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PWR UPPER/LOWER INTERNALS SHIELD

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ABSTRACT

During refueling of a nuclear power plant, the reactor upper internals must be removed from the reactor vessel to permit transfer of the fuel. The upper internals are stored in the flooded reactor cavity. Refueling personnel working in containment at a number of nuclear stations typically receive radiation exposure from a portion of the highly contaminated upper internals package which extends above the normal water level of the refueling pool. This same issue exists with reactor lower internals withdrawn for inservice inspection activities. One solution to this problem is to provide adequate shielding of the unimmersed portion.

The use of lead sheets or blankets for shielding of the protruding components would be time consuming and require more effort for installation since the shielding mass would need to be transported to a support structure over the refueling pool. A preferable approach is to use the existing shielding mass of the refueling pool water. A method of shielding was devised which would use a vacuum pump to draw refueling pool water into an inverted canister suspended over the upper internals to provide shielding from the normally exposed components.

During the Spring 1993 refueling of Indian Point 2 (IP2), a prototype shield device was demonstrated. This shield consists of a cylindrical tank open at the bottom that is suspended over the refueling pool with I-beams. The lower lip of the tank is two feet below normal pool level. After installation, the air within the tank is evacuated, thereby drawing water up into the shield. This extends the height and width of the natural shielding provided by the existing pool water. This paper describes the design, development, testing and demonstration of the prototype device.

INTRODUCTION

The goal of this research and development program was to design, develop, test, and demonstrate a shielding system which would use the existing mass of the refueling pool water to provide shielding from the protruding components of the upper internals in order to reduce the radiation exposure of refueling personnel in containment. Figure 1 is a conceptual sketch of the device. The design had to meet the following objectives:

- Provide sufficient radiation shielding.
- Require minimum exposure for installation.
- Minimize critical path involvement for installation
- Allow similar use as a shield for the lower internals package during a future outage.

The project plan included the following major tasks: field inspection and measurement of the proposed installation site, design, fabrication, load testing, mock-up training and site installation/removal. The project was accomplished in a time frame of approximately ten months.

