WASTE MANAGEMENT ASPECTS OF THE SPENT FUEL POOL RERACK AT INDIAN POINT UNIT #2

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ABSTRACT

The option chosen to increase the storage capacity for spent fuel at Indian Point Unit #2 was the rerack of the fuel pool with high density racks. In order to support this operation the Radwaste section performed numerous operations including a search of all unoccupied fuel cells for foreign material, the characterization and shipment of irradiated hardware, the performance of a safety evaluation, the development of a fuel pool vacuum system and the shipment of spent fuel racks. This paper discusses the development of these tasks in an older pressurized water reactor as they relate to radwaste management, safety, Alara and recent industry concerns over hot particles and fuel pool related worker overexposures.

INTRODUCTION

Indian Point Unit #2 (IP2) is a pressurized water nuclear power reactor owned and operated by the Consolidated Edison Company of New York. IP2 received its Construction Permit from the AEC in October, 1966, and its Operating License in September 1973. The plant went into commercial operation in July, 1974. IP2 has a single spent fuel pool which has undergone three reracks since beginning operation. Reracking involves replacing the fuel storage racks with a denser configuration of racks. The first rerack in 1975 increased spent fuel storage locations from 264 to 482. The pool then underwent another rerack in 1982 going from 482 to 980 spent fuel assembly storage locations. This second generation of racks were free-standing and self supporting and were constructed of ASTM 240-Type 304 stainless steel. The poison material was borated stainless steel. These racks had 980 storage locations and were capable of storing fuel of up to 4.3 wt% U-235 initial enrichment.

In 1988, the company began planning for the third reracking of the pool since it was clear that the ability to discharge a full reactor core of fuel assemblies would not exist after 1995. This fact combined with the projected Yucca Mountain repository opening scheduled for the year 2010, were determining factors in the companies decision to purchase twelve (12) high density Boroflex (a Boron Silicon Polymer) racks. These racks have a ultimate storage capacity of 1376 fuel assemblies which will allow full core discharge until the year 2007. Numerous waste management activities were involved in the rerack project which physically started on March 12, 1990 and ended on September 30, 1990. These activities are the subject of this paper.

WASTE MANAGEMENT ACTIVITIES

Hardware Removal and Identification

An essential step prior to removal of the old fuel pool racks and their replacement with new racks, was that all irradiated reactor components (IRC) and non-irradiated components be identified and characterized. These components are listed in Table 1 and were no longer needed by the station as part of fuel pool operations or refueling. They were also removed prior to pulling racks because they were highly radioactive and required special underwater handling and packaging for shipment. Since it was very important to know the location of the objects a detailed drawing of the pool was provided to an offsite vendor for use in the project. This drawing is shown in Fig. 1.

Prior to pulling the above components from their spent fuel pool locations it was decided that all empty unused fuel assembly locations would be searched for loose debris or other hardware that may have been inadvertently dropped into the pool, or was not reported to the Reactor Engineering Section. The search of the cells was very successful and the following types of miscellaneous debris was found in the pool:

- Small washer
- Paintbrush
- Dosimeter
- Light Lens
- Bag filter
- Short cable
- Small hook

These items were removed with long handled tools after being dose rated by the floor health physics technician who was continuously in the area. Precautions were taken as each item was lifted from the pool to assure the item was not irradiated and did not contaminate the fuel pool-worker with hot particle(s). By procedure, any unidentified or identified object removed from the pool or located near the pool could not be handled without a health physics survey. Each object was noted on a audio, written and video log of the empty cells. It was also noted that a thin layer of dirt and in some cases resin beads were at the bottom of the empty rack cells. Technicians were not surprised at the presence of loose fuel pool resin due to a partial failure of a screen in an outlet fuel pool 30 ft^3 capacity demineralizer in 1987. Immediately after the 1987 event, all resin in accessible locations had been removed. It was determined that the resin in

