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V. S. BOYER
SR. VICE PRESIDENT
NUCLEAR POWER

December 10, 1984

Docket No. 50-277

Mr. John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Peach Bottom Atomic Power Station - Unit 2
Piping Replacement Man-REM Estimates

Dear Mr. Stolz:

This letter is submitted as a follow-up to a telephone conference on October 22, 1984, between Mr. Gerald A. Gears, Peach Bottom NRC Project Manager, Mr. Michael Lamastra, NRC Radiation Assessment Branch, and W. M. Alden of Philadelphia Electric Company Licensing staff to provide information concerning unexpectedly high radiation levels in the reactor recirculation pumps following chemical decontamination of the recirculation system piping.

The attached report describes the circumstances and magnitude of the high radiation levels and corrective actions considered and taken to maintain personnel exposure as low as reasonably achievable (ALARA). Since extraordinary measures were taken to effect a mechanical decontamination of the pumps, it is expected that approximately 70 man-rem will be expended in this decontamination effort.

The scope of the pipe replacement modifications has been increased as a result of inspections performed during the outage and will require additional man-rem exposure beyond the original estimates. In April 1984, following refinement of the craft manhours required for the original scope of the work, it was estimated that 1,945 man-rem exposure would be required. However, replacement of the ten recirculation inlet safe ends and two jet

A001
1/1

pump instrumentation seals will require approximately 300 man-rem more than originally estimated.

If the exposures required for the pump decontamination, recirculation inlet safe ends and jet pump seal replacement are accounted against piping replacement, the total exposure to complete the modifications is estimated to be approximately 2,039 man-rem as indicated in the attached report.

Should you require further information or have any questions, please do not hesitate to contact us.

Very truly yours,

V. S. Boyer

Attachment

cc: J. H. Williams, Resident Inspector

DECONTAMINATION OF RECIRCULATION
SYSTEM PUMPS AND VALVES

INTRODUCTION

In order to maintain personnel exposure as low as reasonable achievable (ALARA) during the pipe installation phase, Philadelphia Electric Company contracted with its NSSS vendor to perform piping decontamination utilizing London Nuclear Ltd. CAN-DECON decontamination reagent. Although the decontamination of the piping was effective, the decontamination of the recirculation pumps was not as effective as expected.

The presence of high radiation levels in the recirculation pumps constitutes a special problem to effect further decontamination of the pump internals. Decisions were made that dose reduction might be effected using other means, i.e., hydrolazing or air injection into the pump cavity followed by water flush. Since the pipe modification project ALARA group was convinced that further dose reductions were possible, special efforts were initiated in the interest of maintaining occupational exposure ALARA.

Chemical decontamination of the recirculation system piping was completed on August 8, 1984. Work efforts during the balance of the month of August were directed at consolidating the radioactive crud from the outboard elbows and the valves. This was accomplished by hydrolancing through openings cut in the pipe and draining through the valve body and suction drains. By the end of August 1984, the suction and discharge elbows outboard of the valves, except for B suction, had been flushed of high level crud, and the radiation levels in the work area, after installation of temporary shielding around the pumps and on piping hot spots, were low enough to allow installation of valve supports to accommodate removal of the elbows outboard of the valves. The outboard elbows were removed during the first two weeks in September. After removal of the elbows, hydrolancing through the valves was performed in order to flush the remaining crud out of the system and to allow work to be initiated on the pipes between the pumps and valves. During the last two weeks in September, the pipes between the pumps and valves were removed, allowing direct acess to the pumps for hydrolancing. Radiation levels inside the pump were 200-300 R/hr and 4000-5000 mr/hr in the work areas around both pumps.

At the end of September, after several attempts to reduce the radiation levels on the 'B' recirculation pump by hydroblitz, radiation levels were 175-200 R/hr inside the pump and 30 R/hr at the pump suction cut.

SURVEY DATA

In order to measure the effectiveness of the chemical decontamination, contact dose rate measurements were taken on the piping system prior to and after chemical decontamination. The post-decontamination surveys indicated an effective decontamination of the piping system, but little or no decontamination of the recirculation pumps and valves. Listed below are the pre and post-decontamination radiation levels associated with the recirculation pumps, valves and adjacent piping.

Surveys #144 (July 31, 1984, pre-decontamination) and #180 (August 8, 1984, post-decontamination) show the following results for the six survey points in and around the pumps and valves. (See Figure 1 for survey point locations):

Survey Point	Pre-Decon (mr/hr)	Post-Decon (mr/hr)	Physical Location
1	300	75	A discharge riser elbow
2	9000	8000**	A pump body
3	350	35	A suction riser elbow
4	200	30	B discharge riser elbow
5	14000	15000**	B pump body
6	230	30	B suction riser elbow

Survey data for May 9, 1984 and August 8, 1984 show the following results for 12 survey points in and around the pumps and valves. (See Figure 2 for survey point locations):

Survey Point	Pre-Decon (mr/hr)	Post-Decon (mr/hr)	Physical Location
5P	229	42.9	A suction riser elbow
6B	--	--	A pump suction string section
6P	334	26.5	A pump suction
7P	1617	1060**	A pump body left
8P	--	3590**	A pump body right
9P	146	89.1	A discharge riser elbow bottom
10P	175	33.2	A discharge riser elbow top
11P	208	25.9	B suction riser elbow top
12P	--	53.8	B suction riser elbow bottom
13P	255	62.5	B pump suction string section
14P	793	1040**	B pump body left
15P	238	3150**	B pump body right
16P	187	19.1	B discharge riser elbow bottom

As demonstrated above, all post-decontamination contact dose rates on the pipes adjacent to the pumps and valves were measured in tens of mr/hr, indicating expected decontamination of the pipe. In contrast, the post-decontamination dose rates on the pump (indicated by **) were still reading in thousands of mr/hr, indicating less than expected decontamination of the pumps. Post-decontamination contact measurements were also made on the valves, (See Figure 3, Survey #181) with contact dose rates reading 1 to 1.2 R/hr, indicating less than expected decontamination of the valves.

The high radiation levels which remained at the pumps and valves caused high radiation levels in the working area at the 116' elevation. Because of these high radiation levels, it was decided that support of the valves, placement of pump shielding, and the placement and alignment of the pipe cutting equipment should be performed with water in the lower part of the recirculation system to provide some shielding. Surveys performed in late June and early July had indicated that water in these pipes reduced the working area radiation levels by approximately 60 percent.

MECHANICAL DECONTAMINATION

Two alternates for crud removal by agitation were considered since it was anticipated that the crud in the recirculation pumps would be as loosely adhered at Peach Bottom as it was at Monticello and access to each side of the pump could be obtained by using the chemical decontamination ports on the suction sides of the pumps and opening the welded flange connections for the valve by-pass on the discharge sides. These alternatives were: 1) inject air through a decontamination fitting during the drain and flush operation with the air bubbles providing the agitation through a scrubbing action; 2) blind hydrolance the pump internals after the system was drained.

Because of concerns that hydrolance nozzles could become wedged in the pump internals during blind hydrolancing and cause increased exposures rather than provide a solution to the high dose rates, it was decided to perform the agitation via air injection. A program was initiated to implement this alternative. A procedure was prepared, equipment was obtained and installed, and final Plant Operations Review Committee approval for the procedure was received on August 14th. During the intervening 6 days (August 8, 1984 to August 14, 1984) radiation levels at the pump and adjacent piping remained stable but high. On August 10, 1984, a Senior Health Physics techncian dedicated to the pipe replacement project prepared detailed surveys of both pumps to establish radiation levels for shielding and to estimate the potential exposure expected during installation of valve supports, pipe cutting equipment, and pump shielding (See Figure 4, Survey #188). The detailed surveys showed high radiation levels over the entire surface of the recirculation pump bowls, and also indicated high dose levels (4 to 6R/hr) on the bottom of the pump discharge pipe which had not been observed in this portion of the pipe on August 8, 1984. Neither post-decontamination survey had fixed survey points on this portion of pipe.

Shortly after the detailed pump survey on August 10, 1984, approximately 800 of the 10,000 gallons of water in the system were drained through the decontamination connection. Before the drain was initiated, a flexible plastic tube was connected to the vent on top of the A recirculation pump discharge to serve as a stand pipe to aid in monitoring the water level in the system. During the operation, it was observed that the water in the plastic tube was "muddy", indicating large quantities of particulate in the fluid.

CHRONOLOGY OF EVENTS

Between August 10 and August 14, 1984, no other surveys at the level of the pumps and valves were documented. During work efforts at the 116 ft. elevation, measurements were taken to verify that the dose rates were stable. The project procedures do not require documentation of this type of survey if radiation levels are unchanged. Under stable radiation conditions, detailed surveys are documented each week or when requested. Personnel exposure experienced during the four days was consistent with ALARA reviews based on the August 10 survey; that is, a working level dose rate of 225 to 275 mr/hr

Between August 10 and August 13, a scaffold was erected below the 'A' pump to support the cutting machine and the cutting machine was brought to the 116' level and placed on the 'A' pump suction pipe. The radiation exposures experienced by the individuals involved with these operations were consistent with the exposure experienced by the Senior Health Physics technician who performed the detailed pump survey on August 10 and with estimates prepared for the ALARA review of these tasks; that is, an average exposure in the work area of 225 to 275 mr/hr. Shortly before midnight, three individuals attempted to set the cutting machine on the A pump suction. Their exposure was documented on the RWP and averaged less than 275 mr/hr for approximately 40 minutes of exposure. Part of their work sequence was video taped and, the tape was examined for this evaluation. Shortly after midnight, three other individuals returned to the pump to realign the machine. The machine was set on the pipe, and an attempt was made to lift the machine up onto the pump suction. The lift was impeded by a lip on the pump, and the pump was jarred by several attempts to lift the 1000 pound cutting machine. These impacts may have caused the movement of the crud on the A pump; however, no comparable impact took place on the B pump.

Survey #191 prepared at 4:00 a.m. on August 14 (Figure 5) indicated that working area dose rates directly under the pumps had increased from 1000 mr/hr to a range of approximately 2000 to 4000 mr/hr.

During the next 30 hours, (4:00 a.m. on August 14 to 10:00 a.m. on August 15), dose levels on the pumps and adjacent pipes continued to change even though there were no external stimuli to initiate the change. Survey #191, taken at 4:00 a.m. on August 14, showed high radiation levels on the bottom on the A pump bowl (See Figure 5). Survey #192, taken at 9:00 p.m., shows that the dose rates on the bottom of the discharge pipes adjacent to the pumps were approximately 5 R/hr (See Figure 6). By 4:00 a.m. on August 15, dose levels at the bottom of the pump suction elbow had risen to 70 and 110 R/hr on the B and A loop, respectively; the dose level on the A pump discharge had risen to 70 R/hr; and work area dose levels had risen to between 600 and 4000 mr/hr on the A loop. Working level dose rates at the suction and discharge valves remained relatively constant at 100 to 500 mr/hr (See Figure 7, Survey #193).

Between noon and 11 p.m. on August 15, 1984, the recirculation system was drained and flushed several times and periodically agitated with short bursts of compressed air. During the day, the radiation levels at the bottom of the pump suction elbow continued to increase as measured with a teletector. At one point, the peak reading on the A pump reportedly reached 700 R/hr and on the B pump, the dose rate exceeded the 1000 R/hr maximum capacity of the teletector.

Late in the evening on the 15th, flushing of the system was terminated because the drain rates were slow. A portion of the drain system (short length of fire hose on each loop), was found kinked and partially plugged. The radiation levels on the drains were reading 50 to 350 R/hr (See Figure 8, Survey #200). Flushing and draining operation were continued on August 16.

