conf. 790602--25

FINAL SUMMARY
FOR THE 1979 ANNUAL ANS MEETING
Atlanta, Georgia

DESIGN AND OPERATION OF A DRY SPENT FUEL STORAGE INSTALLATION

by

M. J. Painter and H. S. Meyer

Allied Chemical Corporation
Idaho Chemical Programs - Operations Office
Idaho National Engineering Laboratory
Idaho Falls, Idaho 83401

Allied Chemical
IDAHO CHEMICAL PROGRAMS

PREPARED FOR THE
DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
UNDER CONTRACT EY-76-C-07-1540

DESIGN AND OPERATION OF A DRY SPENT FUEL STORAGE INSTALLATION

by

M. J. Painter and H. S. Meyer

The Idaho Chemical Processing Plant (ICPP) has received, stored, and reprocessed spent nuclear fuel for the last 25 years. The fuels originate from the reactor safety and testing programs at the Idaho National Engineering Laboratory (formerly the National Reactor Testing Station), Naval Reactors, Experimental Breeder Reactors, university and DOE test reactors, foreign test reactors, and other miscellaneous sources. Most fuels are stored in a conventional water basin. To handle certain new fuels for possible long-term storage prior to reprocessing, ICPP designed, built, and is operating two types of dry spent fuel storage installations.

PEACH BOTTOM STORAGE VAULTS

The Peach Bottom Storage Vaults were built to store spent Peach Bottom I Core 1 fuel, the first high-temperature gas-cooled reactor (HTGR) type fuel received at ICPP. Dry storage was selected to avoid corrosion of the aluminum alloy storage cans in the ICPP basin water and to prevent the subsequent reaction of the carbide fuel with water.

The storage facility has 47 underground storage vaults spaced on 9-m centers in a square array. Each storage vault is about 9-m deep by 0.75-m in diameter and holds a basket with 18 canned fuel elements. The vaults are lined with carbon steel casing, which are cathodically protected, and have 0.6-m of sand-cement grout at the bottom to seal the vault and to provide a base for the fuel. An off-set, 1.2-m-thick concrete plug provides top shielding.

Nuclear criticality safety, radiation safety, fuel temperature, fuel canister integrity, storage vault integrity, and accidents were analyzed prior to fuel receipt.[1] The conclusions were: (1) a criticality was impossible; (2) the fuel temperature would not exceed 250°C; (3) a fission product release during storage was improbable; and (4) the most credible accident, a handling accident that would expose operating personnel to minor doses of radiation, would not result in unacceptable consequences.

Peach Bottom fuel was received at ICPP in 1971. Upon receipt, the casks were cleaned, sampled for helium to assure canister integrity, and moved to the storage facility. The vaults were prepared for receipt by removing the temporary cover and the shielding plug and then placing a cask-centering device over the vault and a cask-support pedestal on the slab next to the vault.

Each cask was disconnected from the transport vehicle and the top plate and plug were removed. Guide and lifting rods were installed on the fuel basket. The cask was lifted by a Manitowoc Model 3900 crawler crane and placed upright on the cask pedestal. The bottom cover was unbolted, the cask moved onto the cask-centering device over the vault, and then the fuel basket lowered into the vault. The lifting rods, cask, and centering device were then removed and the concrete shield plug was lowered into the vault. The storage vaults were sealed for containment and security by welding a steel plate on the top of each vault.

IRRADIATED FUELS STORAGE FACILITY (IFSF)

The IFSF was built at a cost of about $3 million to provide dry storage for one core of Peach Bottom I-Core 2 fuel (804 elements), 1-1/2 cores of Ft. St. Vrain (FSV) fuel (2200 elements), and the irradiated fuel from the 20 reactors in the Rover nuclear rocket program. Dry storage was selected for these fuels because of the cost of providing safe, wet storage and to avoid carbide/water reactions.

The IFSF was built as an extension of the existing storage facilities and has since become an integral part of the ICPP fuel storage complex. To facilitate the required fuel handling and storage tasks, the facility is divided into several functional areas: (1) cask receiving area, (2) cask transfer pit, (3) fuel handling cave, (4) fuel storage area, (5) crane maintenance area, and (6) the control room. Remote equipment includes a cask transfer car, fuel shuttle bin, saw, vacuum cleaner, television camera, and several cranes, manipulators, and shielding windows.

Decay heat is removed from the stored fuel by a forced flow, single-pass air system, designed to remove 350 kW from a full facility. The inlet air (0 to 800 m^3/min supplied in 200 m^3/min increments) passes through roughing filters to remove dust and foreign materials. The exit air passes through prefilters and HEPA filters to remove any particulates; the air is monitored to detect activity prior to release.

A thorough study of the potential hazards associated with the IFSF was made.[2] The conclusions were: (1) a criticality was highly improbable, (2) the facility can withstand all credible combinations of internal accidents and pertinent natural forces without loss of integrity, and (3) the design basis accident, complete loss of cooling air, would not present a radiation or activity release hazard, only a gradual temperature increase of the stored fuel allowing up to 48 hours for recovery before the fuel center line temperature reached 600°C.

Rover fuels were first received at the IFSF in 1975. The casks were placed in a special Rover insert in the cask transfer cart. (Different inserts are required to handle casks containing the different fuel types.) The cask lid was removed and the cart moved into the fuel handling cave. The cardboard tubes containing the fuel were removed from the cask insert by the PaR manipulator and placed in a fuel storage canister. When filled, the canister was lifted by the 2-ton hoist into the fuel shuttle bin for transfer into the fuel storage area and the empty cask was returned by the transfer cart to the truck bay for return shipment.

In the fuel storage area, the fuel canister was removed from the shuttle bin by the 15-ton crane. The operator used an indexing system (to control the crane's bridge and trolley), a trolley-mounted TV camera, and visual observation through a shielding window from the control room to precisely locate the proper storage position for the canister.

Peach Bottom I-Core 2 shipments were received starting in 1975. To fit in the canister storage racks, the fuel had to be cut. In the fuel handling cave, the fuel was removed from the shipping basket and clamped in a vertical position on a remotely-operated band saw. The top of the shipping can was cut off, the fuel removed, and the can discarded as waste. The fuel element was then clamped on the saw, and the top unfueled portion was cut and discarded as waste. The remaining portion of the fuel element was then placed in a storage canister. When full, the storage canisters were transferred into the fuel storage area as previously described.

To date, only dummy FSV fuel has been received. FSV fuel will not require cutting. The fuel will be received in a cask insert holding 6 stacked elements, while the canister storage rack is tall enough to hold only 4. This will necessitate using specially designed tools to remove the elements from the insert and repackage them in the storage canisters prior to storage.

References

1. J. D. Hammond, R. S. P'Pool, and R. D. Modrow, "Safety Analysis Report for Peach Bottom I-Core 1 Fuel Storage Facility," IN-1465 (1971).

2. G. E. Bingham and T. K. Evans, "Final Safety Analysis Report for the Irradiated Fuels Storage Facility," ICP-1052 (1976).