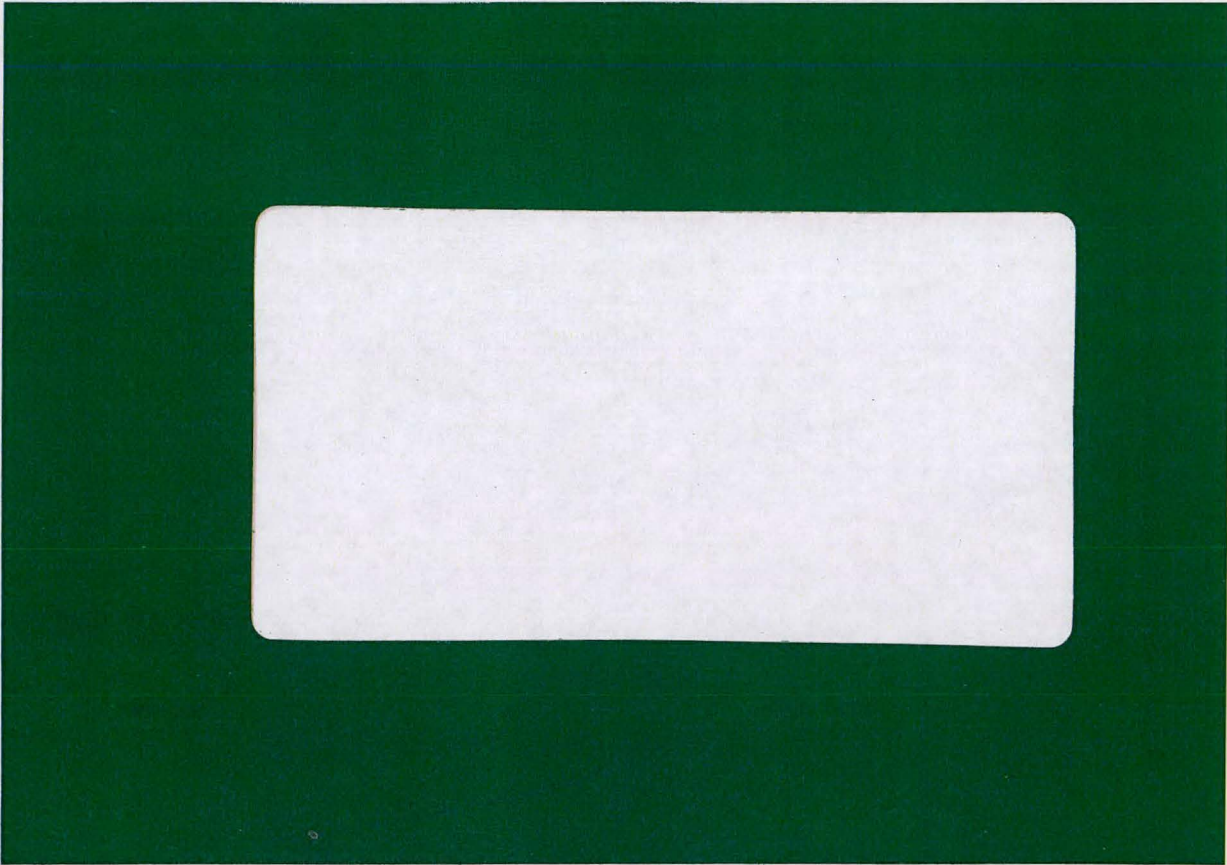


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**SPENT-FUEL DISASSEMBLY AND CANNING PROGRAMS
AT THE BARNWELL NUCLEAR FUEL PLANT (BNFP)**

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**For Presentation at the ANS Topical Meeting:
Spent Fuel Storage for the 80's
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INTRODUCTION

Methods of disassembling and canning spent fuel to allow more efficient storage are being investigated at the BNFP. Studies and development programs are aimed at hot cell disassembly of spent-fuel assemblies to allow storage and shipment of fuel pins only, rather than full fuel assemblies. The objective is to double the capacity for storage or triple the capacity for transportation of spent fuel, as well as to stabilize the fuel for storage. The work is being performed under contract to the U. S. Department of Energy (DOE).

Results indicate that the existing BNFP mechanical headend cells can provide the capability for disassembly and canning in a dry, remotely operated, and maintained facility. Using dedicated equipment, rates of about 12 to 15 assemblies per day (approximately 6 MTU) are projected.