By early morning on August 17th, the lower part of the recirculation system had been drained and filled several times and the dose levels were stable. The high radiation levels adjacent to the pumps, however, had not been reduced. Large radiation sources were distributed from the bottom of the elbow on the suction riser to the bottom of the elbow on the discharge riser on both loops. Figure 9, prepared on August 17th from Survey #206, is typical of the radiation levels observed on both loops.

On August 17, 1984, it was decided to hydrolance the pipes to consolidate the high level deposits distributed throughout the piping at the 116 ft. elevation. Two-inch holes were drilled into the suction and discharge pipes in both loops at the 139 ft. elevation above the location of the high radiation levels. After two days of high pressure hydrolance through the two-inch holes, the high radiation source had been removed from the A discharge elbow but not from the other three elbows. Four large windows were subsequently cut into the piping to allow flushing as well as hydrolancing. A 12-inch square window was cut into the A loop discharge elbow at the 129 ft. elevation'; 22-inch square windows were cut into the other three pipes at the 139 ft. elevation. Crud was flushed through the body drains on the suction and discharge valves.

On August 22, the A recirculation pump discharge valve body drain was plugged with crud and had a radiation level 350 R/hr The drains were modified to allow draining and back flushing. By August 23, it was determined that valves installed in the valve body drains constituted a crud trap and prevented adequate flushing. These drains were removed and replaced with flexible plastic hoses. By August 25, 12-inch windows were cut into the outboard suction and discharge elbows to allow direct flushing of the valves.

On August 29, after 12 days of hydrolance, much of the crud in the outboard elbows had been discharged through the drains. Radiation levels on the valves were approximately equal to those which were existent on August 8 at the end of chemical decontamination (See Figures 3 and 10). Therefore, work was initiated to shield the pumps, support the valves, and cut off the outside elbows adjacent to the suction and discharge valves.

During the first two weeks in September, the outboard elbows were removed which allowed direct access to hydrolaze the valves, the pipes between the valves and pumps, and the pump discharge. On

September 13, a survey was made inside the pump discharge with a teletector and radiation levels of 200-300 R/hr were observed. During the last two weeks in September, the pipes between the pumps and valves were removed, which allowed direct access to the pumps.

At the end of September, after several attempts to hydrolaze the 'B' pump, radiation levels inside the pump were 175-200 R/hr and at the pump suction pipe cut were 30 r/hr.

POSTULATED CAUSE

The most likely source of the increased levels of radiation in the pipes adjacent to the pumps is presumed to be radioactive deposits which existed in the pump internals (impeller and casing) and were subsequently dislodged during the activities on August 14 and 15. It has been postulated that the decontamination fluid was unable to completely dissolve these deposits, but did weaken or break the bonds which held them on the internal surfaces of the pump.

Subsequent soaking for six days in a very weak solution of decontamination fluid and demineralized water softened the deposits or weakened these bonds. It is possible that the activity of the individuals working on the A pump may have caused the initial movement of the surface deposits, and the high level deposits observed at the bottom of the pump suction elbow on August 15. However, since no comparable activities took place on the B pump, the movement may have been solely caused by the softening action and gravity. The compressed air injected into the system on August 15 enhanced the movement of these radiactive deposits and distributed them throughout the horizontal pipes and the valves at the 116 ft. and 119 ft. elevations. The high levels of radiation were the result of the redistribution of this radioactive material into a "less shielded" and "physically proximate" location in the piping system.

Pre-decontamination crud analysis of pipe (flange) film indicated about 16% chrome and 63% iron. Process qualification testing confirmed solubility of this crud form with the London Nuclear CAN-DECON decontamination reagent. This is supported by the decontamination factors achieved on the pipe. Post-decontamination crud analysis of samples obtained during hydrolance operations indicates a higher chrome (in the range of 46-62%) content than iron. During laboratory testing, these high chrome samples were not soluble in CAN-DECON reagent. More recent laboratory analysis was perforemd to affect a conclusion which would indicate that a two-step chemical decontamination process (reduction followed by oxidation) may dissolve the high chrome crud deposits.

For reasons currently unknown, oxides which formed on the pump surfaces are not similar to the oxides formed on the pipe surfaces. Additional investigation is underway to gain insight into the differences between pipe and pump crud deposits.

CORRECTIVE ACTIONS

Five options were considered in order to eliminate the radiation sources in the recirculation pumps to reduce area dose and maintain personnel exposure related to pipe installation As Low As Reasonably Achievable. These options are listed below.

1. Chemical Decontamination

   This option would utilize a decontamination reagent other then the London Nuclear Ltd. reagent which was utilized successfully for pipe decontamination. The reagent selection would be based on the analysis of known pump crud samples which have been collected.

2. Removal of Pump Internals and Decontamination

   Removal of the pump internals provides direct access to the internal surfaces, grooves and crevices that can trap radioactive crud. In addition to the decontamination of these areas, the wear ring, hydrostatic bearing, shaft, and other parts of the pump internals can be inspected. The pressure retaining parts of the pump can also be inspected in accordance with ASME Section XI inservice inspection requirements.

3. Replacement of the Pump Case and Internals

Replacement of the pump case and internals requires replacement of the entire pump including case, internals, coupling, and driver mount with another unit minimizing interchangeability rework.

4. Remote Crud Trap Cleanup

Remote clean-up is a process by which an apparatus such as a water supply nozzle is inserted through the discharge nozzle of the pump. The water nozzle would be guided by the pump case and the impeller, while it is supported by a flexible shaft. The flush from the apparatus could drain through the pump suction or discharge or be sipped by another close proximity vacuum sipper.

5. Special Shielding Designs

In order to continue the work without removal of the high radiation sources in the pumps, special shielding could be installed in and around pump to reduce exposure.

Evaluation of the advantages, disadvantages and the ALARA impact of the options presented above resulted in the selection of Option 2, Removal of Pump Internals and Decontamination. This option will be performed on both recirculation pumps. The following work items are required for the decontamination:

- Removal of the pump-motor coupling spacer
- Motor removal
- Motor storage
- Removal of the pump seal/coupling
- Removal of the motor mount
- Set-up of shielded cask to receive pump internals
- Removal of pump internals
- Perform hydrolazing and/or glass bead blasting as needed
- Decontamination of the internals
- Appropriate Inspections
- Reassembly of the pump and motor

The hydrolazing and/or glass bead blasting will be performed utilizing a high pressure water source. Hydrolazing or high pressure glass bead blasting will be performed on the pump shaft and impeller by alternately lifting and rotating the pump internals in specified increments. The shaft and impeller will be hoisted into a shielded cask, for transport to the Unit 2 refuel floor for further decontamination if required.

With the pump shaft and impeller removed, the internal surfaces of the pump casing will be surveyed to determine the location of the radiation sources and to establish a baseline for assessment of the effectiveness of the decontamination. The ultimate decontamination method to be utilized on the pump casing internals is dependent upon the results of these surveys. Since direct access to the source areas will be available, there is a high degree of assurance that this option will result in successful decontamination of the pump internals. All operations involved in this process will be performed with prior ALARA review. The water spray will be contained and the residue collected for disposal.

MAN-REM ESTIMATES

The initial Man-REM estimate prior to start of the outage to complete piping replacement modifications was 1,810 Man-REM as submitted via letter, S. L. Daltroff, PECo, to J. F. Stolz, USNRC, on March 8, 1984. Further refinement in the manhour estimates completed in mid-April, 1984, indicated at that time that a man-REM expenditure of 1,945 would be required to complete all pipe replacement modification work. These estimates were based on the following scope of work:

Original Scope

- o complete replacement of recirculation system piping loops A and B
- o replacement of Residual Heat Removal (RHR) system shutdown cooling suction and return piping inside containment
- o replacement of a portion of the RHR head spray piping inside containment
- o replacement of a portion of the reactor water cleanup (RWCU) piping outside containment
- o replacement of the RWCU containment penetration

Expanded Scope

As a result of indications discovered while performing additional weld inspections during the outage, the scope of work has been increased, since the time of the April man-REM estimates, to include the following:

- o replacement of two jet pump instrumentation seal reducers
- o replacement of ten recirculation inlet riser safe ends

An ALARA milestone review of all pipe modification related tasks was completed following pipe removal to assess the accumulated man-REM exposure for the completed phases of the project.

After 26 weeks of outage time, the pipe replacement modifications have accumulated 870 man-REM in 32,550 radiation work permit (RWP) hours. The April, 1984, man-REM estimate and the actual man-REM exposure for the three phases of the project completed to date is as follows:

Project Phase	April 1984 Estimated Man-REM	Actual Man-REM Exposure
I Pre-Decontamination	445	386.5
II Pipe Decontamination	38	40.4
III Pipe Removal	516	326.3

The actual exposures through the pipe removal phase are tracking at approximately 78% of the April exposure estimates.

The April, 1984, man-REM estimates for project phases IV and V (Pipe Replacement and Restoration) were 887 man-REM and 59 man-REM, respectively. The Pipe Replacement Phase of the project is being re-estimated due to the increased scope of work consisting of the replacement of two jet pump instrumentation seal reducers, the ten recirculation system inlet riser safe ends, and installation phase modifications required because of deferral of work in the vicinity of the recirculation pumps. Additionally, the man-REM exposure required for the unforeseen necessity of decontaminating the recirculation pumps will contribute to the projected man-REM to complete the piping modifications. The estimated exposure to complete the Pipe Replacement and Restoration phases of the project are as follows:

Project Phase	April 1984 Estimate Man-REM	Current Estimate Man-REM
IV Pipe Replacement	887	887
o Pump Decontamination	N/A	70
o Jet Pump Instrumentation Seal	N/A	80
o Recirc Inlet Riser Safe Ends	N/A	190
o Total (phase IV)	887	1227
V Restoration	59	59

Both the April, 1984, estimate and current estimate are based on an area dose rate of 150 mr/hr following pipe decontamination. The accuracy of the current estimates for the Pipe Replacement and Restoration phases is dependent upon the results achieved in performing the recirculation pump decontamination described.

A comparison of the current estimates based on the increased scope of work, actual man-REM exposure tracked to date and the April, 1984, estimate is as follows:

Project Phase	April 1984 Estimate Man-REM	Estimate based on Actual through Phase III completion Estimated Man-REM
I Pre-Decontamination	445	386.5**
II Piping Decontamination	38	40.4**
III Pipe Removal	516	326.3**
IV Pipe Replacement	887	1227
V Restoration	59	59
	1945	2039.2

**Denotes actual dose expended.

Work is proceeding on decontamination of the pump with both impellers having been hydroblitzed and removed from the drywell. At completion of decomtamination, performance of radiological surveys will indicate the effectiveness of the hydrolazing. The surveys will be utilized to perform a re-estimate of the Pipe Replacement and Restoration phase man-REM exposure to complete the project.

