A MULTIPURPOSE REPROCESSING HOT CELL

R. D. Fletcher

Allied Chemical Corporation
550 Second Street
Idaho Falls, Idaho 83401

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ABSTRACT

A multipurpose hot cell is being designed for use at the Idaho Chemical Processing Plant for handling future scheduled fuels that cannot be adequately handled by the existing facilities and equipment. In addition to providing considerable flexibility to handle a wide variety of fuel sizes up to 2,500 lbs. in weight, the design will provide for remote maintenance or replacement of the in-cell equipment with a minimum of exposure to personnel and also provide process piping connections for custom processing of small quantities of fuel.
INTRODUCTION

Several of the irradiated nuclear fuels scheduled for reprocessing at the Idaho Chemical Processing Plant (ICPP) at the Idaho National Engineering Laboratory (INEL) in the near future cannot be adequately handled by the existing facilities and equipment. This will require modifications to the fuel storage basin, procurement of new fuel transfer and handling equipment, and the installation of a new headend dissolving system. A part of the new headend system will be a multipurpose hot cell to be used primarily for routine fuel charging to the dissolvers in the plant cell below. This will provide considerable flexibility in handling and temporarily storing a wide variety of fuel sizes up to 2,500 lbs. in weight. The hot cell will also provide direct viewing for remote maintenance or replacement of the in-cell equipment with potentially as-low-as practicable radiation exposure to operating and maintenance personnel.

GENERAL DESCRIPTION

The new multipurpose hot cell will be located in the Process Makeup Area of the Process Building directly above the existing L and M cells as shown in Figure 1. The irradiated fuel will be transported from the CFP storage basin building to a location near the hot cell in a special fuel transfer cask (Figure 2) by a 30-ton capacity Gerlinger straddle carrier. A new 35-ton bridge crane, which will service the
Figure 1. Process makeup area, plan view.
Figure 2. Fluorinel transfer cask.
immediate hot cell area, will be used to position the 30-ton fuel transfer cask on an air-bearing pad to facilitate moving the cask against the side of the cell for unloading. Figure 3 shows the cask in position against the cell.

HOT CELL DESCRIPTION

Internal dimensions of the hot cell will be 15 feet x 17 feet x $17\frac{3}{4}$ feet high with 40-inch thick stainless lined barytes concrete walls. This wall thickness is calculated to result in a radiation field of 0.125 mR per hour on the outside surface of the cell with the maximum scheduled fuel storage in the cell. Five viewing windows are located in the cell walls (Figure 3) to provide adequate viewing of each in-cell operation. Each window will be 36-inches by 36 inches on the cold side and will match the 40 inch wall thickness. The in-cell lighting will be sufficient to give an "as-viewed" illumination level of approximately 100 foot candles outside the cell. A pair of heavy duty master-slave manipulators are located at each window location for fuel handling and remote maintenance or replacement of the in-cell equipment. Fuel elements or in-cell equipment that are too heavy to be handled by the master-slave manipulators are lifted and positioned by a 2-ton capacity bridge mounted manipulator (Figure 4) which covers the entire cell area. The grapple on the end of the manipulator is designed to lower the heavier fuel elements down to the bottom of the dissolvers by cable which is well beyond the telescoping limit of the manipulator.
Figure 3. Fluorine hot cell, plan view.
TELESCOPING LIFT

FUEL STORAGE

FUEL TABLE 15½ HIGH

CENTRIFUGE

DECON PUMP

12" X 6" CURB

12" HIGH BASE

Figure 4. Fluorinel hot cell, section.
A stepped access door will be provided in the north cell wall to simplify initial equipment installation and checkout. It will also provide quick access in the future for direct maintenance of equipment if remote maintenance is not practicable under certain circumstances. The door will have an air bearing pad built into the bottom for ease of manual operation.

Reagent addition for future custom processing in the cell will be primarily through spiraled pipe sleeves in the west wall. The same type of sleeves will also be provided beneath each of the five viewing windows. Additional access will be provided by 6-inch diameter stepped plugs in the west wall and a small air lock, approximately 12-inch x 12-inch, for the introduction of small tools etc. into the cell in the east wall.

**CELL EQUIPMENT**

The hot cell is basically designed to shear or cut fuel to length if required, temporarily store fuel, lower or drop fuel into specified dissolvers below in M-cell, remove and package insoluble particulates contained in some dissolver solutions, and remotely repair or remove and replace failed equipment and in-cell valves. The in-cell equipment will consist of a fuel receiving table with associated fuel cutter, fuel storage cabinets, two solid bowl continuous centrifuges, a solids container storage rack, and a neutron interrogator. The fuel receiving
table will contain a retrieval-type mechanism for pulling fuel from the
transfer cask onto the table or pushing fuel back into a cask if required.
Consequently, all large fuel assemblies must be provided with a retrieval
and handling bail at one end. The fuel cutter will be provided to cut
off inert end materials from at least two of the fuel types prior to re-
processing. As an example, Figure 5 shows the material that will be
removed from both ends of the TRIGA fuel elements to simplify and reduce
the cost of processing. Only the 15-inch center part will be processed.
The cutter will be adjustable for fuel lengths from 24-inches to approx-
imately 48-inches with provisions for expansion to longer fuel lengths
if required. The fuel storage cabinets, with built-in neutron absorbers,
will provide critically safe storage for the fuel prior to lowering into
the dissolver shown in Figure 6. The temporary fuel storage will save
approximately 3 to 5 hours (depending on fuel type) per 24 hours of pro-
cessing time because of the transfer cask turnaround time between the
storage basin and the hot cell. A full dissolver charge can be collected
in the storage cabinets while the previous charge is being processed.
The bottom of the dissolver as shown in Figure 7 has been designed with
2-inch thick bars 2 inches apart to withstand the accidental drop of a
2,500 lb. fuel element. The two centrifuges will remove the insoluble
particulates from some of the dissolver solutions and drop the solids
into solids containers which will be 5-inch diameter and 24-inches long.
The filled solids containers will be temporarily stored in the solids
storage rack prior to removal from the hot cell for disposal. Prior to
Figure 5. TRIGA fuel element.
Figure 7. Dissolver fuel support plate arrangement.
removal, each solids container will be placed in the neutron interrogator to determine the uranium content of the contained solids by detection of the induced gammas. If the uranium content exceeds an established limit, the solids and container will be lowered into the dissolver and reprocessed.
Figure 1. Process makeup area, plan view.

Figure 2. Fluorinel transfer cask.

Figure 3. Fluorinel hot cell, plan view.

Figure 4. Fluorinel hot cell, section.

Figure 5. TRIGA fuel element.

Figure 6. Fluorinel dissolver.

Figure 7. Dissolver fuel support plate arrangement.