineering channels based on operating conditions existing at the time.

Hazards

No special considerations other than those already covered by Reactor Standards are necessary, but two precautionary notes are advisable: (1) Charge-discharge of fringe poison columns requires that appropriate compensating enrichment be out of the reactor when the fringe poison charges are out (in other words local combinations should not exceed the reactivity of a fringe zone consisting entirely of natural uranium), (2) Only 5-inch N is to be used in the central zone; use of standard-length N elements could result in a reactivity increase of 1.5%, and close control procedures on any 4-inch inventory is necessary.

Termination

This Process Improvement Transition Authorization will remain in effect until Reactor Process Standards authorize the E-N loading as a standard operational pattern. Until optimization of the E-N loading is complete, the exact charge makeup and core loading pattern should be left flexible; a new supplement to the original PITA will be required for any charge makeup different from that specified in Table I of this document.

RESPONSIBILITIES

Research and Engineering

Process Technology Sub-Section will be responsible for determining operating limits, for interpreting fuel performance and tube corrosion data, for providing fuel exposure recommendations, and for providing mixer element recommendations.

Operational Physics Sub-Section will be responsible for the selection of the charge makeup and location and all modifications of same, for requesting and obtaining any product formation data from special tubes, for determining the reactivity parameters, for analysis and modification of the flux distribution and for publishing the final report.

Manufacturing Section

H Reactor Operation will be responsible for the operational safety and production continuity of the reactor, planning and scheduling of the program and collection of routine operating data.

Production Operation will be responsible for liaison with Production Fuels Section to fulfill material quality and quantity requirements, and for normal charge-discharge schedule recommendations.

E. L. Conner, Jr.
File Physics Unit
Operational Physics Sub-Section
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

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References

1. HW-78673, PITA IP-22, E-N Demonstration Load, E. L. Conner, Jr., 8-16-63
2. HW-79675, The Reactivity Evaluation of PITA IP-22, E. N. Demonstration Load, Sup. III, T. H. Essig, November 18, 1963
3. HW-78901, Provisional Specifications for Prototypical Lithium-Aluminum Target Element 05T, J.J. Wick, Jr., 9-2-63

Table I

<u>Code No.</u>	<u>5.0 Inch N Charge Makeup, Rear-to-Front</u>	<u>Total</u>
a	SDDP, 6E, N, E, Mixer, 10E, N, 11E, N, 12E	40E, 3N, 1 Mixer
b	SDDP, 8E, Mixer, 4E, N, 11E, N, 11E, N, 6E	40E, 3N, 1 Mixer

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Figure 1

Sixth H Reactor Central Zone Loading

[P] PCCF Tubes

[A] Air Channels

[G] Graphite Stringers

a and b charges are as listed in Table 1.

[B] B-Metal

Note: The boundary between the enrichment and central zone charges is subject to modifications.

[] Fringe Poison

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