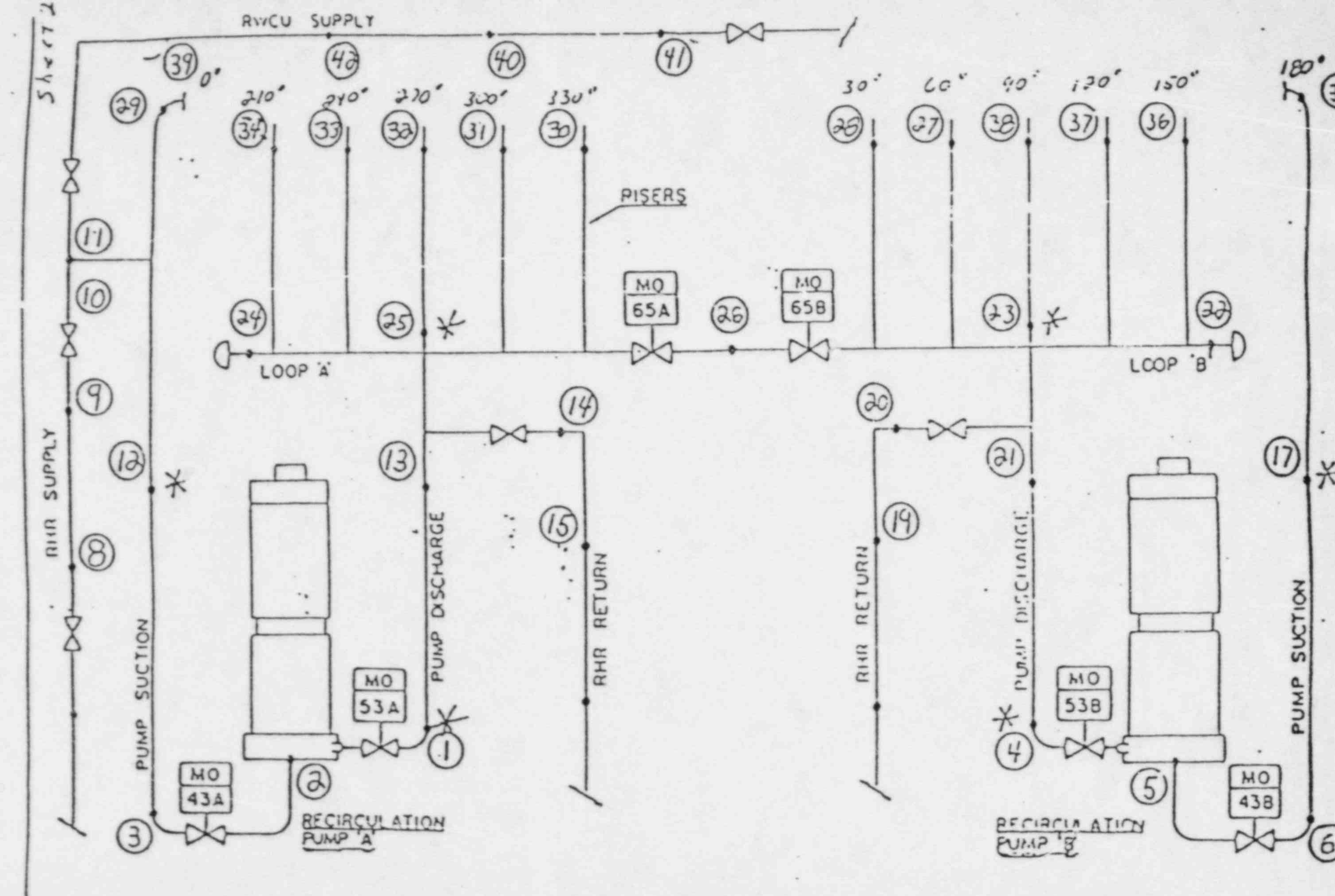


FIGURE 1

PEACH BOTTOM UNIT 2

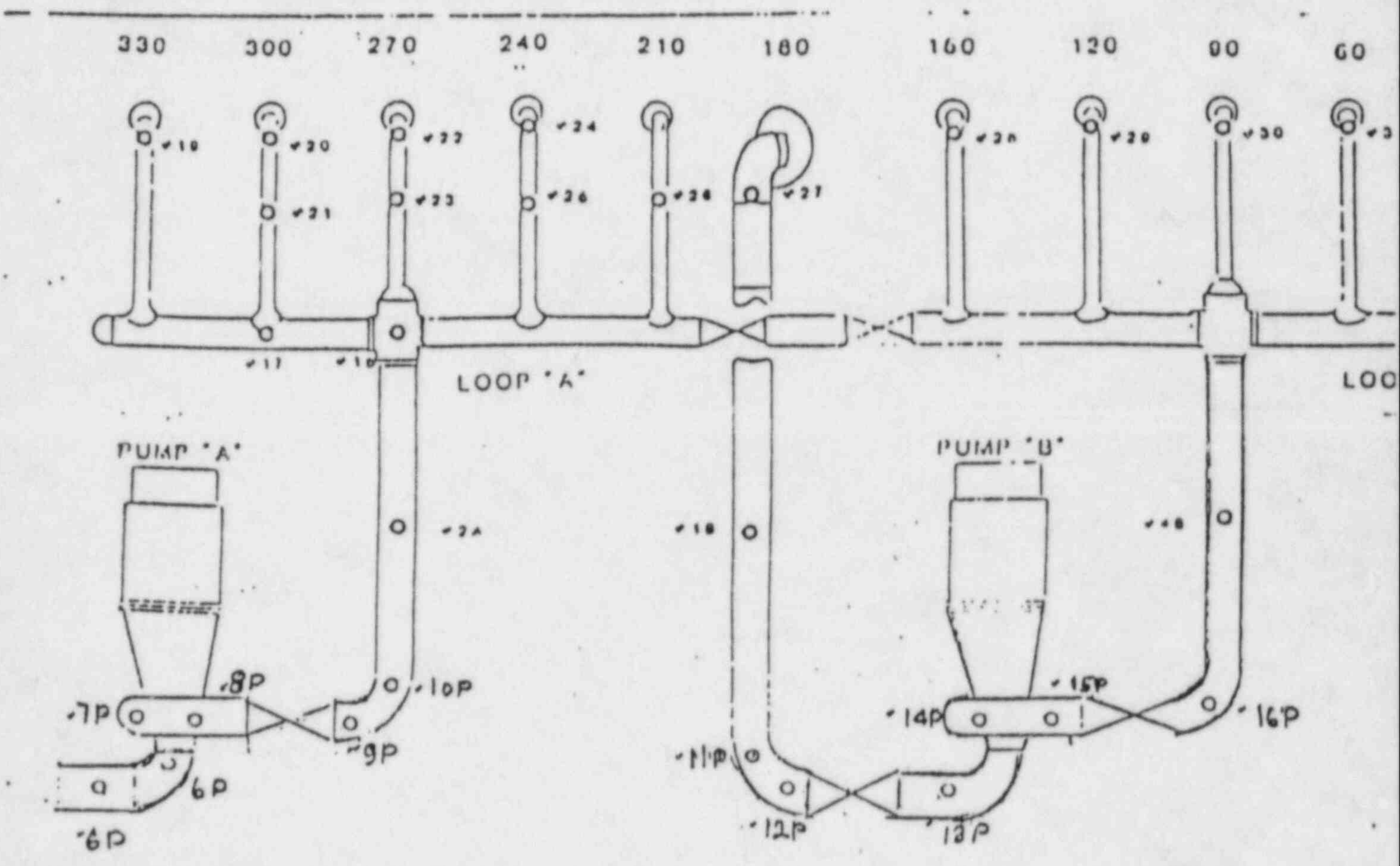
DATE

TIME

SURVEY TAKEN BY

NOTES
1. SURVEY POINTS SHOWN •
2. ADDITIONAL POINTS MAY BE TAKEN
3. ALL POINTS TO BE RECORDED ON TABLE 6.13

FIGURE 2



330
300
270
240
210
180
160
120
90
60
LOOP 'A'
PUMP 'A'
PUMP 'B'
7P
8P
9P
10P
6P
11P
12P
13P
14P
15P
16P

FIGURE 3A

PBAPS – RADIATION–CONTAMINATION – DIAGRAM SHEET

196-21309 12/81
DOCTYPE 502

UNIT 2 [X] · UNIT 3 [ ]

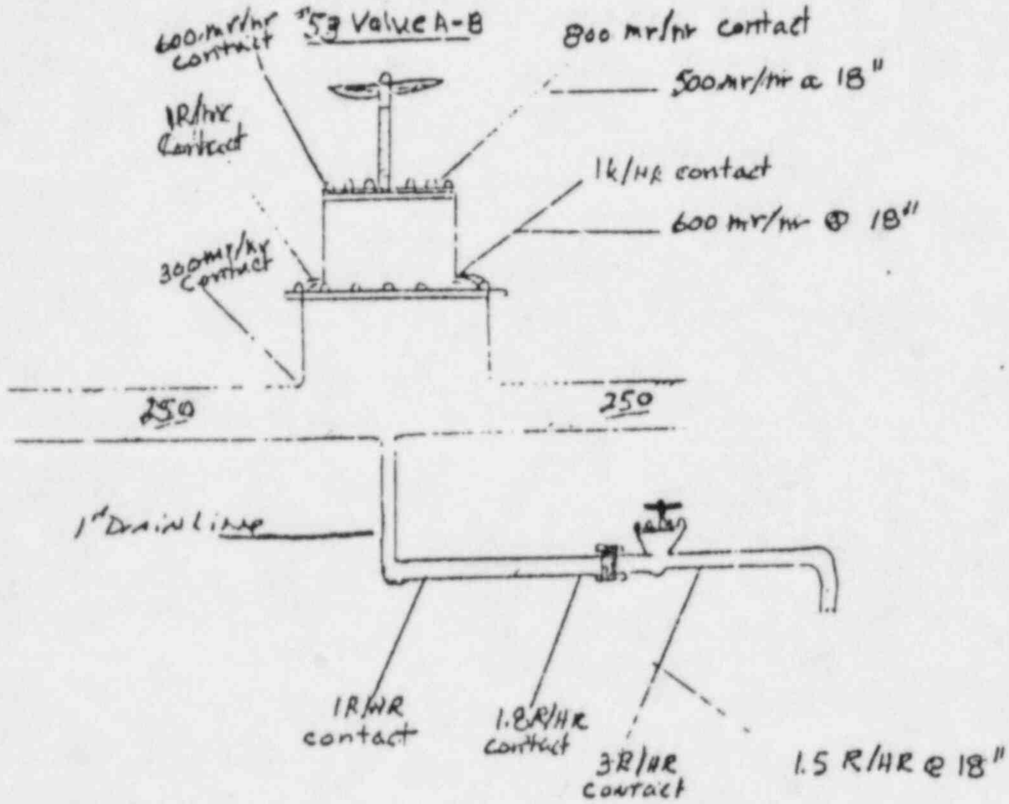
R.W.P. NO. 02-01-513

SURVEY NO. 181

DATE · 8-8-84 TIME · 14:25 SURVEY BY · Luttrell

AREA · RX2 Drywell 116' #43-53 Valves A-B

AREA DIAGRAM · REMARKS ~~Posta~~ PRE - SHIELDING EVALUATION



NOTE
G/A WALKWAY 200-400 mr/hr
G/A AT TOP OF VALVE ..
300 - 700 mr/hr
INST USED .. RO2A # 2541

LEGEND: △ · SMEAR ◯ · CONTACT RADIATION READING

(DUPLICATE)