TABLE I

Indian Point #2 Spent Fuel Pool Superfluous Contents

SFP Position	Description	Estimated Radiation Level on Contact
F13	Debris can with 5/8" dia 3" long bolt (recovered from reactor 4/26/89)	6000 R/HR
A15	Empty assembly with eight (8) damaged thimble plugs	>500 R/HR
Suspended by lanyards over approx. position N68	Three (3) burnable poison assemblies APS1 (SNM-PU/BE one primary source) A6P2 12P33	>100 R/HR
Down in rack along south wall	1981 loose parts canister S.S. can approx. 3" dia x 2' long containing irradiated pieces	Unknown
A11	Fixed incore canister from 1976	>100 R/HR
A12	Fixed incore canister from 1976 [Contains SNM] [Miniature U235] [fission] [detectors]	>100 R/HR
Down in rack along south wall	Two (2) additional thimble plugs	>500 R/HR
Down in rack along south wall	Small piece of BP rod	Unknown
	Non-Irradiated Tools and Components (Other than Required)	
NN1	Pipe	Unknown
U68	Test mandrel with attached handling pole	Unknown
AA68	Long pole tool	Unknown

the empty fuel rack cells and under the racks must be removed during the rerack, and planning began on a system to remove it.

Once the cell search was completed a 14 ft^3 steel liner was lowered 39 feet to the bottom of the pool in the spent fuel cask area (see Fig. 1), using a safe load path which did not allow objects over 2005 lbs. to move over spent fuel. The weight of 2005 lbs was chosen based on station technical specification requirements that limit movement of any object that weights more than a fuel assembly over spent fuel. The liner lid was removed remotely underwater and a crusher/shearer was placed over the opening of the liner. Each irradiated item such as burnable poison rods and thimble plugs were dose rated over their entire length, and then were crushed or cut in a shearer where they fell into the liner. A dose profile sheet for each item and a log of all items that went into the liner were recorded for waste classification, certification, shipment, and burial.

