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IMPACT OF A DELAY IN THE COMPLETION OF THE DEFENSE WASTE PROCESSING FACILITY

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Summary

This report presents the results of an analysis and evaluation of a delay in completion of the Defense Waste Processing Facility (DWPF) at the DOE Savannah River Plant (SRP).

The report describes the precipitate hydrolysis problem, which is causing fouling on the hydrolysis reactor coils, and lists several solutions SRP personnel are researching. Estimates on the cost and timeline implications range from several hundred thousand dollars and a few months to a hundred million dollars and several years.

Provided DOE and its contractors solve this problem and DWPF begins hot operations by late 1992, reactor operations will not be affected due to lack of waste storage space. This is a function of the schedule for start-up, production mode, and power level of the reactors. All reactors are expected to start up on tritium production, whose targets are not processed by the chemical facilities.

This report recommends the mechanical completion of DWPF with the acid hydrolysis design approach. I also recommend

an independent world-class chemist study the options available for start-up with the problem permanently solved.

Introduction

Until Congressional authorization of DWPF in 1980, DOE was continuing to build and fill waste tanks. After Congress appropriated funds n 1981 to design and construct DWPF, DOE planned to complete only enough waste tanks to meet the need through DWPF start-up. With a reported delay in the start-up of DWPF, the concern arose as to the capability of the Office of Defense Waste and Transportation Management (DWTM) to meet the needs of nuclear materials production. If these needs cannot be met, DWTM may be responsible for the shutdown of the materials production complex and thus the nuclear weapons production.

This study analyzes and evaluates the impact of a DWPF start-up delay on the Savannah River waste managers ability to prevent materials and weapons production shutdown. If the answer was "a shutdown is inevitable," DWTM and the Office of Nuclear Materials Production could have had some advance notice of the potential impact and could have planned for such a contingency before the problem reached a crisis.

Background

Since start-up of SRP in 1953, about 30 million gallons of liquid high-level waste (HLW) have accumulated. This liquid HLW, generated during plutonium and uranium recovery, is stored in 51 underground storage tanks.

DWPF is designed to use a chemical process to segregate most of the tank contents for disposal as low-level waste (LLW), and then process the remaining liquid waste into low level radioactive salts. The accumulated HLW sludge will be solidified into borosilicate glass at the DWPF through a melting process. The glass will be stored in stainless steel canisters and temporarily placed in the Glass Waste Storage Building until final storage at a permanent repository.

In the DWPF process, sodium tetraphenylborate is used in the tank farm to decontaminate the HLW salt solution by precipitating radioactive cesium and nonradioactive potassium tetraphenylborate. The tetraphenylborate salts are then hydrolyzed with formic acid to remove aromatic hydrocarbons (mainly benzene and benzene derivatives) to minimize the amount of combustible material in the salt stream before it is fed to the melter.

The Precipitate Hydrolysis Experimental Facility (PHEF) is a 1/5 scale model of the DWPF Salt Processing Cell, used to verify the precipitate hydrolysis process.

Current Status: Nature of Problem

The DWPF Project Office at SRP has reported problems with the PHEF during test runs with hydroxylamine nitrate (HAN) and sodium titanate. Heavy organics (diphenylamine and biphenyl) were not adequately separating from the aqueous phase but were accumulating in the decanters. Also, a waxy residue accumulated on the cooling coils and other cool surfaces of the hydrolysis reactor, presumably due to deposits of organics and titanate. This fouling significantly increases the cycle time of the hydrolysis reactor. (Du Pont estimates the DWPF would need cleaning about once a week due to this accumulated tar-like coil residue.) Additionally, recovery of the organics dropped below 60% during tests, compared to a design criterion of > 90%, which would increase the amount of combustion in the melter.

Current Status: Solutions Being Investigated

Du Pont created a Precipitate Hydrolysis Task Team in September, 1988 to study bench-scale solutions to the problem. Candidate remedies involve flow sheet and operating condition changes to different DWPF components, as well as design changes.

Options for resolving the precipitate hydrolysis problem include

- methods to reduce nitrite levels (e.g. late washing)
- minimizing the Cu catalyst
- using alternate catalysts
- reducing reaction time
- reducing residual heel left in reactor batches
- changing temperature and HAN concentration
- use of high boiler carriers
- reactor cleaning techniques
- ion exchange

Both mechanical and chemical options have been studied for the decanter build-up of organics. Earlier this month, Du Pont reported test runs show the decanter separation problems apparently solved.

Conclusions: Timeline/Cost Implications

The schedule presented during the recent Energy Systems Acquisition Review put the mechanical completion of the vitrification facility in the 3rd quarter of FY89 and vitrification start-up in the 2nd quarter of FY92.

The delay in start-up may pose only a small problem if the solution is a simple change in operation or chemical fix. Du Pont estimated a $1-2 million cost, mainly for the new tests, and not including any DWPF design work. Design changes could potentially mean a longer delay in start-up. The worst case would probably be choosing an ion exchange option which could potentially cost $100 million plus several years to implement.

Conclusions: Impact on Waste Storage

None, provided the precipitate hydrolysis problem is solved and DWPF hot operation is achieved by late 1992. The 3rd quarter of FY92 is the deadline for vitrification start-up under the current waste management forecast (based on K Reactor starting up July 1989 and L and P Reactors starting up late 1989).

All three reactors have been shut down since April 1988. (K Reactor was already shut down for a scheduled long outage.) During this extended reactor outage, plutonium (Pu) scrap has been processed through the chemical processing facilities. Processing Pu scrap generates much less liquid waste than processing spent reactor fuel and irradiated Pu targets. Before April, 1988 power at all three reactors had been reduced to about 47%. When the reactors are restarted, all three are expected to be on tritium production. Tritium targets are processed in the tritium facilities rather than in the chemical processing facilities. As for the uranium driver fuel, all spent fuel storage facilities have been emptied, and there is a large spent fuel storage capability available. Also, until completion of contractor flow tests; new analysis and review by outside review groups such as NAS/NAE, John Ahearn's overview organization, DOE's EH organization and the Congressionally-mandated outside overview organization (not yet formed); the SRP reactors will probably operate between 25% power and 35% power. Therefore, Du Pont is working on new waste forecasts using current reactor start-up dates and planned operating forecasts.

As long as the start-up deadline is met, there will be enough tank capacity to prevent a canyon or reactor shut down.

Other Issues

In September, 1988 the DWPF Project Office estimated the cold runs might take 18 months instead of 12. (They are still doing a preliminary analysis.)

Recommendations

This report recommends the mechanical completion of DWPF with the acid hydrolysis design approach. However, although Du Pont has already consulted several chemists from other locations, I also recommend bringing in a world-class chemist to provide Headquarters with an independent review of the DWPF situation and recommend an overall strategy of actions and changes to reach start-up with the problem permanently solved.

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