FIGURE 3B

PBAPS – RADIATION–CONTAMINATION – DIAGRAM SHEET

196-21309 12/81
DOCTYPE 502

UNIT 2 ☒ · UNIT 3 ☐

R.W.P. NO. 02-01-543

SURVEY NO. 181

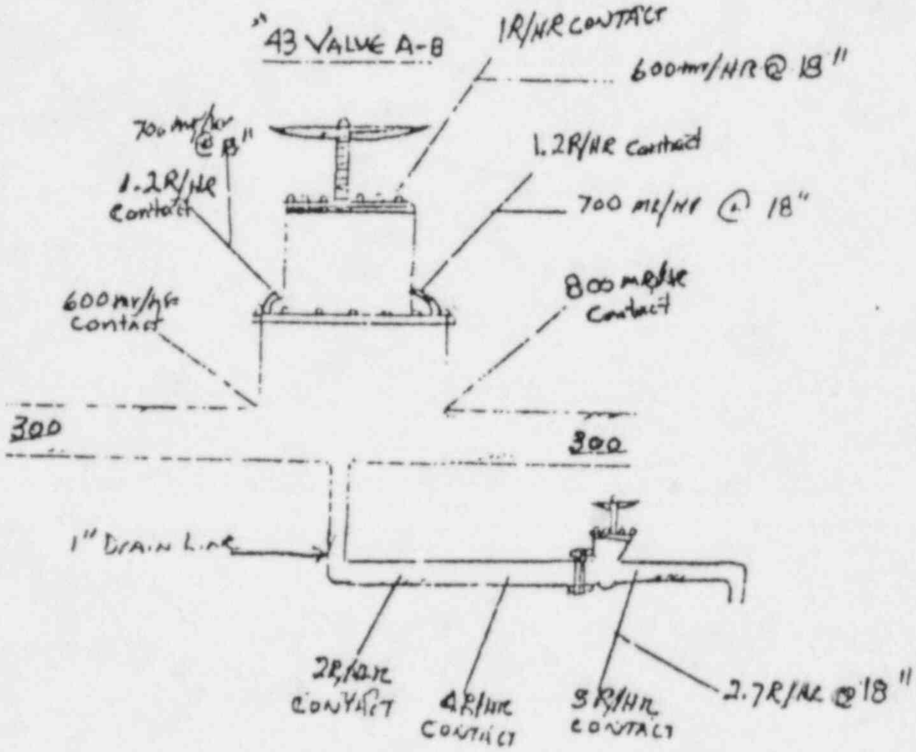
DATE · 8-8-84

TIME · 1425

SURVEY BY · Luttrell

AREA · Dry well 116' Valve 43 A·B & 53 A·B RX2

AREA DIAGRAM · REMARKS ~~Post~~ PRE - SHIELDING EVALUATION



NOTE

G/A WALKWAY 200-400 mr/hr
TOP OF VALVE ...
300 - 700 mr/hr

INST USED "R02A 2541

LEGEND: △ · SMEAR ♂ · CONTACT RADIATION READING

(DUPLICATE)

FIGURE 4A

PBAPS - RADIATION CONTAMINATION DIAGRAM SHEET

INC 21309 12/81
DOCTYPE 507

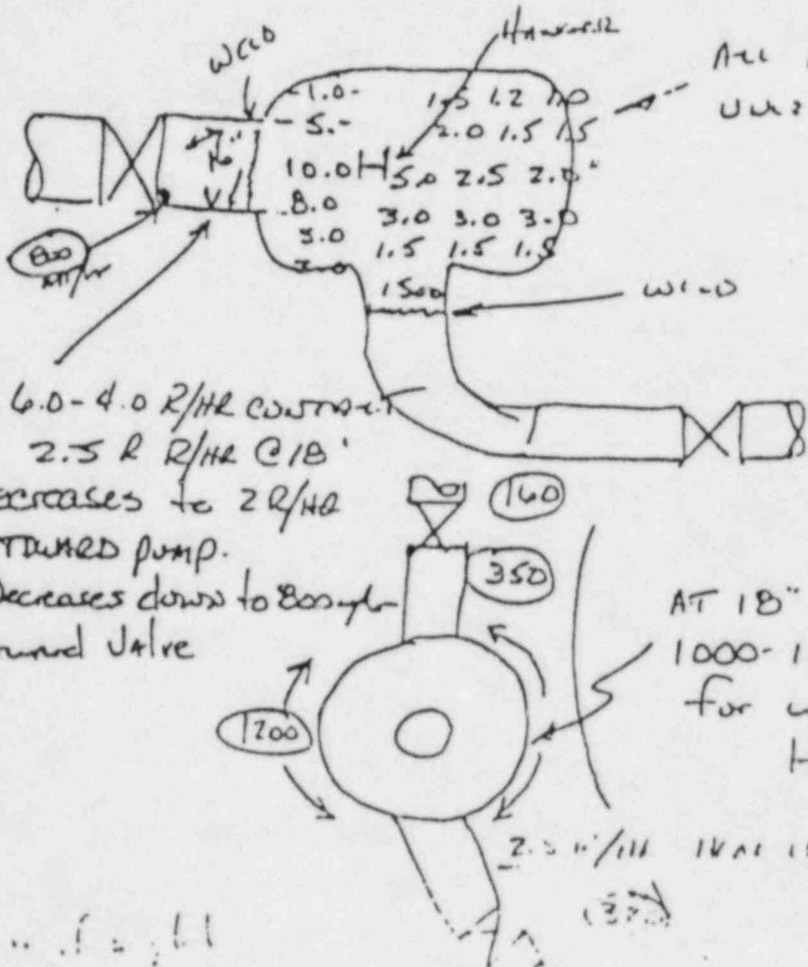
UNIT 2 ☑ UNIT 3 ☐

R.W.P. NO. 2 [illegible]
SURVEY NO. 188
DATE 8/10/84 TIME 1200 SURVEY BY W Rogers
AREA Rx 2 116' 'A' Pump

AREA DIAGRAM - REMARKS

H.P.
1.0 hour /225 mr

All Readings in R/HR unless otherwise noted



AT 18" READINGS OF
1000-1200 mr/hr chest high
for workers under pump
Head Level less.

page 1 of 3

LEGEND △ - SMEAR ○ - CONTACT RADIATION READING

(ORIGINAL)

FIGURE 4B

PBAPS - RADIATION-CONTAMINATION - DIAGRAM SHEET

194 21309 12/81
DOCTYPE 502

UNIT 2 [x] UNIT 3 [ ]

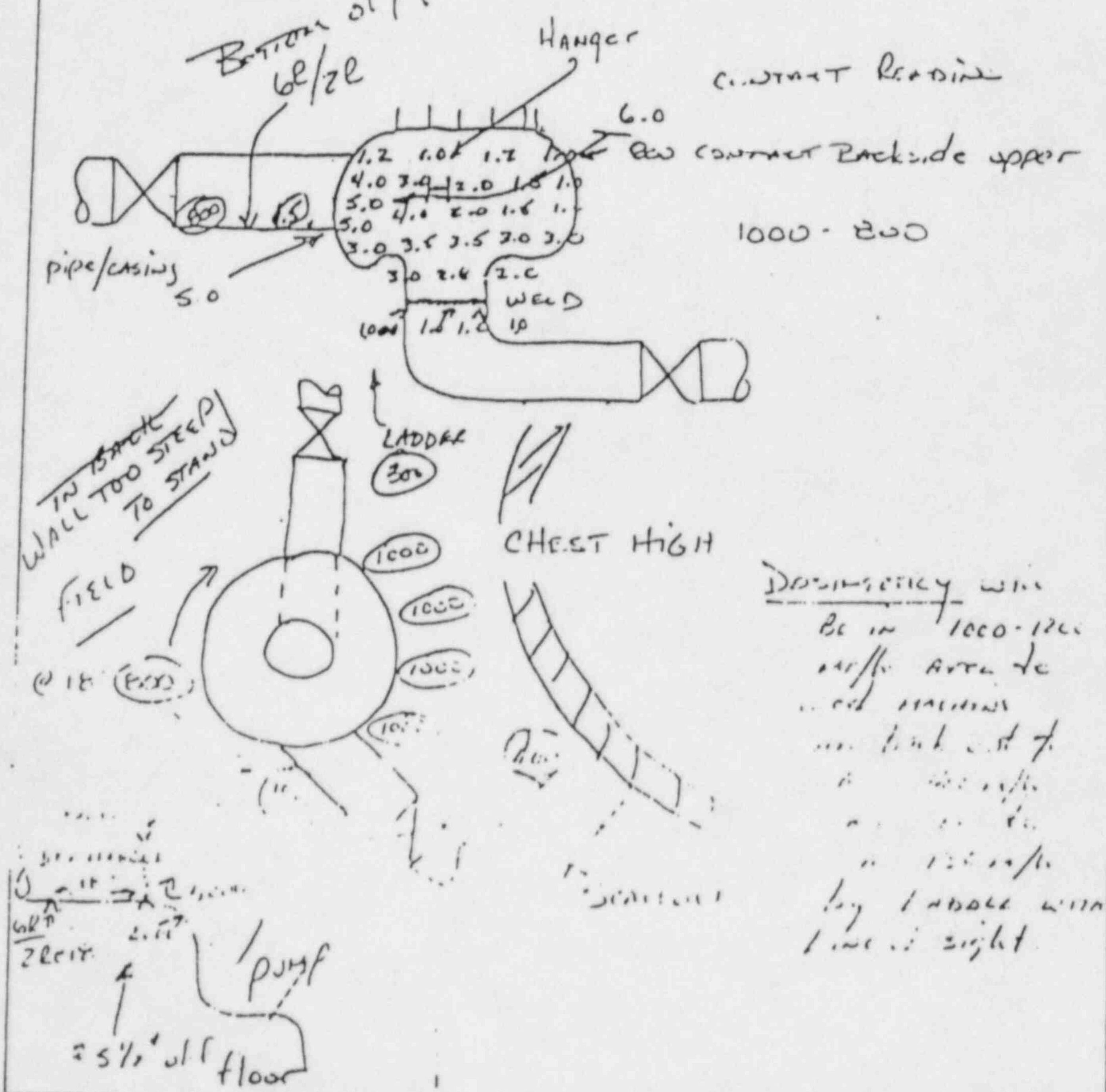
R.W.P. NO. 2-01-0543

SURVEY NO. 1

DATE: 8/17/84 TIME: 1200 SURVEY BY: W. Rogers

AREA: Rx 2 116' 'B' Recirc Pump

AREA DIAGRAM - REMARKS



LEGEND: △ = SMEAR ◯ = CONTACT RADIATION READING

FIGURE 5A

PBAPS RADIATION - CONTAMINATION - AIRBORNE SURVEY

UNIT 2 [X] UNIT 3 [ ]

RWP NO 2-94-0776

SURVEY NO 191

DATE 8/14/84 TIME 0400 SURVEY BY [illegible]

AREA A Recirc Pump

REASON Determine Dose Rates

RADIATION - INSTRUMENT SERIAL NO C2540 202A

	ITEM	BETA MRAD/HR	GAMMA MR/HR	NEUTRONS MREM/HR	TOTAL MREM/HR	DISTANCE
1	Contact on Pump		2-14 R/hr		2-14 R/hr	1"
2	Work Area on Scaffold		1.5-4 R/hr		1.5-4 R/hr	8-10"
3						

CONTAMINATION - INSTRUMENT SERIAL NO

	ITEM	BETA-GAMMA DPM/100 cm²	ALPHA DPM/100 cm²
1			
16			

AIRBORNE - INSTRUMENT SERIAL NO

SAMPLING

START

STOP

AVERAGE FLOW RATE

COUNTER

ISOTOPES

N/A

REMARKS:

