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SURVEILLANCE INSPECTION VIEWING AIDS REVIEW OF OPERATING EXPERIENCE WITH UNDER WATER CCTV AT TARAPUR.

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INTRODUCTION

The main reason of surveillance inspection and reactor components is to check up development of any defects due to radiation, stresses, corrosion etc. Since all these components are highly radioactive, inspection becomes a difficult task without proper viewing aids.

There are different types of viewing aids for surveillance inspection in use.

1. High power Binoculars
2. Borescope
3. Fibre Scope
4. Glass bottom float devices
5. Closed circuit Television

For nuclear reactor inspection, conventional CCTV requires modifications, in view of high radiation fields and under water operation.

The main advantages of CCTV against conventional viewing aids are:

a) Operating personnel can observe reactor internal components and fuel assemblies etc. at different angles and at different angles and at different magnifications.

b) Clarity and magnification capabilities of CCTV are the best amongst alternative methods currently available.

c) Several members of staff can view underwater reactor areas and decide upon plan of action.

d) CCTV only can provide permanent record by means of video tape recorder.

e) Remote simultaneous viewing of any operation can be done at different accessable locations.

...2

USE OF CCTV AT TARAPUR

Under water closed circuit television was used for the first time in India for various jobs at Tarapur Boiling Water Reactors.

Briefly CCTV was used for -

1. Cutting of bracer rods inside a reactor vessel
2. Inspection of Failed Fuel Bundles
3. Inspection of Core Internals
4. Final Core verification after fuel loading.

To perform all these jobs CCTV camera and cable was in contact with reactor water.

DETAILS OF CCTV EQUIPMENT USED

Figure 1 shows block schematic of CCTV equipment. Figure 1 is dividédiin two parts A & B. A consists of water tight camera box containing lens assembly vidicon tube and pre amplifier and 33 metres cable which goes under water. Part B consists of video amplifier Power/Sync. board, T.V. receiver and video tape recorder.

Underwater CCTV camera used at Tarapur was housed in a 67 x 13 x 10 cms rectangular stainless steel box weighing about 40 kg. This camera housing is suitable for depths upto 33 meter hydrostatic head. It was connected to video equipment by means of 33 meter cable. The under water illumination was provided by two or three underwater droplights, each of 1000 watts.

OPERATIONAL PROBLEMS & ITS RECTIFICATION

Fig.2 shows the cut section of Tarapur reactor vessel with cavity and fuel bridge. To inspect guide tube thimbles or stabilizer bracer rods, CCTV camera was lowered from the fuel bridge at El.200'. Following problems were faced on the CCTV which were successfully overcome by on site modifications.

1. Due to heavy weight of camera and cable, difficulties were experienced while lowering the camera and while maneuvoring the camera through a 8" hole in the bottom grid.

...3

2. Water proofing made at the cable connector with RTV sealing was inadequate to take the weight of the cable and resulted in breaking of the co-axial conductors.

3. Water tight box is rectangular in shape and fixed by allen screws at the ends generally posed a problem of decontamination and that of water tightness.

In addition to the above, additional difficulties were faced while angling the camera and maintaining the viewing angle.

All the above problems were overcome by onsite modifications as follows:

1. In order to provide easy maneuvoring and angling, nylon ropes were used which were tied at opposite sides by providing special brackets (Fig.3).

2. Nylon ropes were attached ahead of cable connector and connected to the winch to eleminate sharp bends at the connector while lowering the camera (Fig.3).

3. Various types of sealing components viz. duc-seal m-seal, Dunlop rubber seal were made use of for waterproofing.

4. Marsh marine Neoprene boot was strengthened by teflon sleeve insert (Fig.4). Indigenous neoprene boots were developed.