Indian Point #2 Spent Fuel Pool

Addendum 8.1

Page 1 of 1

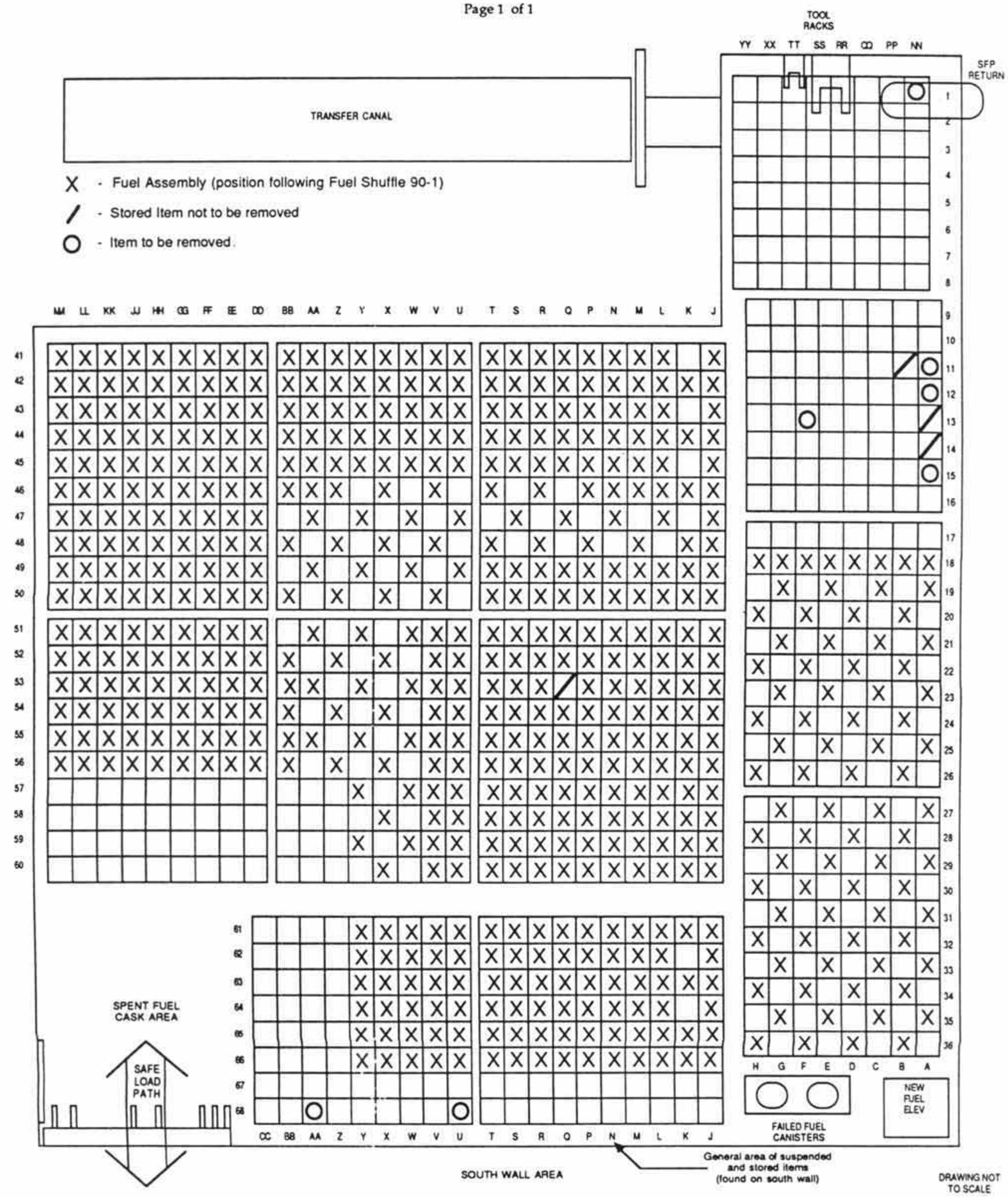

Fig. 1. Indian Point #2 Spent Fuel Pool.

Once volume reduction of the components were complete the crusher/shearer was removed from the pool as it was sprayed off with demineralized water to remove hot metal chips. Dose rates and hot particle surveys were taken prior to placing the crusher/shearer back in its LSA box. The disposable liner lid was put back on, and a Type B cask was received in the fuel storage building. The cask lid and drain plug were removed and kept next to the truck bay, and the cask was submerged and set in the pool next to the full liner. Carefully the liner was transferred underwater into the cask. The shielded lid was lowered underwater onto the cask and the cask was lifted slowly to the surface. As it broke water it was dose rated and sprayed down with demineralized water for contamination control. The cask was torqued, the drain plug replaced and it was loaded and shipped without incident. The Station's first 491.0 curie IRC liner was successfully buried.

Several factors contributed to the successful operation. Among them were:

- Awareness of hot particle control, unplanned exposures during refueling and floating fuel pool debris industry events.
- Planning the movement of all materials into and out of the pool. Final worker total exposure was 496 mR for the job.
- Proper worker monitoring and remote handling of all components underwater, complemented by the use of an experienced vendor assured a trouble free job.
- A firm grasp of all safety evaluation issues under 10 CFR 50.59.
- Development of irradiated component history, description, and radiation level assured accurate shipment curie characterization.

Rack Removal and Shipment

In preparation for the old racks to the removed from the pool, the radwaste section reviewed the design of a steel 2143 ft^3 strong tight container (STC) to ship the old racks from the site to a volume reduction facility. One of the chief concerns with the box was that it was overwidth by 22" on each side of the truck and required a special hauling permit and overwidth posting in both front and rear. A second concern with regard to shipping out the racks was removal of metal chips, loose contamination and resin from the racks that could cause them to be greater than 200 mR/hr on the surface of the shipping package. This concern was addressed by the following steps:

1. Before each rack was lifted a three head 8000 psi hydrolazer head was send down the now unoccupied fuel assembly cell locations in the racks, and any small pieces of debris were pushed out the bottom of the rack to the fuel pool floor.
2. The outside of the fuel rack was hydrolazed as it was lifted and broke the pool water surface. If any spots on the rack threatened the USDOT limit of 200 mR/hr contact with the package it was blasted again with water. Concern with the 2 meter reading limit of 10 mR/hr also drove the need for further cleaning.
3. Each rack which ranged in size from 937 ft^3 to 1265 ft^3 was bagged in a special canvas bag after it drip dried over the pool.
4. The racks were braced and shored in the shipping STC boxes to assure they wouldn't shift during transportation.