FIGURE 5B

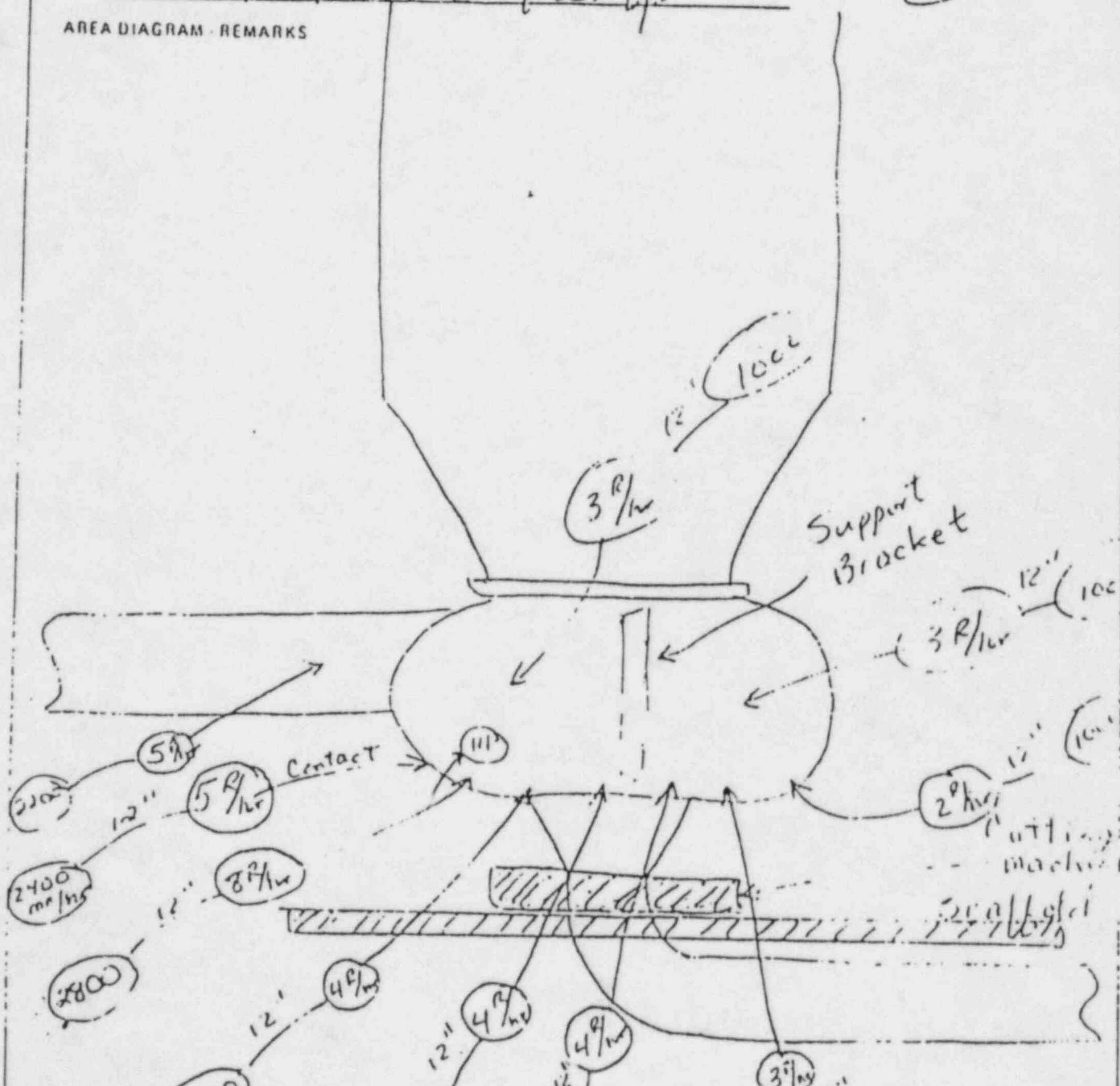
PBAPS - RADIATION-CONTAMINATION - DIAGRAM SHEET

196-21309 12/81
DOCTYPE 502

UNIT 2 ☐ · UNIT 3 ☐

R.W.P. NO. 2-94-0776
SURVEY NO. 191
DATE: 8/14/87   TIME: 0400   SURVEY BY: [illegible]
AREA: A Recirc Pump

AREA DIAGRAM · REMARKS



LEGEND: △ - SMEAR   ○ - CONTACT RADIATION READING

(ORIGINAL)

FIGURE 5C

PBAPS - RADIATION- CONTAMINATION - DIAGRAM SHEET

196-21309 12/81
DOCTYPE 507

UNIT 2 ☑ UNIT 3 ☐

RWP NO 2-94-0776

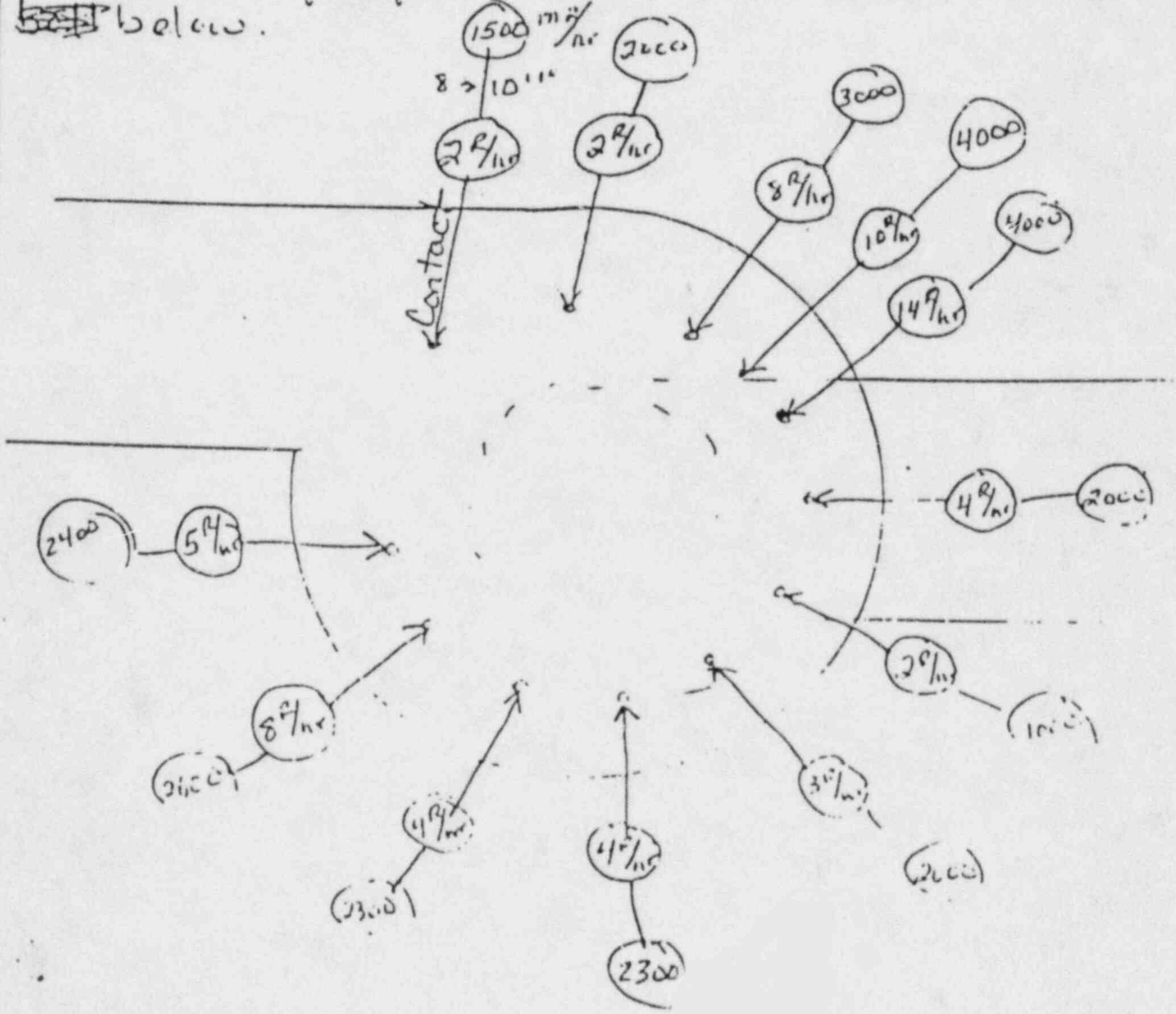
SURVEY NO 191

DATE 8/14/84 TIME 0400 SURVEY BY Southall

AREA A Recirc Pump

AREA DIAGRAM REMARKS

Dose rates on Contact with bottom of pump volute and work Area ~~[illegible]~~ below.



LEGEND △ - SMEAR ○ - CONTACT RADIATION READING

(ORIGINAL)

FIGURE 6

PBAPS RADIATION - CONTAMINATION - AIRBORNE SURVEY

UNIT 2 [X] UNIT 3 [ ]

RWP NO 2-94-0637

SURVEY NO 192

DATE 8-14-84 TIME - 2100 SURVEY BY - W. McMurry

AREA U2 D/W 116' A&B Recirc Pump Discharge

REASON - Installing level indicators

RADIATION - INSTRUMENT Teletector
SERIAL NO. 29641

	ITEM	BETA MRAD/HR	GAMMA MR/HR	NEUTRONS MREM/HR	TOTAL MREM/HR	DISTANCE
1	"A" Recirc disch. Pipe @ Indicator	ND	400/75	N/A	400/75	contact / 3'
2	"A" Recirc disch. Pipe Bottom	ND	5000/1400	N/A	5000/1400	Contact / 18"
3	"B" Recirc disch Pipe @ Indc.	ND	2000/100	N/A	2000/100	Contact / 3'
4	"B" Recirc disch. Pipe Bottom	ND	5000/500	N/A	5000/500	Contact 18"
5						
6						
7						
8						

CONTAMINATION - INSTRUMENT
SERIAL NO.

	ITEM	BETA+GAMMA DPM/100 cm²	ALPHA DPM/100 cm²
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

AIRBORNE - INSTRUMENT
SERIAL NO.

SAMPLING

START -
STOP -

AVERAGE FLOW RATE FT³/MIN

COUNTER EFF

GROSS COUNTS BKGD CPM NET CPM

COUNTING TIME

NET CPM

µCi/CC

SCALER EFF VOL × 2.22 × 10⁶

ISOTOPES

REMARKS

2100

FIGURE 7A

PBAPS RADIATION - CONTAMINATION - AIRBORNE SURVEY

.V6-21268 REV. 12/81
DOCTYPE 602

UNIT 2 ☑ - UNIT 3 ☐

R.W.P. NO. 2-01-0543
SURVEY NO. 193
DATE - 8/15/84 TIME - 0400 SURVEY BY - Sawtelle/Henry
AREA - Rx 2 D/W 116'
REASON - RWP update 'B' & 'A' Recirc. Pump.

RADIATION - INSTRUMENT SERIAL NO. Tele 31504 6/14/85; RO2A C2542 8/8/85

	ITEM	BETA MRAD/HR	GAMMA MR/HR	NEUTRONS MREM/HR	TOTAL MREM/HR	DISTANCE
1	Gen Area 116'	ND-2 Rad/hr	50-4 R/hr	N/A	50-6 Rem/hr	Field
2	Pipes/Valves/Pumps	ND-40 Rad/hr	1-110 R/hr	↓	1-150 Rem/hr	1"
3						
4	See MAP					
5						
6						
7						
8						

CONTAMINATION - INSTRUMENT SERIAL NO. RO2A C2542

	ITEM	BETA/GAMMA DPM/100 cm²	ALPHA DPM/100 cm²
1	floor	24 mRad/hr/ftc	NA
2	floor	24	
3	floor	8	
4	floor	12	
5	floor	8	
6	floor	16	
7	floor	16	
8	floor	8	
9	Valve	16	
10	Scaff around Pump	8	
11	floor	16	
12	Scaff around Pump	4	
13	wall/outer	12	
14	wall/outer	12	
15	wall/outer	4	
16			

