ROUGH DRAFT

DECOMMISSIONING REPROCESSING PLANTS

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Decommissioning Reprocessing Plants

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When a decision has been made to decommission a reprocessing plant, a considerable amount of planning must be done by the facilities engineering and operating staffs. It has been estimated[1] that six months of planning, study, and training would be necessary in the case of decommissioning a plant such as Barnwell. These studies would be required to answer the questions below.[1,2]

1. What is the status of the plant when the decision is made to decommission or cease operation?
2. To what level must the plant be decontaminated?
3. Does the initial plant design incorporate systems that will enhance system decontamination - that is, can all surface be contacted with decontaminants at the proper conditions?
4. To what use will the site be put following decommissioning?
5. Are there current regulatory criteria that have applicability to reprocessing plant decommissioning, and what are the ultimate storage requirements for the numerous diversified wastes that will be generated?

Several other questions are germane relative to decommissioning, but will not be addressed in this paper. Current ERDA and NRC development programs are underway that will answer questions relative to the mode of decommissioning, funding, and the packaging and disposal of the wastes generated from a decommissioning program.

Because of the brief period allotted to this subject, it will only be possible to partially address some of the above listed questions. Most of the information presented in this paper is based on experience which should be factored into decommissioning planning.

Plant Status

Prior to selecting a means of decontamination prior to decommissioning a reprocessing plant, the status of the plant will have to be ascertained. Remote radiation surveys will have to be conducted and the chemical species of the residual contaminants established. The use of material balances as a means of establishing residual plutonium quantities in vessels will not be a positive indication of missing material. Where plant plutonium throughput values were once significant, small quantities of plutonium can be located in the plant and be undetectable. As the result of the high specific activity of plutonium and transuranics, a small quantity of these materials left in and on the surfaces of equipment contributes significantly to the decontamination procedures involved.

Plant Decontamination Level

An important factor to be considered is the point where decontamination is no longer practical either by economic reasons or because the terminal radioactive plant condition has been reached. Basic experience data recently made available has indicated that pilot scale,[3] government production,[4] and commercial[5] reprocesing facilities have been able to obtain the same relative average plant decontamination factors (which are an indication of plant cleaning effectiveness). In each instance, the average decontamination factors were 10^3 and represent cleanup of plants performing unit operations

characteristic of the Purex flowsheet. Data comparing the average decontamination factors of pilot scale (ORNL) and reprocessing plant experience (Savannah River) is presented on Table 1. It should be stressed that the decontamination of these facilities was not as severe as would be required of plant decommissioning.

The technology associated with the decontamination of reprocessing plants and reactors is available today, however, on the decommissioning of reprocessing plants is non-existent. A recent literature search[6] on decontamination and decommissioning, categorized only five reports on the specialized field of reprocessing plant decommissioning. For the most part, these reports were based on ORNL pilot plant experience. Experience has been accumulated at ORNL in numerous pilot plant programs, involving systems for the reprocessing of irradiated fuel (to the 750 lb/day level), in which complete systems have been decontaminated, equipment disassembled, and the remaining site prepared for direct installation of equipment for the next pilot demonstration. The experience gained in the decommissioning of reactors is a close analogy to the problem of reprocessing plant decommissioning. However, reactors are usually contaminated with induced activity, whereas reprocessing plants are contaminated with fission products, uranium and plutonium; the decontamination methods selected are considerably different and more effective.

The Metal Recovery Plant at ORNL, which operated for a 9-yr period, employed all of the unit operations common to reprocessing plants. These unit operations consisted of irradiated fuel storage and handling, dissolution, solvent extraction, evaporation, ion exchange, and product polishing. Upon its shutdown in 1959, the facility was decontaminated with mineral acids and left in a standby condition. Since that time, there has been no detectable release of the residual activity to the environs.

Plant Designs

An important facet of the successful decontamination and decommissioning will be the result of the original designers' thoroughness. Areas or components that are hard to decontaminate or disassemble will create serious problems upon decommissioning. Typical components that will create problems include decanter pots, plugged lines, waste tanks, areas of organic-aqueous interfaces, and evaporators. The problems associated with the use of air-spargers will be magnified many times when final decommissioning is necessary and mixing of decontaminants is attempted. We have found by experience that activity can locate behind the stainless steel cell pans as the result of process spills which creates special decontamination problems. One of the major problems will be the formation and subsequent detection of solid plutonium polymer in crevices and dead legs. This polymer can only be dissolved in HNO_3-HF mixtures. Attention to these critical equipment items in the original design phase is essential.

An ANSI standard[7] has recently been adapted which provides for design criteria for reprocessing plant decommissioning. A breakdown of the major criteria presented in the standard is presented in Table 2.

An example of a vessel equipped for internal decontamination[3] used during the Thorex pilot plant is presented in Fig. 1. This type of system significantly reduced the time required for vessel decontamination and the quantity of decontaminant used.