SUGGESTIONS TO PROSPECTIVE MANUFACTURERS FOR IMPROVING RELIABILITY OF CCTV SYSTEMS

Underwater CCTV system finds its use not only in nuclear reactors but also in Oceanographic survey and for the Indian Navy for under water work. As a number of difficulties were experienced due to weight of camera and cable, following suggestions are worth noting by prospective manufacturers since underwater CCTV system is still being imported in India.

i) Under water CCTV camera box should be as light as possible, but at the same time it should not float and swing with water ripples, when dipped into the water.

...4

ii) As regards its use in nuclear reactors, for ease of decontamination, the surface should be smooth and circular. The camera eye piece glass and its back connections should be of threaded type with 'O' rings for water tightness.

iii) The co-axial signal conductors in the cable should be multistrand.

iv) The movement of conductors inside the cable connector should be less. The connector should not reflect any tension on the conductors due to sharp bends.

v) The camera angle should be adjustable from remote control. In other words Pan & Tilt Mechanism should be housed alongwith the camera.

vi) All optics used should be of non browning type and suitable for high radiation fields.

vii) Remote zooming facility will be very useful.

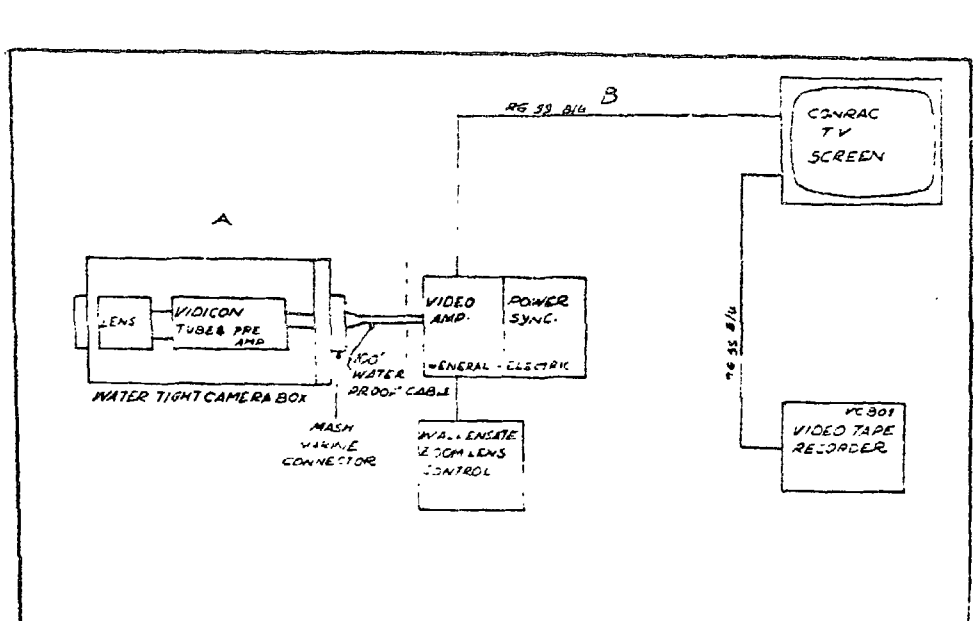

FIG 5

BLOCK SCHEMATIC OF UNDER WATER CCTV SYSTEM

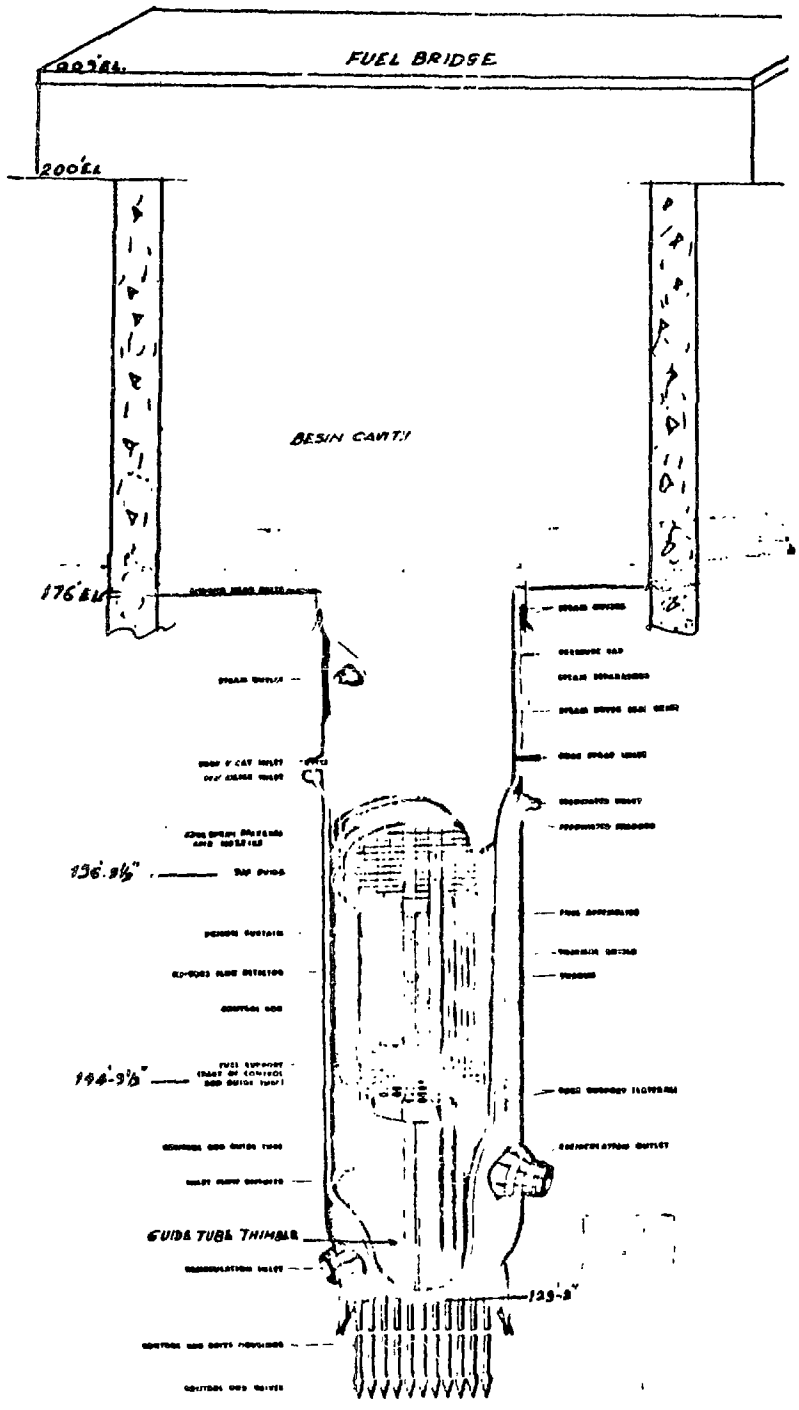
FUEL BRIDGE
200'EL
BESIN CANT.!
176'EL
136.9½"
194'-9½"
GUIDE TUBE THIMBLE
139'-8"