AIRBORNE - INSTRUMENT SERIAL NO. 10 vol. 13-84

SAMPLING

START - 2045
STOP - 0320 AVERAGE FLOW RATE FT³/MIN. 1.0 COUNTER EFF. .398

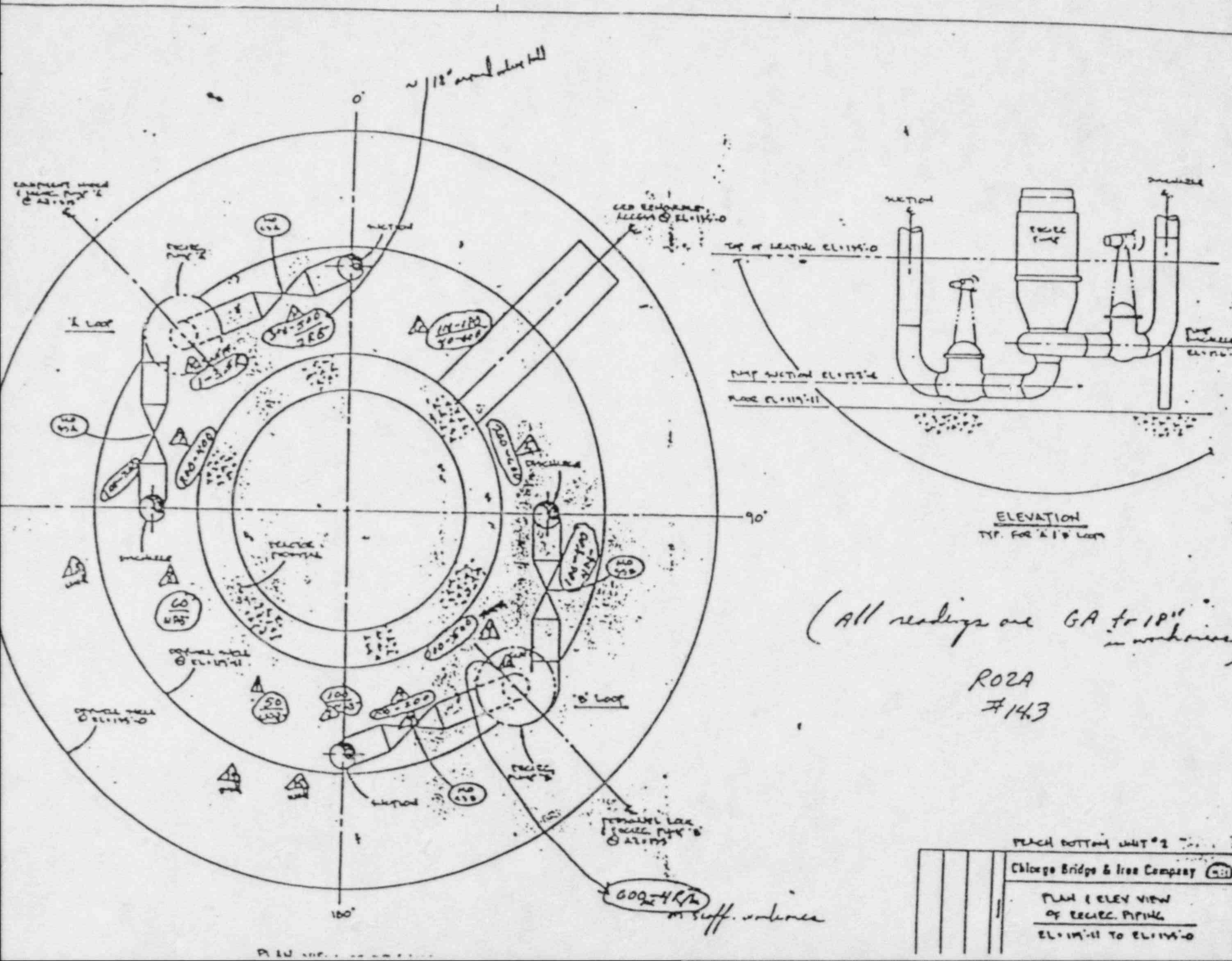
[GROSS COUNTS 15,397 / COUNTING TIME 10 min] - [BKGD CPM 24] = [NET CPM 1516]

[NET CPM 1516] / [.398 SCALER EFF.] · [395 VOL.] · 6×10^{10} = [1.6N10] μCi/CM³

ISOTOPES

REMARKS:

FIGURE 7B



~12' around dry well
0°
90°
180°
SUCTION
DISCHARGE
RECIRC PUMP 'A'
RECIRC PUMP 'B'
'A' LOOP
'B' LOOP
REACTOR PEDESTAL
ELEVATION
TYP. FOR 'A' & 'B' LOOPS
TOP OF HEATING EL. 135'-0
PUMP SUCTION EL. 123'-6
FLOOR EL. 119'-11
RECIRC PUMP
600 – 4 R/hr
in suff. workarea
(All readings are GA for 18" in workarea)
R02A
#143
PEACH BOTTOM UNIT #2
Chicago Bridge & Iron Company
PLAN & ELEV VIEW
OF RECIRC. PIPING
EL. 119'-11 TO EL. 135'-0

FIGURE 7C

PBAPS – RADIATION–CONTAMINATION – DIAGRAM SHEET

104-21309 12/81
DOCTYPE 502

UNIT 2 ☒ · UNIT 3 ☐

R.W.P. NO. 2-01-0543

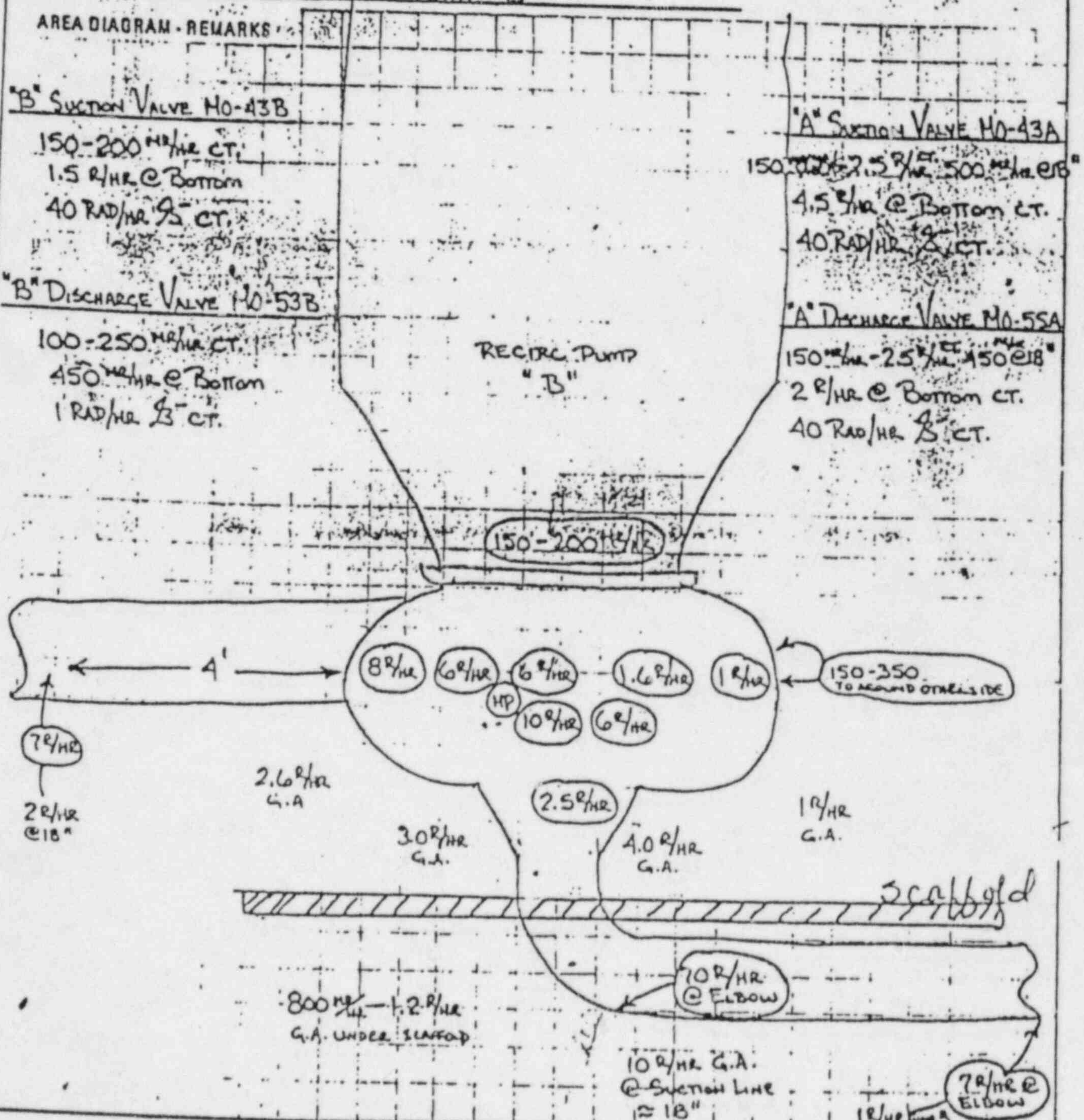
SURVEY NO. 193

DATE 08-15-84 TIME 0115

AREA Rx2 D/W 116' @ Recirc Pump "B"

SURVEY BY B.K. Tomlinson

AREA DIAGRAM · REMARKS



LEGEND: ◯ - CONTACT RADIATION READING.

FIGURE 7D

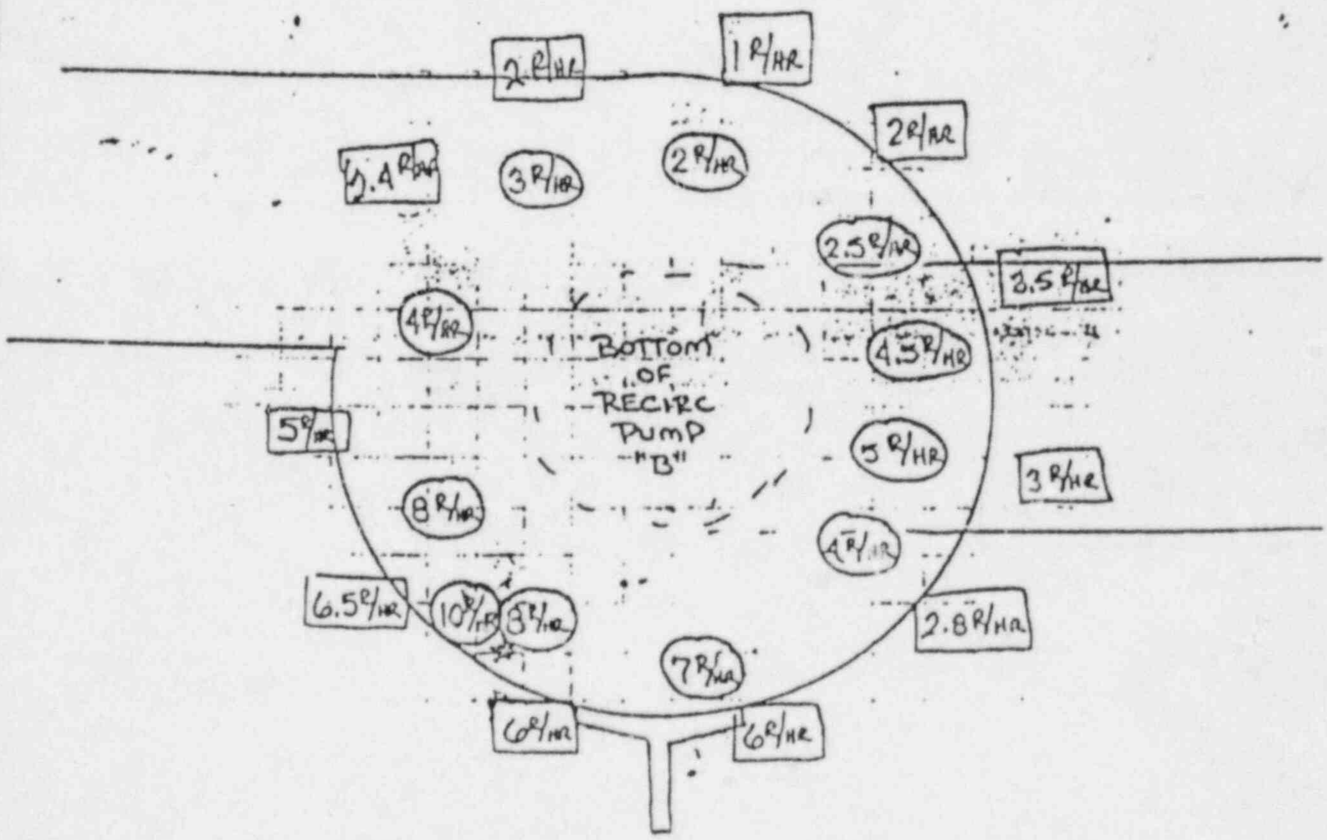
PBAPS – RADIATION–CONTAMINATION – DIAGRAM SHEET

196-21309 12/81
DOCTYPE 602

UNIT 2 ☒ · UNIT 3 ☐

R.W.P. NO. 2-01-0543
SURVEY NO. 193
DATE · 08-15-84 TIME · 0115 SURVEY BY · R.K. Tomlinson
AREA · Rx2 D/W 116' @ Recirc Pump "B"

