CONF-791049--26

PLENARY LECTURE — A SPECIAL RADIOELEMENT PROBLEM: ORNL ASSISTANCE TO THREE MILE ISLAND IN HANDLING CONTAMINATED AIR AND WATER

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For Presentation at the 23rd Conference on
Analytical Chemistry in Energy Technology
October 9, 1979

*Operated by Union Carbide Corporation under contract W-7405-eng-26 with the U.S. Department of Energy.

Introduction

Before launching into the technical aspects of this presentation, I would like to make a few personal observations. First, I would like to thank Dub Shults for the opportunity to present this lecture. I do consider it a great honor. My rapid affirmative response to Dub to present this paper was not based on the technical subject to the presented, but rather the fact that this paper would be presented as the first one in a conference. If you have ever had the opportunity to present the last paper in the last session on the last day of a conference as I have done on occasion, you would also jump at the chance to be first.

As the investigative work concerning the post-accident period comes to light, it will be apparent that ORNL will have played a significant role in the recovery of TMI. Work in the area of waste handling, analytical service, flowsheet development, and decontamination will all be regarded as significant. Efforts in this specific areas of assistance to TMI are really the results of the close working relationship between chemical engineers and analytical chemists.

The two major areas of involvement, and the subject of this discussion, are contaminated air and water handling which resulted from the accident. In order to give you an appreciation for the specific problems involved in this area, it will be necessary to present the status of the various systems as they existed shortly following the accident. The outline to be followed in this presentation is presented on Fig. 1. F-1

An original photograph of the Three Mile Island site is presented in Fig. 2. The site is located in a predominantly farming community with two major population communities, namely Middletown and Goldsboro. F-2

PRESENTATION OUTLINE

- INTRODUCTION
- STATUS OF OFF-GAS SYSTEM FOLLOWING ACCIDENT
- MODIFICATIONS TO OFF-GAS SYSTEM
- STATUS OF TMI WATER FOLLOWING ACCIDENT
- LOW-ACTIVITY-LEVEL WATER PROCESSING
- INTERMEDIATE-ACTIVITY-LEVEL WATER PROCESSING
- HIGH-ACTIVITY-LEVEL WATER PROCESSING
- TECHNICAL AND POLITICAL STATUS

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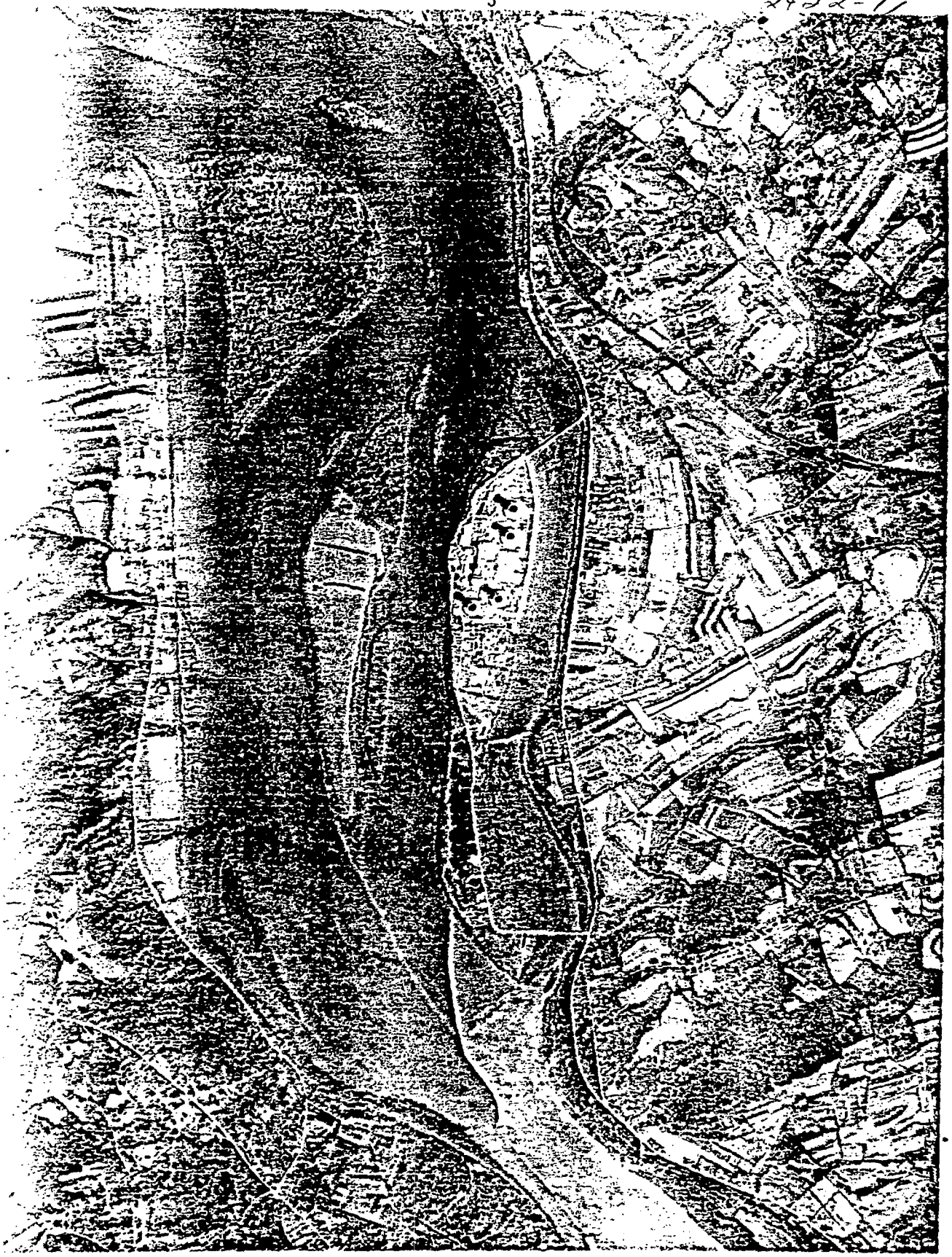