These precautions plus accurate characterization of the isotopes on the rack assured compliance with the information provided in USNRC Information Notice 88-101: "Shipment of Contaminated Equipment between Nuclear Power Stations." USDOT regulations Title 49 Part 173.441 states that the external surface of an open transport vehicle should not exceed 200 mR/hr on contact with the external surface of the package. The Radwaste Section took precautions in the shipment of large cargo boxes such as fuel racks to gain access to the bottom of the loaded box in order to survey for the 200 mR/hr limit. A total of 12 racks were shipped over a three month period. Prior arrangements with a volume reduction vendor allowed the station to get an excellent 92.8% volume reduction on the racks. Only 920.3 ft^3 of disposal site allocation was charged against the station for all twelve racks.

Vacuum Systems

As each rack was removed the rerack vendor needed to assure that the fuel pool floor under the rack was completely clean before putting a new high density rack in its place. The vacuum system in Fig. 2 was developed to provide a low dose quick way to remove the small amount of debris under each rack. The system consisted of a 300 gpm underwater Tri-Nuclear filter attached to a 24" diameter, 72" tall painted carbon steel pressure vessel. The inlet to the pressure vessel was attached to a flexible vacuum hose. The system worked by creating a negative suction in the pressure vessel to catch large diameter sand sized or greater particles and then discharging any fines to the mechanical filter in the Tri-Nuclear filter. The filter housing then had a bottom discharge back into the pool. The system was located completely within the spent fuel pool transfer canal thus eliminating three concerns:

1. Draining down the pool by drawing a suction of spent fuel pool water outside the pool.
2. Interfering with the rerack operation in the main fuel storage section of the pool (see Fig 1).