AREA DIAGRAM · REMARKS



☐# = DOSE RATE @ HP HEAD LEVEL ON SCAFFOLD ≈ 6 - 12" FROM PUMP BOTTOM

LEGEND: △ – SMEAR ◯ – CONTACT RADIATION READING

(ORIGINAL)

RO2A # 2540 C.D.D. 5/9/84

FIGURE 7E

PBAPS – RADIATION–CONTAMINATION – DIAGRAM SHEET

196-21309 12/81
DOCTYPE 602

UNIT 2 ☒ · UNIT 3 ☐

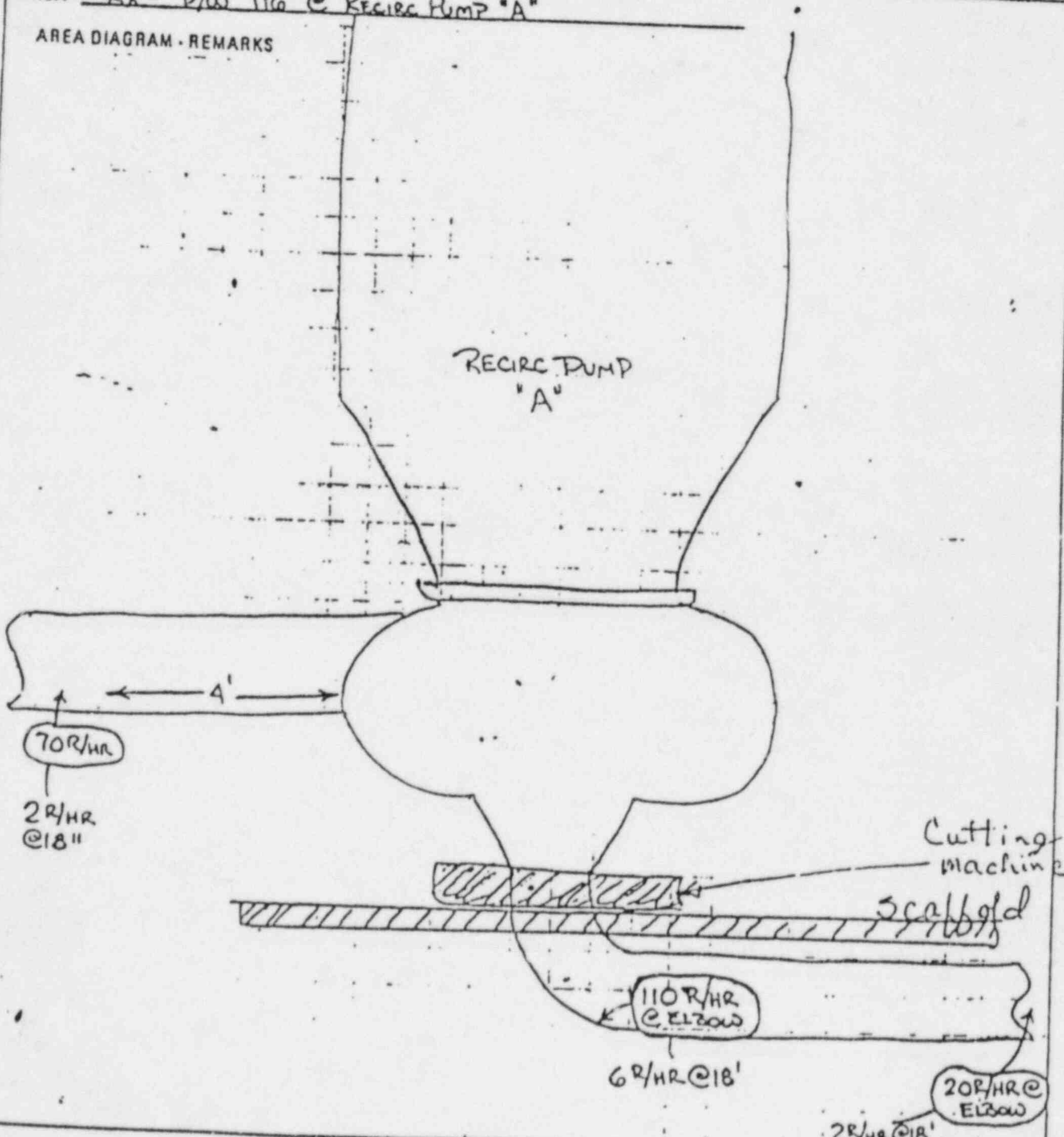
R.W.P. NO. 2-01-0543

SURVEY NO. 193

DATE · 08-15-84 TIME · 0330 SURVEY BY · SAUTELLE

AREA · Rx 2 D/W 116' @ RECIRC PUMP "A"

AREA DIAGRAM · REMARKS



LEGEND:

◯ - CONTACT RADIATION READING

FIGURE 8

RBAPS **RADIATION - CONTAMINATION - AIRBORNE SURVEY**

196 21268 REV. 12/81
DOC TYPE 5 0 2

(3)

UNIT 2 [X] - UNIT 3 [ ]

R.W.P. NO. 2-94-0637

SURVEY NO. 200

DATE - 8/16/84 TIME - 0200 SURVEY BY - [illegible]

AREA - 116' el D/W (Job Coverage)

REASON - Changing drain line hoses for decon sys of A+B

RADIATION - INSTRUMENT SERIAL NO. Tele 89641 Rosa 9542

	ITEM	BETA MRAD/HR	GAMMA MR/HR	NEUTRONS MREM/HR	TOTAL MREM/HR	DISTANCE
1	Fire Hose Fitting on A suction	ND	50R to	NA	50R to	Contact
2	drain line		350R		350R	
3	" " " " "	ND	1R to 10R	NA	1R to 10R	6" to field
4	Fire Hose Fitting on B suction	ND	1R to	NA	1R to	Contact
5	drain line	ND	3R		3R	
6	" " " "	ND	300 to 1000	NA	300 to 1000	18" to Field
7	Fire hose off B side	ND	500 to	NA	500 to	Contact
8			3000		3000	

CONTAMINATION - INSTRUMENT SERIAL NO. ____

	ITEM	BETA+GAMMA DPM/100 cm²	ALPHA DPM/100 cm²
1			
2			
3			
4			
5			
6			
7			
8	NJR		
9			
10			
11			
12			
13			
14			
15			
16			

AIRBORNE - INSTRUMENT SERIAL NO. 3-54

SAMPLING

START - 1920 AVERAGE FLOW RATE COUNTER

STOP - 0015 FT³/MIN 1.0 EFF .400

GROSS COUNTS 5335 / COUNT AND TIME 10 - BKGD CPM 20 - NET CPM 514

NET CPM 514 / .400 SCALER EFF - 4.15 VOL - 6.10⁻⁸ [illegible]

ISOTOPES

REMARKS: NOTE: B side was changed [illegible]

FIGURE 9A

PBAPS RADIATION - CONTAMINATION - AIRBORNE SURVEY

HP 2126B REV. 12/81
DOCTYPE 5 0 2

UNIT 2 [X] - UNIT 3 [ ]

R.W.P. NO. 2-01-0543

SURVEY NO. 206

DATE - 8-17-84 TIME - 0030 SURVEY BY - G.R. Cicotte

AREA - RX2 DRYWELL A+B RECIRC PUMPS

REASON - CHANGING CONDITIONS / POST DECON FLUSH

RADIATION - INSTRUMENT SERIAL NO. 29641 612 B

	ITEM	BETA MRAD/HR	GAMMA MR/HR	NEUTRONS MREM/HR	TOTAL MREM/HR	DISTANCE
1	SEE MAP — ALL READINGS IN R/HR γ					
2						
3						
4						
5						
6						
7						
8						

CONTAMINATION - INSTRUMENT SERIAL NO. ______

	ITEM	BETA+GAMMA DPM/100 cm²	ALPHA DPM/100cm²
1	N/A		
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