Goldsboro is located to the west of the site and may be seen on the lower portion of the photograph. Middletown, located north of the site, is just off of the photograph on the left-hand side. It was estimated that approximately 2 million people reside within a 50-mile radius of the site.

The accident occurred in the TMI-2 reactor system which may be observed in the lower left hand corner of the photograph presented as Fig. 3. The F-3
significant items in this photograph include the auxiliary buildings and the fuel handling structure. The stack, through which minor releases of radioactivity emanated early in the accident, is the black structure adjacent to TMI-2 and the Auxiliary Building-2. The headquarters for the on-site ORNL team was one of the trailers located in the upper right-hand corner of the photograph.

Contaminated Air Handling

The release of radioactive material to the environment as the result of the accident will be an item of concern for a long period. Insignificant quantities of radioactive material were released to the Susquehanna River via the liquid pathway; however, these releases were below the established normal plant technical specifications for discharge under normal operations. The major insult to the population surrounding the TMI site resulted from the release of the ^{133}Xe isotope via the air pathway which emanated from the stack in the days following the accident. Figure 4 F-4
presents the average dose to the population as a function of distance from the site during the period from March 28 through April 7, 1979. As is recognized, the most hazardous isotope present in the air pathway was iodine, because of its adverse effect on the human environment through the

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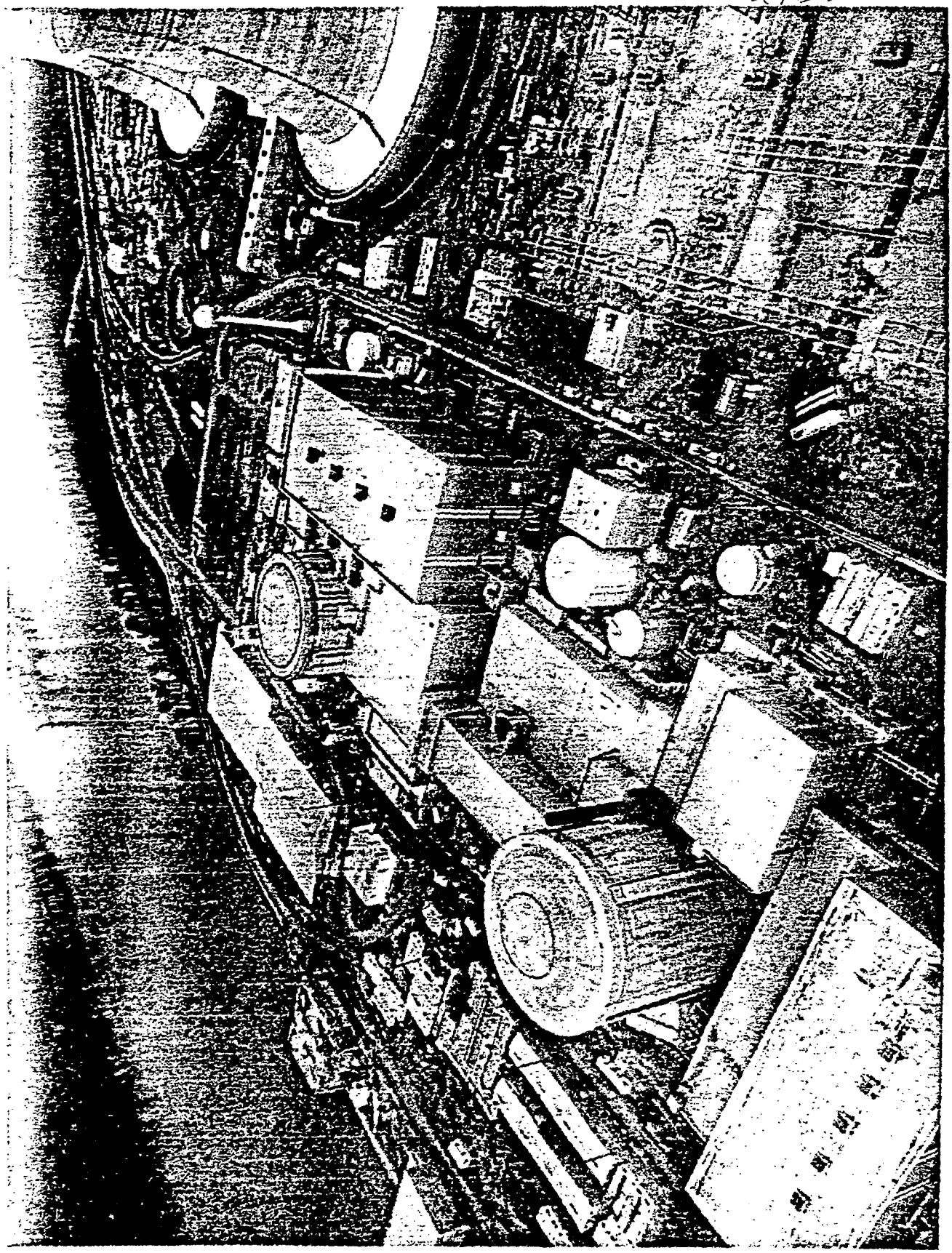
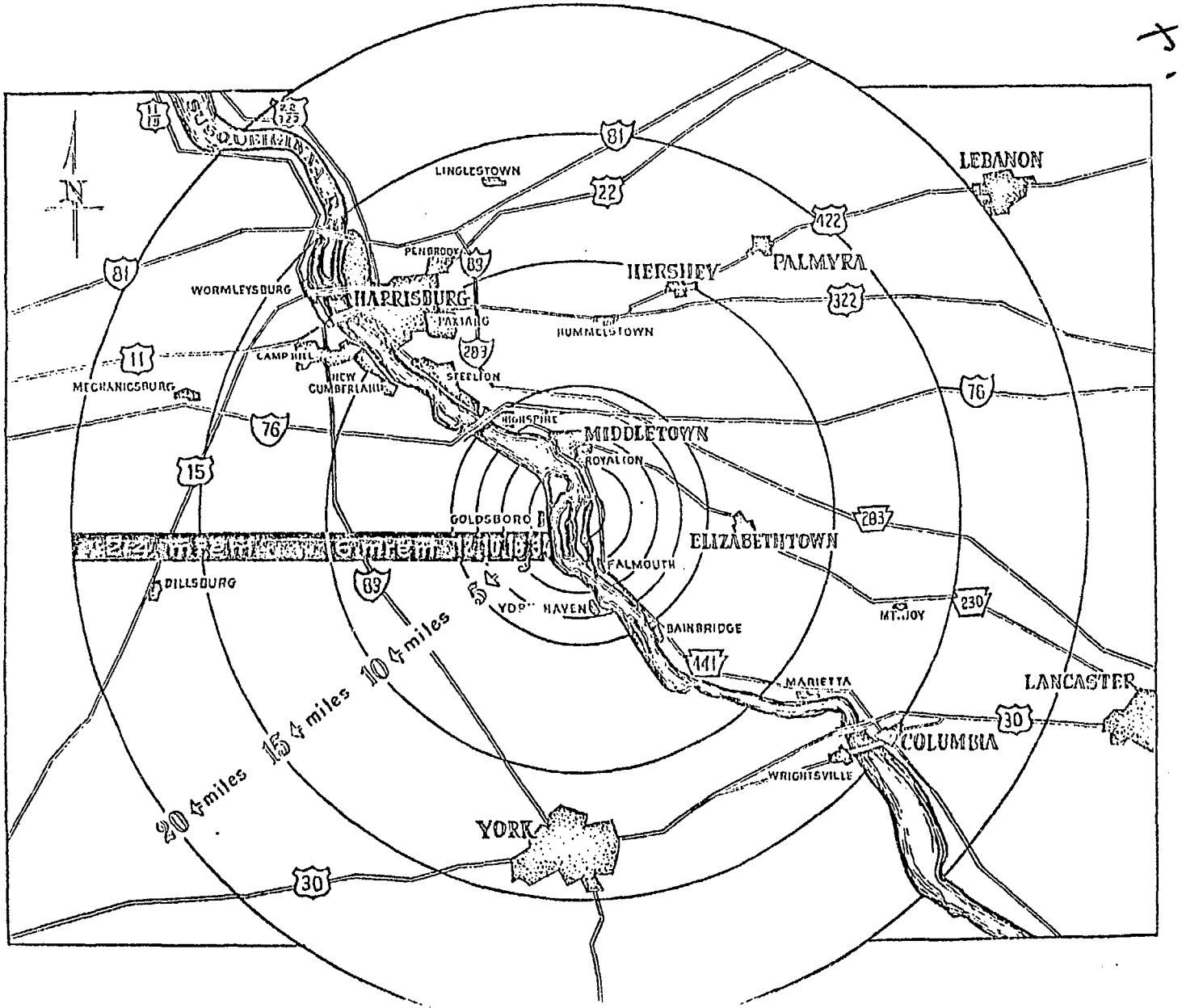