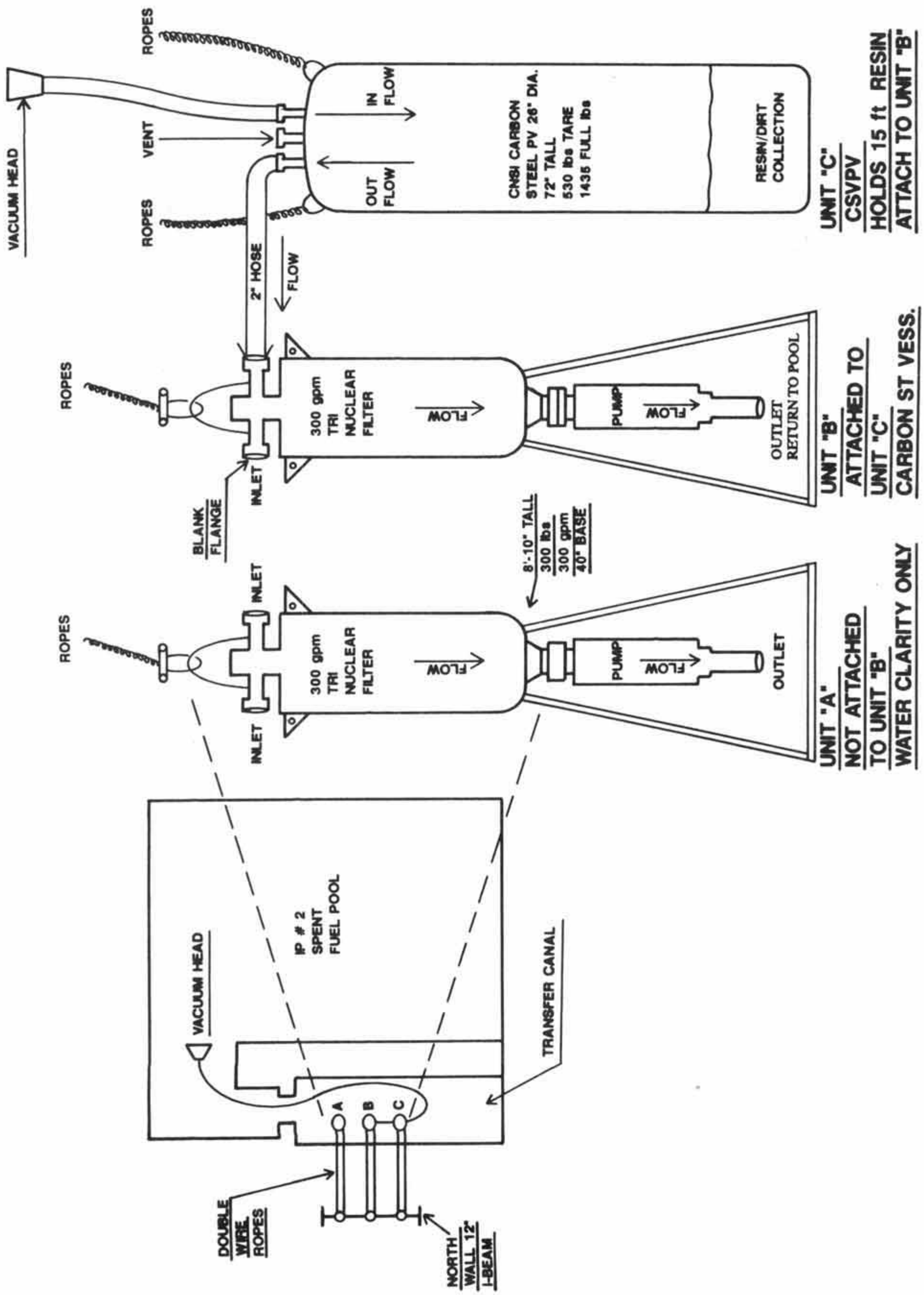

Fig. 2. Transfer canal vacuum system.

3. Providing a work platform on the edge of the pool to monitor the dose rates on the filter housing, change out mechanical filter and avoid moving equipment over spent fuel. Change out for filters was set at a maximum dose rate of 10 R/hr at 18" from the filter housing.

The system worked well to remove several cubic feet of loose debris off the floor of the pool. A more elaborate system to vacuum the pool was, however, needed when the last two racks were pulled from the pool in area next to SFP cooling return. This area was the section of the pool floor that received the bulk of the resin that broke through the demineralizer outlet screen in 1987. The system in Fig. 3 was developed to address the removal of this resin in a low worker dose efficient manner. It consisted of a flexible hose with vacuum head connected to a sandpiper pump located on the refueling deck. The outlet of the pump then went to a hydrotested hose which fed a fillhead located on top of a high integrity container (HIC). The HIC located in large concrete shield was then dewatered to a second pump on the refueling deck that discharged to the pool.

The system worked very well and removed all the remaining dirt/resin on the floor of the pool. Since the system physically removed water from the pool to another location within the Fuel Storage Building numerous precautions had to be taken with regard to its use. They included:

- The closed vacuum system from pump to pump had to be pressure tested to 1-1/2 times operating pressure.
- The system had to be manned by at least three individuals the entire time it was running.
- The HIC level had to be monitored by a T.V. camera and have an automatic shutoff if the water level reached 90% of the HIC's capacity.
- A 6" high dam had to be placed across the two exits from the building.
- A calculation based on the sandpipers pumping capacity had to performed in order to predict the length of time to drain the SFP to its low-level alarm setpoint in the unlikely event of a line break. The operator had to be able to shutoff the pumps within a fraction of this calculated time.
- The vacuum hose and the discharge hose were pulled from the pool after each shift or worker break to prevent inadvertent water suction from the SFP.

CONCLUSIONS

Radwaste support of a large six month fuel pool rerack job at Indian Point was successful because of planning and innovation. The planning not only considered items that were the direct responsibility of the section, but how they related to the overall job. Each step considered not only what physically had done, but also considered radioactive waste industry lessons learned, plant safety, and radiation protection. It was extremely helpful to the Radwaste Sections to be the first work group into the pool to perform irradiated hardware removal and empty fuel cell searches, because it familiarized them with the scope of the later rack removal and replacement work. Radwaste Supervisor innovation played a key role in allowing the pool to be returned to its original cleanliness after significant activity in the pool over several months.

Several lessons learned were evident at the conclusion of the job. They included:

- Leave the radiologically clean hydrolazer pump and motor in an outdoor area to avoid the spread of contamination.
- The amount of time the old empty fuel racks should be uncovered prior to bagging and boxing in the shipping container should be minimized to prevent the spread of contamination.
- Hot particle surveys of floor areas outside of the fuel storage building should be increased during the rack replacement.
- Since the rack removal and replacement involves alot of material entering and exiting the building, housekeeping and material management are extremely important.
- Objects entering the pool even for brief periods should not be made of carbon steel.
- Wrapped poles and tools which have been used in the pool should be packaged and leave the building as quickly as possible to avoid contamination of the wrapping material.

