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H REACTOR ENRICHMENT

AUTHOR

R. L. Turner

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PRELIMINARY REPORT - This report was prepared only for use within General Electric Company in the course of work under Atomic Energy Commission Contract W-31-109-Eng-52. Any views or opinions expressed in the report are those of the authors only.

R. T. Jessen, Manager
H Reactor Operation

H REACTOR ENRICHMENT

You requested information on the optimum amount of enrichment for H Reactor. Your request is approximately equivalent to asking: What is the optimum number of effective central zone tubes (ECT) that should be maintained at H Reactor?

The factors that enter a problem of this type are:

1. Power level
2. Goal exposure
3. Metal costs as a function of power level and goal exposure
4. Rupture rate as a function of power level, goal exposure, and ECT
5. Reactivity as a function of power level, goal exposure, and ECT

We have developed a net return equation⁽¹⁾ from which a variable goal exposure plan can be developed that will permit discharging to be done at near optimum goal exposure for whatever ECT or power level conditions prevail, provided the proper rupture rates are used. If we assume that discharge will be done on such a variable goal plan and use our current "best estimate" of rupture rates, we can determine what the optimum number of ECT's will be for H Reactor.

Calculations have been made for H Reactor using the net return equation to solve for net return plus fixed costs per calendar day⁽²⁾. Results of these calculations are tabulated below:

(1) HW-58996, "Methods of Optimizing Net Return - C and K Reactors," RL Turner, & RR Bloomstrand, 2-2-59, (Secret).

1. RT Jessen
2. MA Clinton
3. RL Dickeman
4. GC Pullmer
5. GR Gallagher
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At 5°C Inlet

<u>Maximum Tube Power, kw</u>	<u>ECT</u>	<u>(Z) (\$/Calendar Day)</u>
1050	1500	32,680
	1600	33,480
	1650	33,260
1100	1500	33,700
	1600	34,300
	1650	33,940
1150	1500	34,580
	1600	34,880
	1650	34,400
1306 (Bulk Limit*)	1500	Approx. 33,000
1224 " "	1600	35,260
1187 " "	1650	34,700

At 10°C Inlet

<u>Maximum Tube Power, kw</u>	<u>ECT</u>	<u>(Z) (\$/Calendar Day)</u>
1050	1500	32,400
	1600	33,180
1100	1500	33,340
	1600	33,800
1150	1500	34,070
	1600	34,200
1232 (Bulk Limit*)	1500	Approx. 32,000
1155 " "	1600	34,280

At 15°C Inlet

<u>Maximum Tube Power, kw</u>	<u>ECT</u>	<u>(Z) (\$/Calendar Day)</u>
1050	1500	32,100
	1600	32,560
1100	1500	32,860
	1600	33,040

* Based on 93.5°C, 84,000 gpm.

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At 15°C Inlet (continued)

<u>Maximum Tube Power, kw</u>	<u>ECT</u>	<u>(Z) (\$/Calendar Day)</u>
1158 (Bulk Limit*)	1500	33,400
1086 " "	1600	32,950

At 20°C Inlet

<u>Maximum Tube Power, kw</u>	<u>ECT</u>	<u>(Z) (\$/Calendar Day)</u>
1050	1500	31,650
	1600	32,000
	1650	31,880
1100	1500	32,240
	1600	32,320
	1650	32,020
1085 (Bulk Limit*)	1500	32,100
1017 " "	1600	31,680
986 " "	1650	31,260

As you can see from the above table, when maximum tube powers are 1150 kw or less and inlet temperature is not greater than 10°C, the optimum number of ECT's is about 1600. As inlet temperatures increase above 10°C an incentive for operating at lower ECT's begins to appear.

We do not advise reducing ECT's at this time for the following reasons:

1. Sufficient operating experience has not been obtained with I & E slugs to predict rupture rates with very much accuracy.
2. The rupture rate may be lower than anticipated, which would favor the higher ECT value, or higher the anticipated, which would favor the lower ECT value.
3. Tube powers will probably be limited at 1150 kw or less during most of calendar year 1959 on your planned power raise program.
4. The bulk limit may be increased a degree or a degree and one half during this year.
5. For the estimate of rupture rates used to calculate the above numbers, the difference in (Z) between operating at 1600 ECT and 1500 ECT is only on the order of one per cent, even under the summer conditions most favorable to the lower ECT.

* Based on 93.5°C, 84,000 gpm.

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As higher power levels are reached and as more rupture experience is obtained, operation with less than 1600 ECT may well prove advisable. We will re-evaluate the situation periodically to determine what changes should be made.

RL Turner

Process Analysis Operation
Research And Engineering Operation

RL Turner:md

APPROVED:

J. F. Music

J. F. Music, Manager
Process Technology Operation
Research And Engineering Operation

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