SYSTEM DEVELOPMENT

Two separate canning processes for reference pressurized water reactor (PWR) fuel are being developed. With the first option, fuel pins from two assemblies are loaded into a 23.50-centimeter (9.25-inch) square can that fits into a single-assembly storage location in a BNFP spent-fuel pool rack, thus doubling storage capacity within the same pool space. With the second option, pins from three assemblies are loaded into a 32.40-centimeter (12.75-inch) diameter cylindrical can for shipment off site to a federal repository, thus tripling the capacity of a legal-weight truck cask. Similar percentage increases are possible with BWR assemblies.

The mechanical process used to disassemble the fuel is identical for each option. The existing fuel assembly transfer system delivers fuel from the storage pool to the disassembly equipment in the BNFP dry remote processing cell. With the fuel assembly horizontal, the fuel assembly control thimble tubes are severed between the forward end fitting and the fuel pins. Then a special mechanical device called a "puller" is used to remove the fuel pins.

After pin removal, canning of the fuel pins for the two options would be accomplished as follows:

- (1) Under the first option, the pins from one assembly are collected and loaded with an axial push into a diagonal half-section of a square can. A divider permits fuel assembly accountability. After the first half-section is filled, the can is rotated so the other half-section can be filled with fuel pins from a second fuel assembly. The can is then mechanically capped and transferred back to the pool.

- (2) Under the second option, pins from three assemblies are loaded into a cylindrical can divided into three segments for placement in a legal-weight truck cask. After can loading, seal welding closure (versus mechanical capping above), and leak testing, a crane engages the filled can at the positioning station for transfer to a separate cask loading area.

Common off-line systems required include:

- (1) A nontransuranic solid waste system that compacts and packages the fuel assembly minus fuel pin (i.e., the cut end fitting and the fuel skeleton)
- (2) A "jammed-pin" assembly relocation system that allows nonstandard disassembly away from the normal processing area
- (3) An empty fuel can supply system that feeds and positions cans without remote crane assistance.

If the fuel pins require depressurization prior to repository emplacement, a low-power laser system can vent and reseal the plenums using a minimum of in-cell equipment.

Licensability studies have verified the feasibility of this concept for fuel aged five years. These studies indicate that this concept would be inherently safer than pool storage of undisassembled fuel aged six months or fuel shearing operations for which the BNFP storage pool and remote processing cell were designed, respectively. For example, the slightly undermoderated configuration of undisassembled fuel is further undermoderated for canned, disassembled fuel. Also, the heat load is 10 times lower and the radiation source term is 20 times lower for fuel aged five years versus six months. Cladding breach during disassembly is specifically minimized, whereas the shearing process would deliberately breach cladding integrity.

Economics studies indicate that hot cell disassembly is cost effective with new storage pool additions to double capacity once the capacity of an AFR exceeds several thousand tons of stored fuel. Calculations indicate that disassembly would reduce shipping cost typically by 40 to 50%.

COMPONENT DEVELOPMENT

Milestones achieved at the BNFP have verified the following supporting data:

- (1) Development of a device to pull the fuel pin free from the assembly spacer grids has been successful. Individual pin pulling forces can be expected to range between 9 and 90 kilograms (20 to 200 pounds). A "biter" which grips the pin for pulling, must bite

with approximately 32 kilograms (70 pounds) force to prevent slip under a design maximum pulling force of 159 kilograms (350 pounds).

- (2) It was found that selected trough cross sections, assisted by vibration during fuel pin collection, preshape loose pin bundles so that can loading forces do not damage or place excessive axial load on the pins.
- (3) For the PWR fuel assemblies studied, the cross-sectional area of the can required to load fuel pins was found to be 15 to 20% greater than the minimal theoretical area.
- (4) Proof-of-principle demonstrations for laser and friction saw removals of end fittings have been successfully completed. Laser drilling, depressurizing, and resealing of plenum chamber facsimiles have been similarly demonstrated.

CONCLUSIONS

Doubling pool storage and tripling truck cask shipping capability appear feasible based on preliminary development work performed at the BNFP. This would be accomplished by disassembly of the fuel assembly and canning of the fuel pins. The dry, remote disassembly and canning in the headend cells offer adequate rates, easily controlled operator exposure, and visual inspection of the fuel pins and operations through shielded windows.

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