FIG 2

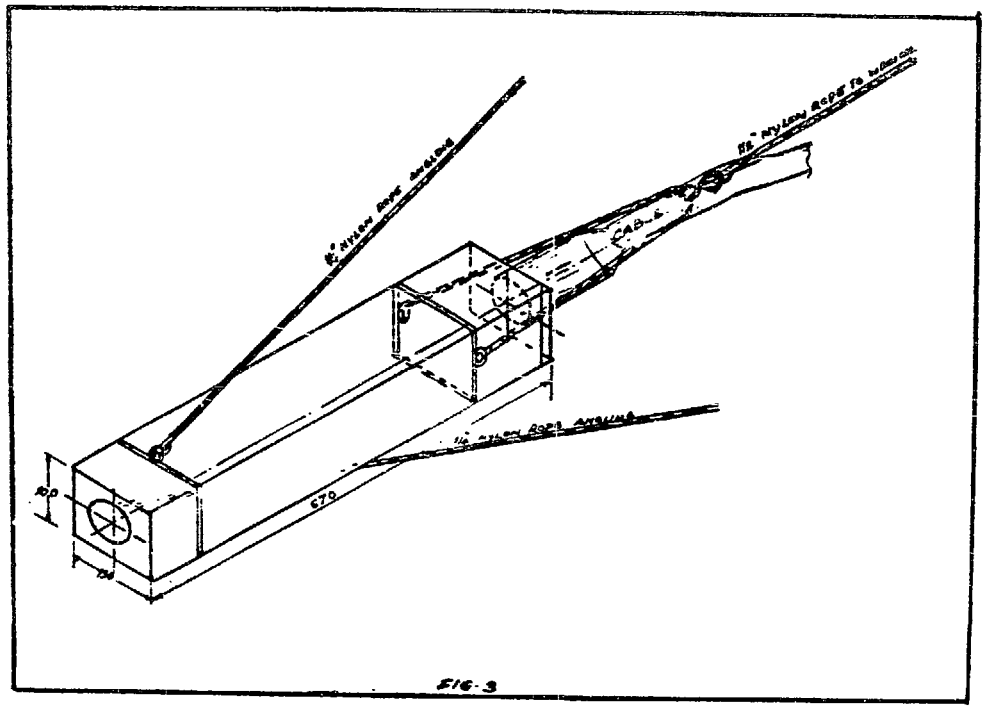

Fig 3

ISOMETRIC VIEW SHOWING ANGLING LOWER NYLON ROPE ARRANGEMENT

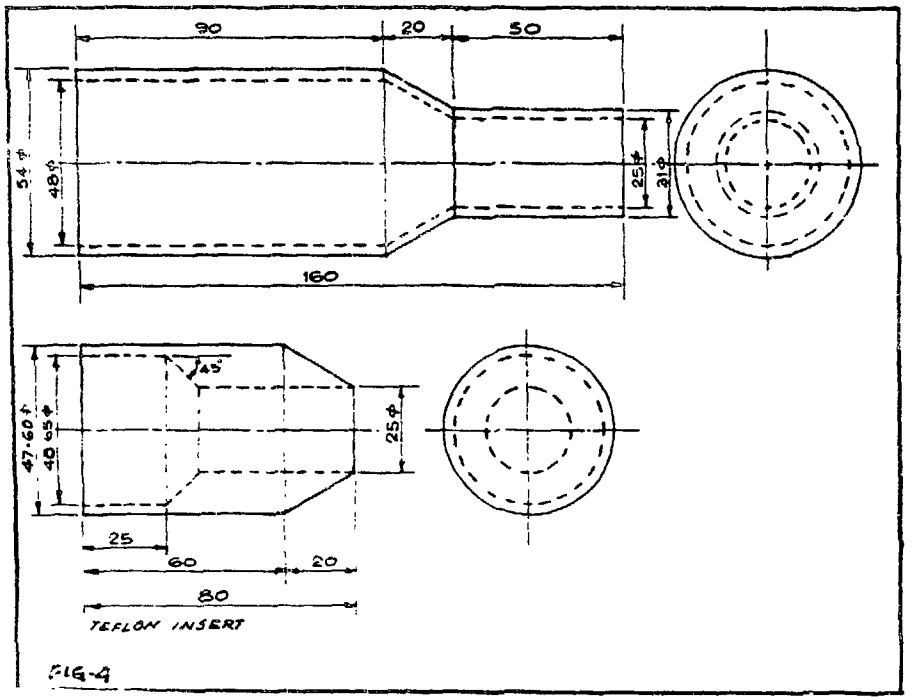

FIG-4.

SKETCH SHOWING NEOPRENE BOOT TEFLON INSERT