Figure 1

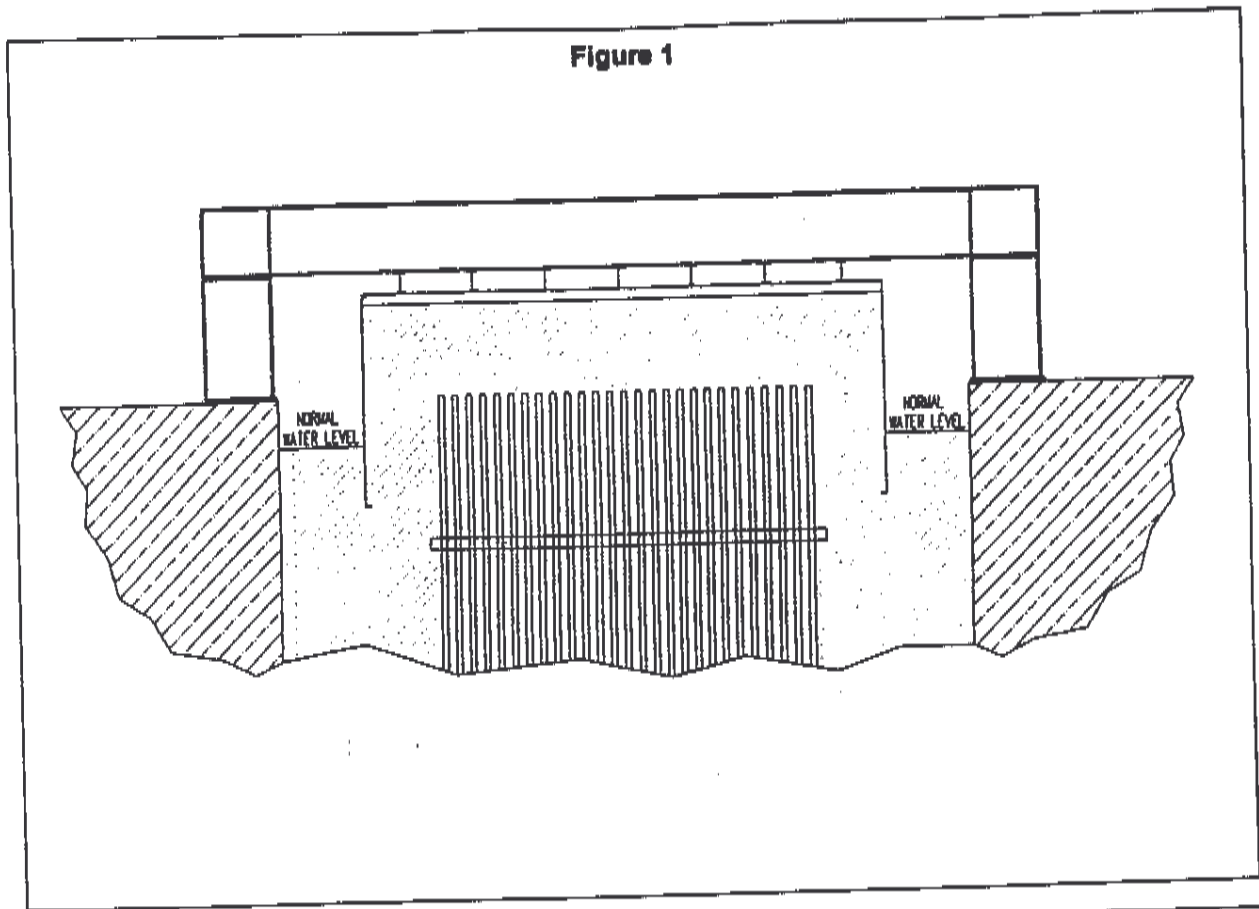
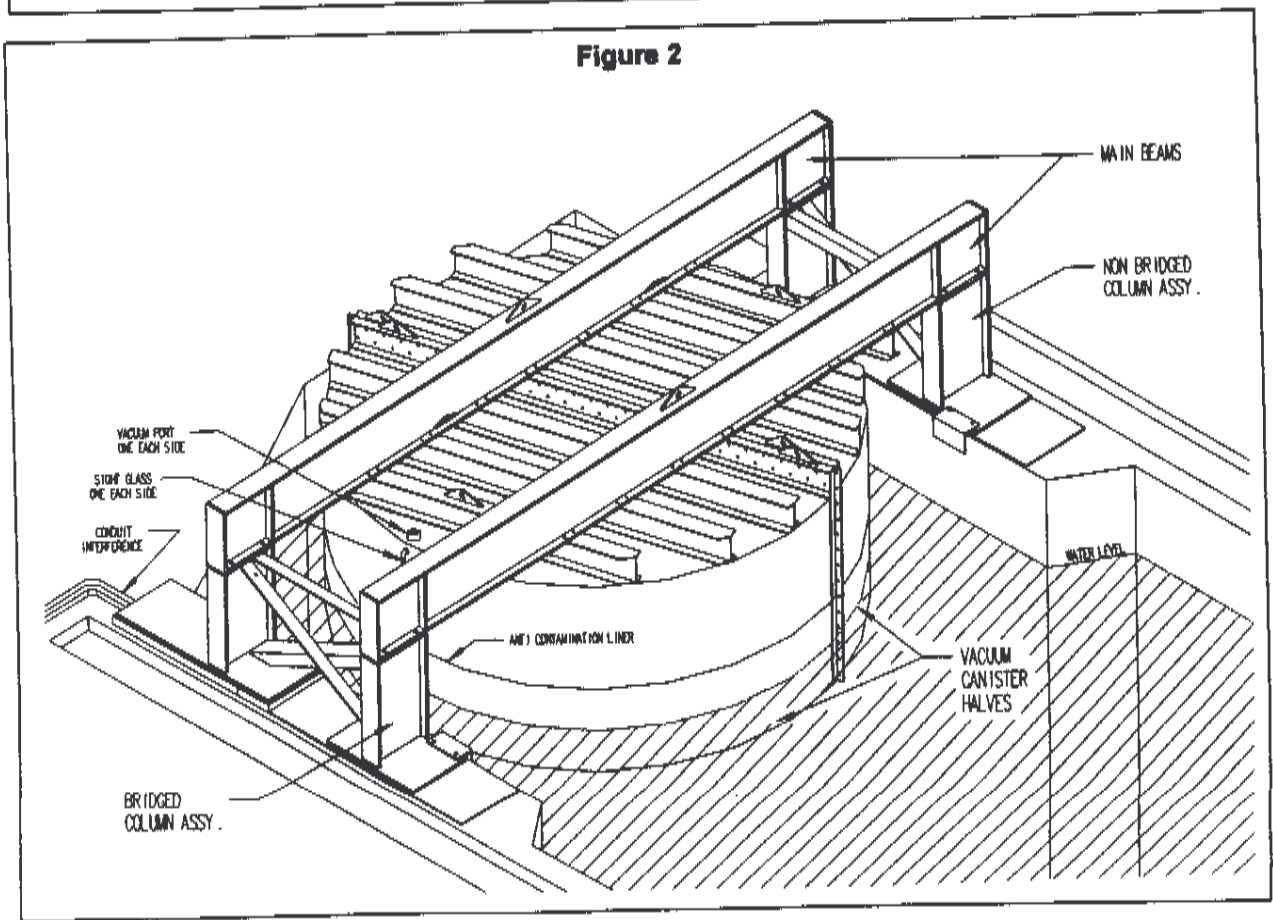
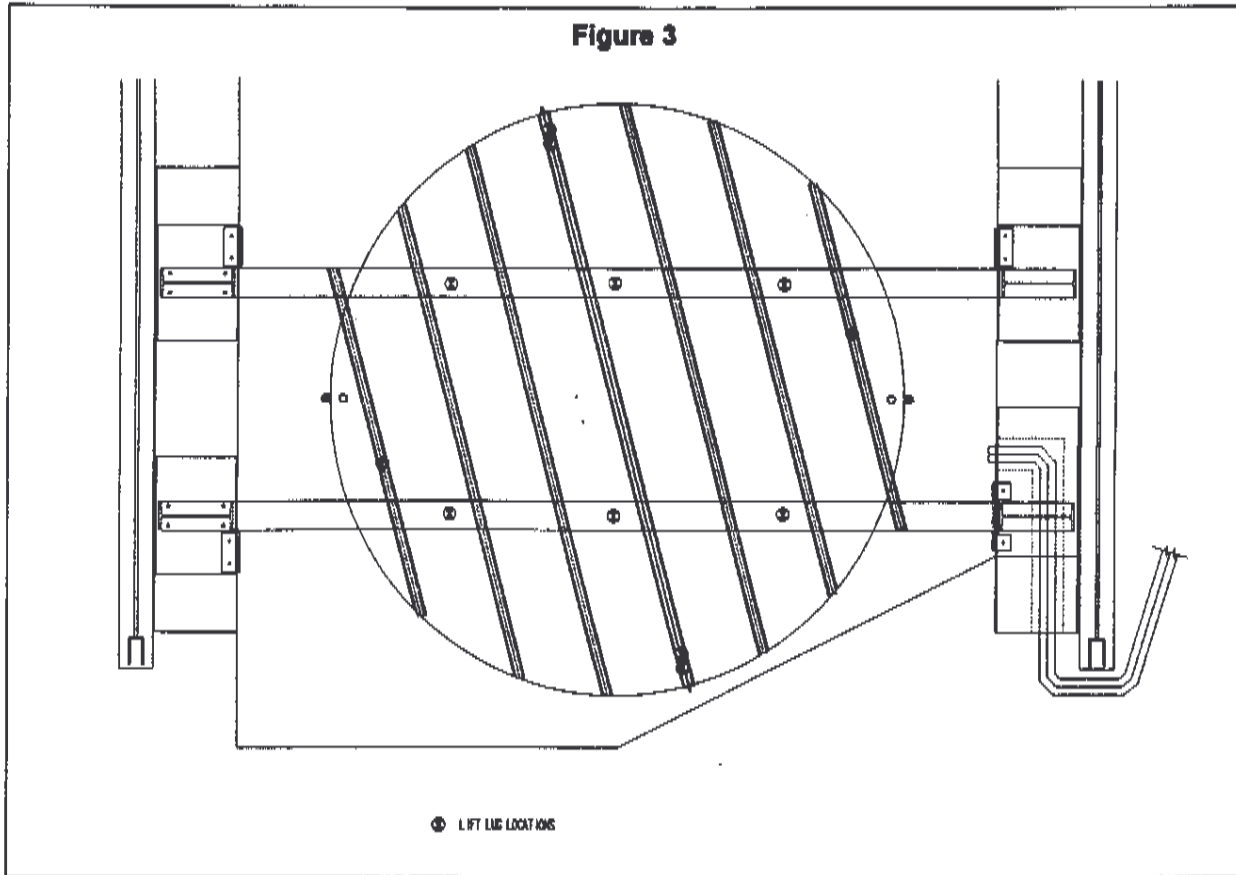


Figure 2





Survey Location	Dose Rate (mR/hr)		Reduction Factor
	No Shield	With Shield	
2	160	20	8.0
3	100	22	4.5
4	120	28	4.3
7	180	28	6.4
8	140	30	4.7
9	100	22	4.5
11	240	20	12.0
12	180	22	8.2
13	220	28	7.9
14	100	30	3.3
Average	154	25	6.2

Figure 4. Indian Point 2 Hydro-vac® Radiation Survey Data

Author Biography

W. Alan Homyk is the Radiation Protection Manager at Con Edison's Indian Point 2 Nuclear Power Station. He directs all aspects of the site health physics, radiological engineering, radioactive waste, and chemistry programs. Prior to joining Con Edison, he worked for General Dynamics - Electric Boat Division and Bechtel Corporation. Mr. Homyk has a B.S. in Nuclear Engineering from Rensselaer Polytechnic Institute and an M.B.A. from Eastern Michigan University. He is a Certified Health Physicist and is a Registered Professional Engineer in New York State.

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