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EVALUATION OF BENEFITS DESIRABLE FROM THE
INSTALLATION OF REMOTELY CONTROLLED TOOLS
IN THE REACTOR DISCHARGE AREA

AUTHOR

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IRRADIATION PROCESSING DEPARTMENT

By Authority of WA Snyder,CG-PR-2, 11-22-93By DK Hanson, 12-17-93Verified By Jerry Mally 1-4-94.

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This document consists of
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To: G. W. Botsford, Supervisor
 Mechanical Development "A" Operation
 Equipment Development Operation

Derivable
EVALUATION OF BENEFITS DERIVABLE FROM THE INSTALLATION
 OF REMOTELY CONTROLLED TOOLS IN THE REACTOR DISCHARGE AREA

A series of remotely controlled tools are being developed to perform many of the manual functions associated with the operation of the reactor discharge areas. These tools will be carried in the discharge area on a dolly designed to run on rails laid on the bottom flange of the main I-beams supporting the discharge area elevator. The dolly and tools will be under the control of an operator stationed at a location remote from the radiation encountered in the discharge area. The dolly, provided with a General Mills type mechanical arm, is being developed by General Mills, Inc.¹ A cap remover, currently under development and scheduled for installation on the "K" Reactors,² will be mounted on the dolly. Other tools in design and scheduled for interchangeably mounting on the dolly are:

1. A rib removing outter to be used to remove the process tube ribs preparatory to the removal of a stuck ruptured fuel element.
2. A process tube cutter which can be used to chop into small lengths a worn-out process tube being removed.
3. A directable nozzle which can wash down a contaminated area with a high pressure stream of water.

1. "Design, Development and Research Contract DDR-42." (Parties are General Mills, Inc. and General Electric Company.
2. "K Area Cap Remover Program Report." RB Willson to RS Bell, dated March 23, 1958.

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IRRADIATION PROCESSING DEPARTMENT

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To: C. W. Botsford

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The General Mills mechanical arm is capable of sawing, snipping, drilling, and etc., using interchangeable heads as well as picking up and handling functions inherent in the prehensile hand normally used.

The cap removing mechanism is designed to be a routinely usable tool. It will be used to remove caps and discharge ruptured fuel elements within the scram recovery time and to permit routinely discharging fuel elements in a discharge operation during the reactor cooling off period. The economic benefits of the cap remover operating on the "K" Reactors is comprehensively covered in other documents^{2,6}; by developing the correct ratio, the "K" evaluation should also be applicable to the other reactors. The most satisfactory ratio is one using productivity and from the referenced document⁶, it can be shown that the savings from the use of a cap remover would approximate these figures:

Annual Savings - two "K" Reactors

Rupture Discharge During Operation	69,288 MWD
Scram Recovery Rupture Discharge	55,560 MWD
Discharge During Cooling Period	6,000 MWD

Assuming the same rupture rate in the old reactors, and assuming the old reactors operate at about one-third the power level of a "K" Reactor, and that about one-half of the ruptures experienced can be successfully discharged.

Annual Savings - per old reactor

Rupture Discharge During Operation	11,500 MWD	5,750 MWD
Scram Recovery Rupture Discharge	9,250 MWD	4,625 MWD
Discharge During Cooling Period	1,000 MWD	1,000 MWD
TOTAL PRODUCTION SAVING/OLD REACTOR/YEAR	21,750 MWD	11,375

The above tabulated savings are all represented by increased production; the savings resulting from decreased personnel exposure to radiation are not so easy to develop. The referenced report⁶ claims a reduction of 12 R per year per two "K" Reactors for the cap removal-discharging operation alone. This figure would certainly not be less for the old reactors because of the higher radiation levels routinely encountered in an old reactor discharge area.

6. "Evaluation of Proposed Quickie Discharge Procedure - 100-K Reactors," HW-56076, by TM Hall, dated May 13, 1958.

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IRRADIATION PROCESSING DEPARTMENT

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To: C. W. Botsford

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A study of the radiation exposure experience of IPD personnel^{3,4} shows at least 62% of the Mechanical craft exposure, 42% of the Processing operator exposure, and 54% of the Radiation Monitoring exposure for all IPD radiation work occurs in the reactor discharge area.

Being very conservative and assuming the adoption of mechanical means for remotely doing charge-discharge work, removing stuck ruptures, decontamination, and etc., would only reduce the experienced radiation exposure by 50%, the following tabulation was made. The data source was referenced documents 3 and 4.

Craft	Extrapolated 12 mo. AV/MAN	No. Men	Total Dose	Saving Realizable at 50% Reduction
Rad. Monitors	3.46	80	276 R	138 R 74.5
Proc. Operators	2.08	279	580 R	290 R 122
Pipefitters	2.36	95	224 R	112 R 69.5
Millwrights	2.06	81	167 R	83 R 52
Mech. Supervisors	1.64	38	62 R	31 R 19.25
TOTAL SAVING IN RADIATION/8 REACTORS/YEAR				654 R 337.25

The adoption of mechanization on the discharge area does not necessarily mean that a fixed percentage of the work will be done by machines, but that a large part of the high radiation level work will be done remotely. As presently planned, the breakdown of jobs will probably be as follows:

1. The greater portion of the rear face discharging will be done mechanically.
2. High radiation level stuck ruptured fuel element removal operations such as rib removal, nosale and pigtail removal, and decontamination will be done mechanically.
3. The manipulator will very readily pick-up radiated fuel elements lost in the process piping array.
4. Some of the tube removal operations accounting for the high radiation exposure, such as disposing of the removed process tubing, may be mechanized.

The entire Discharge Area Mechanization program is outlined in reference document 5. This document describes alternate means of mechanization of the discharge area operation, develops and describes the selected method for mechanization, and gives the program estimated cost breakdown.

3. "Radiation Exposure Breakdown for IPD Personnel," PC Jerman to Dist., 5-22-58.
4. "IPD Radiation Exposure Status - First 20 Weeks - 1958," PC Jerman to Dist., 5-28-58.
5. "Budget Study Report, FY-1960 Plant & Equipment Budget, Reduced Personnel Exposure," HW-55068, CE Frantz to JW Ballows, dated February 21, 1958.

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Mechanical Development "A" Operation

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