AVERAGE ESTIMATED DOSES (MILLIREMS)
1 TO 20 MILES FROM TMI
MARCH 28 THROUGH APRIL 7, 1979
(Source NR.C.)



food chain. In all, a total of 13-16 Ci of this isotope was released over the accident period. When compared to the Windscale incident of 19__, where 2200 Ci of iodine was released in a single burst, the TMI release is small. Many things were done on the site to maintain this release at a minimal level.

Status of Off-Gas System Following the Accident. An assessment of the condition of the off-gas handling and treatment system and support buildings was begun shortly after the accident and is still in progress. The immediate problem following the accident was the release of iodine and the noble gases in excess of release specifications for normal operations. Because iodine has a more pronounced effect on the health and welfare of the downstream population, serious attention was given to the effectiveness of the charcoal traps designed to remove this isotope. Both downstream and upstream samples of the charcoal traps contained in the Auxiliary 2 and Fuel Handling Buildings, through which all gaseous releases from TMI-2 emanated, indicated that the traps were ineffective for the removal of iodine. Problems inherent in establishing the effectiveness of the off-gas removal systems involved high radiation levels surrounding both the monitoring equipment and the traps themselves. Figure 5 shows a schematic representation of the off-gas system immediately following the accident. F-5

Modifications to the Off-Gas System. Results of the tests conducted on the iodine trapping efficiency of the charcoal units within the Auxiliary 2 and Fuel Handling Buildings indicated that all the traps should be replaced. Therefore, a total of 300 traps were changed (180 in the Auxiliary Building and 120 in the Fuel Handling Building) throughout the period of April 20-May 3.