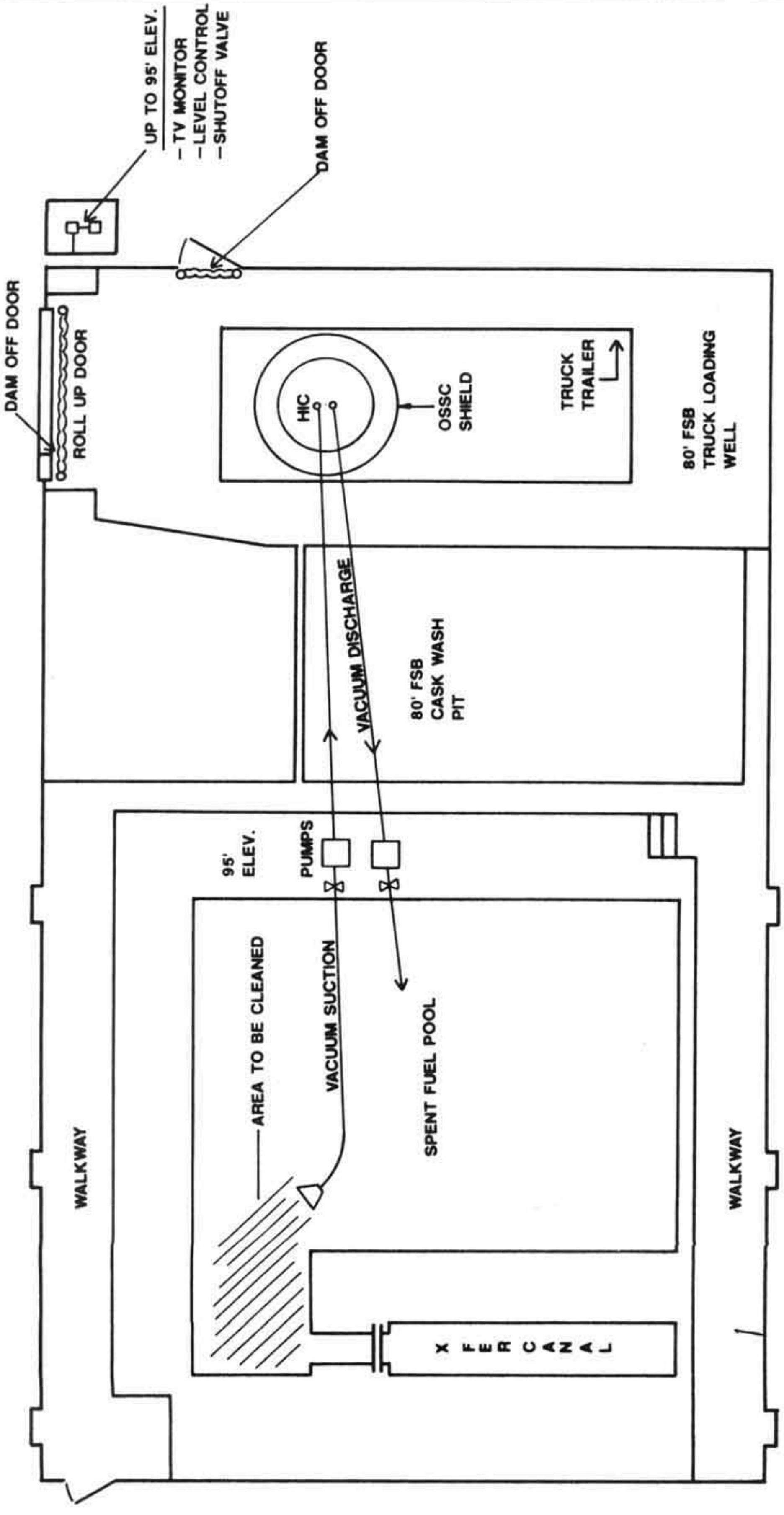

Fig. 3. OSSC/HIC vacuum system.