AIRBORNE - INSTRUMENT SERIAL NO. ______

SAMPLING

START - ______ AVERAGE FLOW RATE COUNTER

STOP - ______ FT3/MIN ______ EFF ______

GROSS COUNTS / COUNTING TIME - BKGD CPM = NET CPM

NET CPM / (SCALER EFF × VOL × 2.2 × 10⁶) = μCi/CM³

ISOTOPES

N/A

REMARKS: NOT FOR EXPOSURE CONTROL: G-M INSTRUMENT

8-17-84/0030

FIGURE 9B

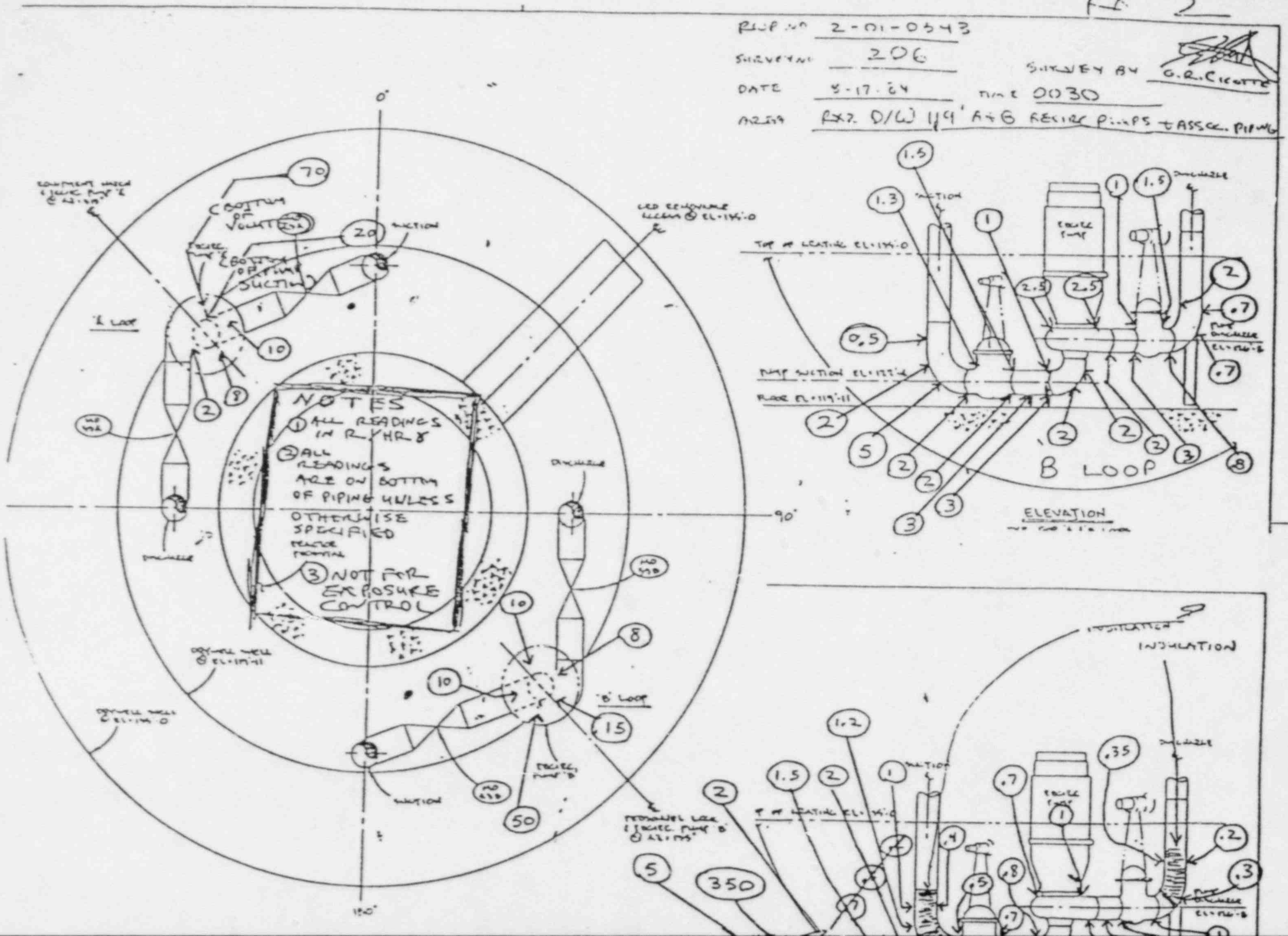
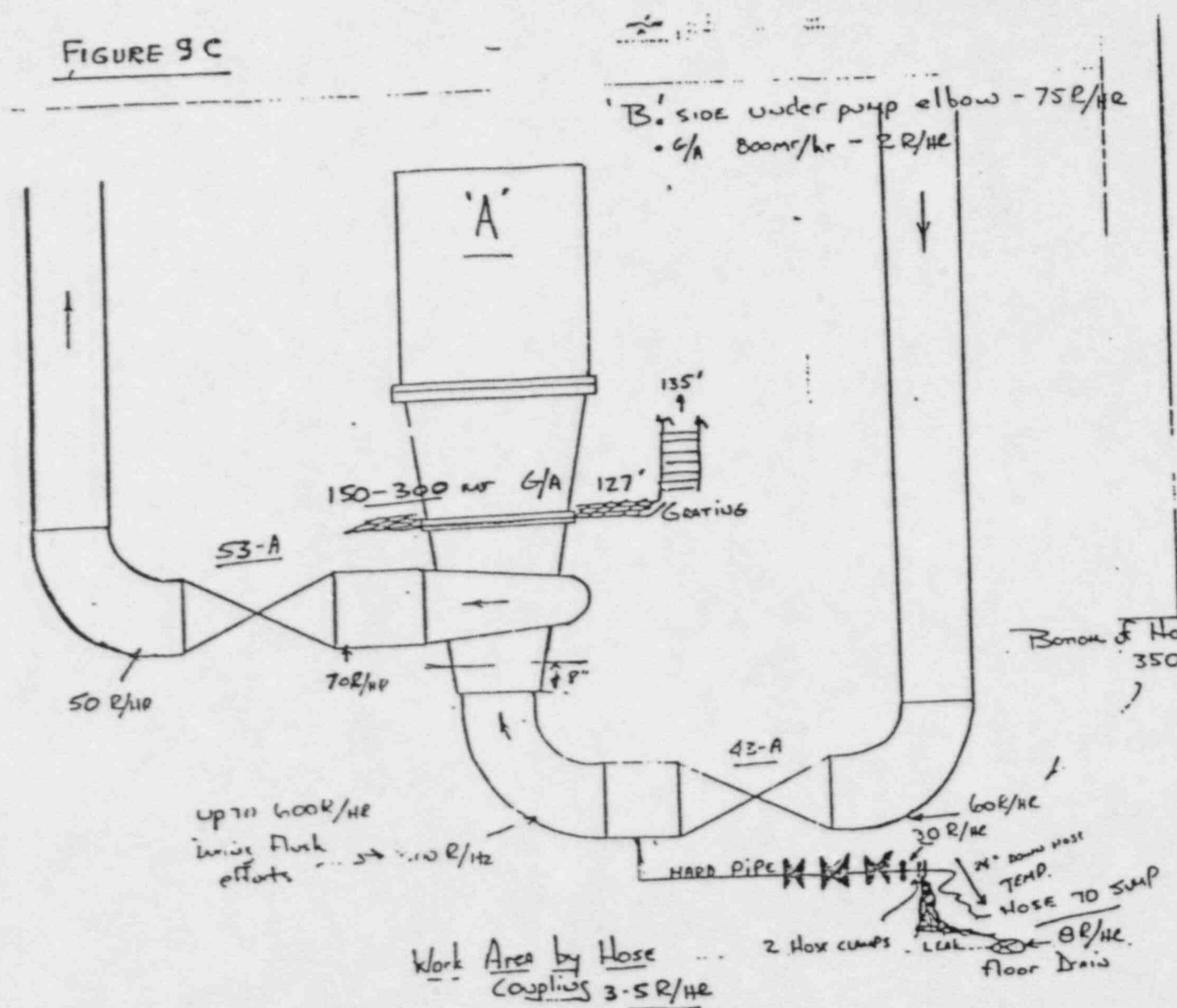
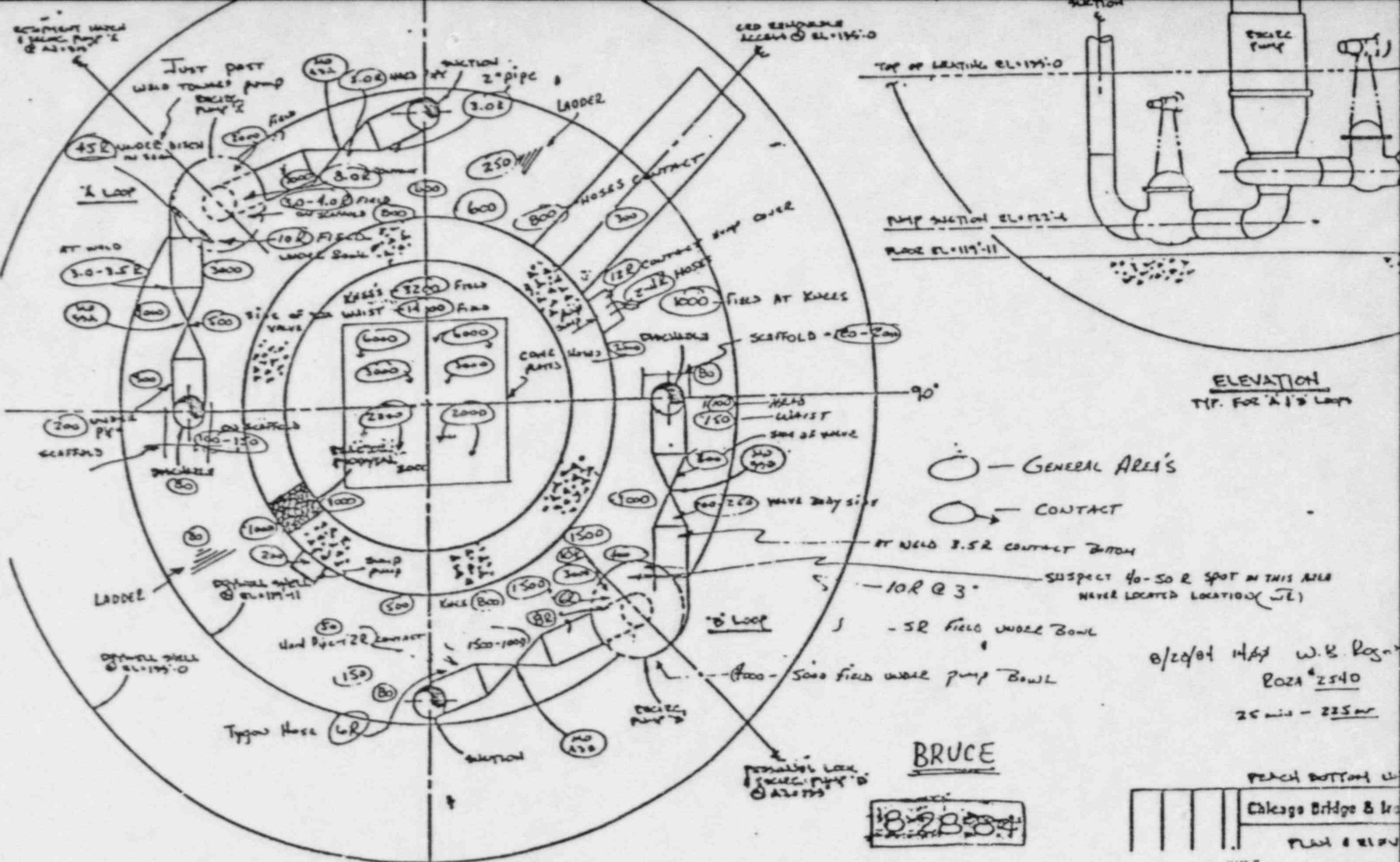

EX 2
RWP NO 2-01-0543
SURVEY NO 206
SURVEY BY G.R. Cicotte
DATE 8-17-84
TIME 0030
AREA RXB. D/W 119' A+B RECIRC PUMPS + ASSOC. PIPING
NOTES
1 ALL READINGS IN R/HR γ
2 ALL READINGS ARE ON BOTTOM OF PIPING UNLESS OTHERWISE SPECIFIED
3 NOT FOR EXPOSURE CONTROL
BOTTOM OF VOLUTE
BOTTOM OF PUMP SUCTION
SUCTION
DISCHARGE
0°
90°
180°
B LOOP
ELEVATION
INSULATION
70
20
10
8
2
15
50
350
1.5
1.3
1
2.5
0.5
.7
3
5
1.2
.35
.2
.3
.4
.5
.8

FIGURE 9C



'B.' SIDE under pump elbow - 75R/HR
• G/A 800mr/hr - 2R/HR
'A'
135'
150-300 mr G/A 127'
GRATING
53-A
50 R/HR
70R/HR
8"
43-A
Bottom of Hose 350R/HR
60R/HR
30 R/HR
up to 600R/HR
during flush efforts
HARD PIPE
TEMP.
HOSE TO SUMP
8R/HR
2 Hose clamps
LEAK
floor Drain
Work Area by Hose Couplings 3-5R/HR



JUST PAST WELD TOWARD PUMP
45R UNDER BISCH
'A' LOOP
AT WELD
3.0-3.5R
3000
10R FIELD UNDER BOWL
3.0-4.0R FIELD ON SCAFFOLD
3.02
2" pipe
SUCTION
LADDER
250
600
800 HOSES CONTACT
12R CONTACT SUMP COVER
1000 FIELD AT KNEES
KNEES 3200 FIELD
WAIST 14,000 FIELD
SIDE OF VALVE
500
CORE AREAS
2000
1000
SCAFFOLD
DISCHARGE
SUCTION
ON SCAFFOLD
100-150
200 UNDER PIPE
LADDER
1500
DRYWELL SHELL @ EL=135'-0
Tygon Hose 6R
HEAD
WAIST
150
VALVE BODY SIDE
AT WELD 3.5R CONTACT BOTTOM
-10R @ 3"
SUSPECT 40-50 R SPOT IN THIS AREA NEVER LOCATED LOCATION (WL)
'B' LOOP
-5R FIELD UNDER BOWL
-5000 FIELD UNDER PUMP BOWL
RECIRC PUMP 'B'
SUCTION
90°
ELEVATION
TYP. FOR 'A' & 'B' LOOPS
TOP OF GRATING EL=135'-0
PUMP SUCTION EL=122'-4
FLOOR EL=119'-11
RECIRC PUMP
SUCTION
— GENERAL AREA'S
— CONTACT
8/20/84 1445 W.B. Rogers
ROZA # 2540
25 min – 225 mr
BRUCE
8-28-84
PEACH BOTTOM
Chicago Bridge & Iron
PLAN & ELEV

Figure 10