Personnel Protection

Personnel radiation exposures also become a prime factor in decommissioning a reprocessing plant. Basically, the exposure received by personnel will be a factor of the mode of decommissioning. It is expected that dismantling a facility will result in a higher man-rem personnel exposure than entombment of a facility. Moth-balling will result in the least exposure. It can not be stressed too strongly that experience during decontamination results in

higher personnel exposures than during normal plant operation. Reviewing a plant's "unusual occurrences" will always show that excessive exposures take place during shut-down periods and unusual opeations. Direct decontamination of equipment and all structures will also contribute to excessive personnel exposures as the result of previously undetected "hot" spots. Specific personnel exposure planning is essential at the onset of a decontamination program to limit personnel exposures below 10 CFR 20 limits.

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Table
Fig 1

EXAMPLE OF DECONTAMINATION EFFECTIVENESS -
REPROCESSING PLANTS

	Radiation Level (R/hr)	
	Full Scale Plant[a]	Pilot Scale Plant[b]
Before Decontamination	68	100
After Decontamination	0.02	0.035
Overall D. F.	3.4×10^3	2.9×10^3

[a] August, 1975 Experience, SR Plant.

[b] March, 1957 Experience, ORNL Purex.

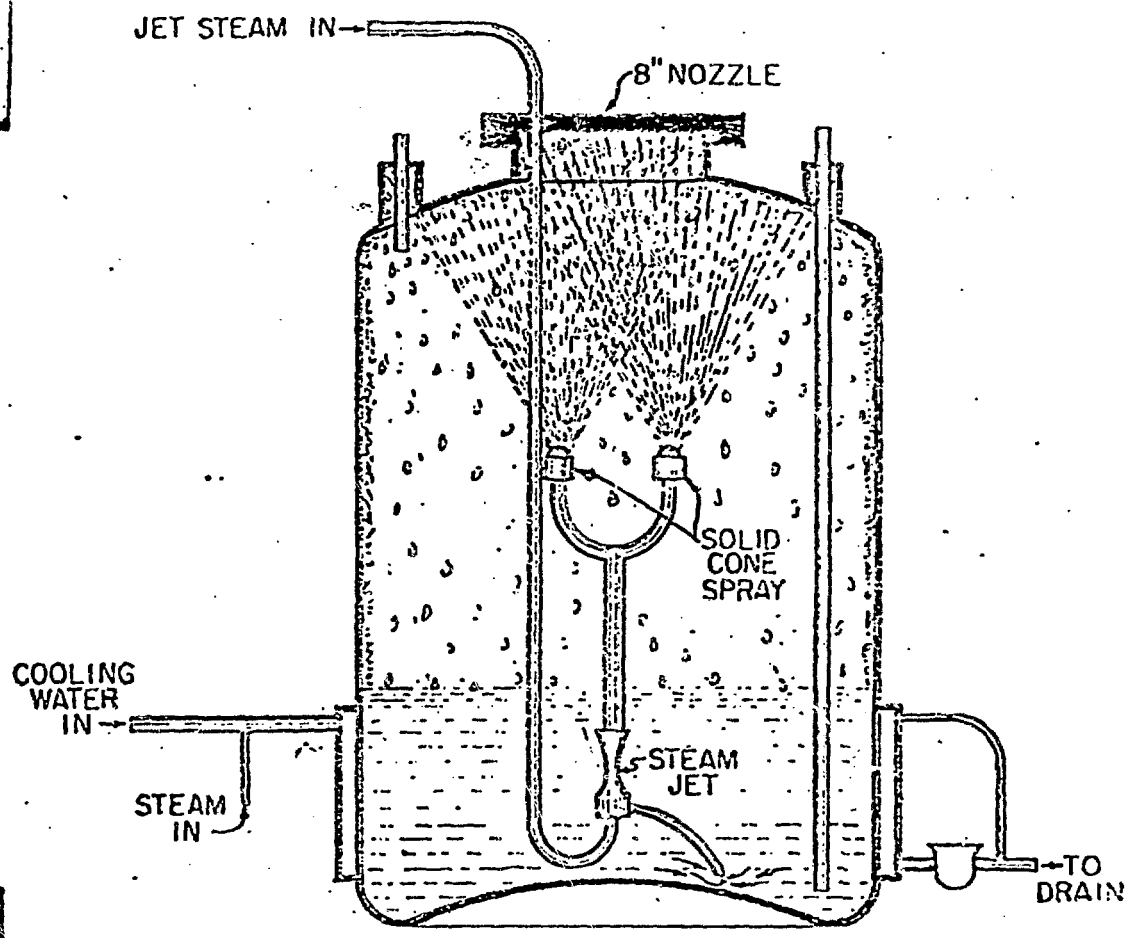
(8)

Figure Table 1

PROPOSED DESIGN CRITERIA FOR REPROCESSING PLANT DECOMMISSIONING*

1. FUEL STORAGE POOL DESIGNED FOR COVERING AND SEALING.
2. PROCESS EQUIPMENT DESIGNED FOR DECONTAMINATION.
3. CELLS DESIGNED FOR DECONTAMINATION AND SEALING.
4. WASTE SYSTEMS DESIGNED FOR RADIOACTIVE MATERIAL REMOVAL.
5. STACKS, FILTERS, AUXILIARY EQUIPMENT DESIGNED FOR DECONTAMINATION/OR REMOVAL.

*Guidance from ANSI Standard N300-1974.



TANK INTERNAL DECONTAMINATION SYSTEM

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