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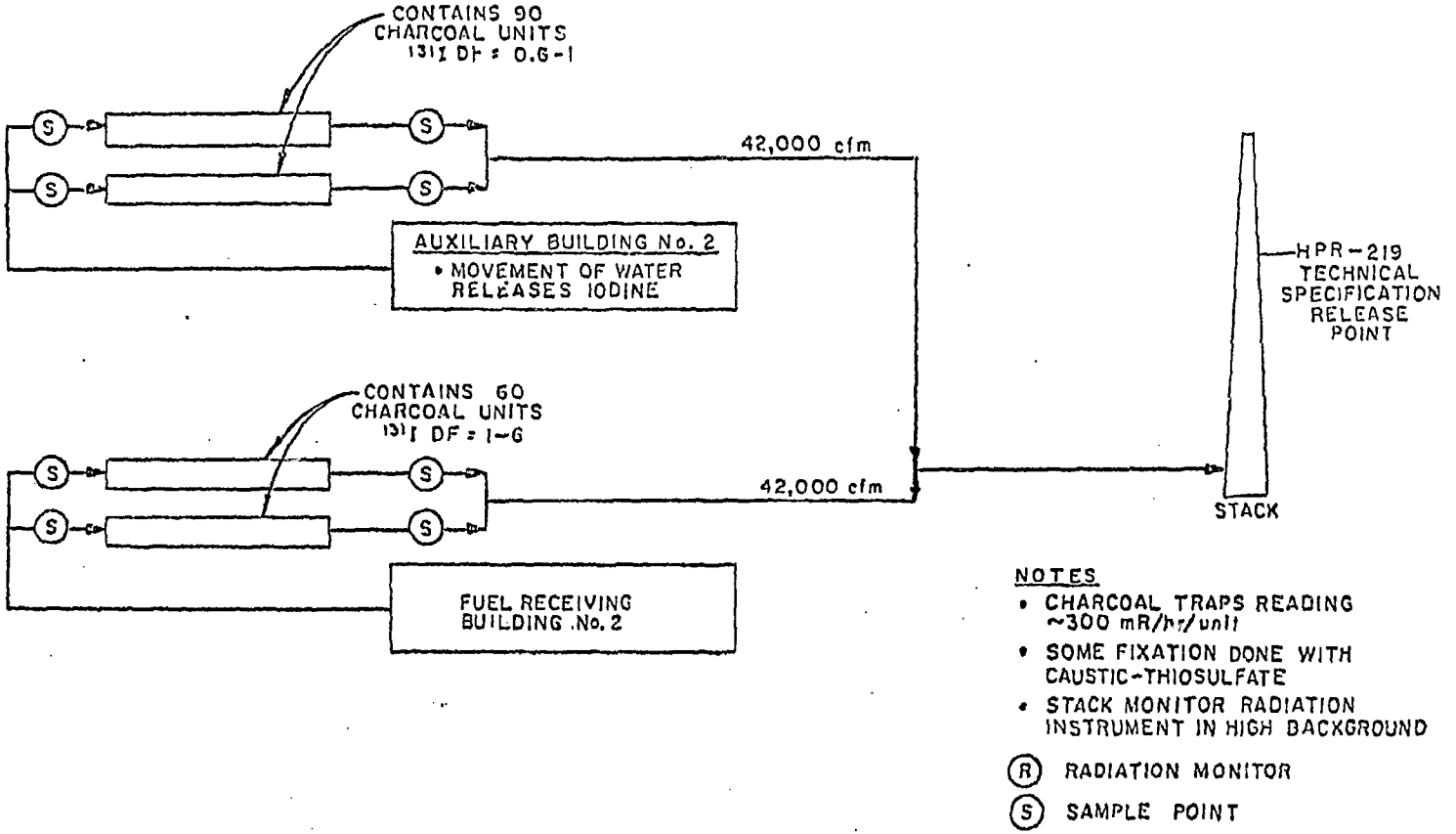

Fig 1. Off-gas system following accident.

Because the reactor system was not yet stabilized from the standpoint of the natural convection cooling mode and the primary loop contained an estimated 6 million Ci of iodine, the decision was made to provide the existing off-gas trains with a supplemental system. This system, which contained four trains totaling a treatment capacity of 100,000 cfm, was located in Pasco, Washington. It was flown to the TMI-2 site for installation on the Auxiliary 2 Building roof and was placed onstream on May 3, 1979. Currently, three of the four trains are in operation.[3] Figure 6 summarizes, in schematic fashion, the overall modifications made to the off-gas system. An additional modification, shown on the figure, is the capping of the stack vent; this provided an added margin of safety. F-6

In addition to the modifications outlined, the floor areas suspected to be contaminated by iodine-containing solution were frequently wet with sodium thiosulfate in an attempt to decrease the level of iodine activity in the Auxiliary Building atmosphere (and thus reduce the iodine release).

Results

The actions discussed above, along with a major effort to minimize transfer and/or leakage of solutions containing iodine and noble gases, led to a steady decrease in iodine release (Fig. 7). The most significant reductions were achieved when the existing charcoal adsorbers were changed (Fig. 8), when the new charcoal treatment system became operative, and when the plant stack was capped. The level of ^{131}I release varied from 0.05 to 2 Ci/day, which exceeded the technical specification quarterly average release rate limit of 0.002 Ci/day. When the new set of adsorbers was put into operation on May 3, the ^{131}I release rate dropped to approximately 1 μCi/day. F-7 F-8

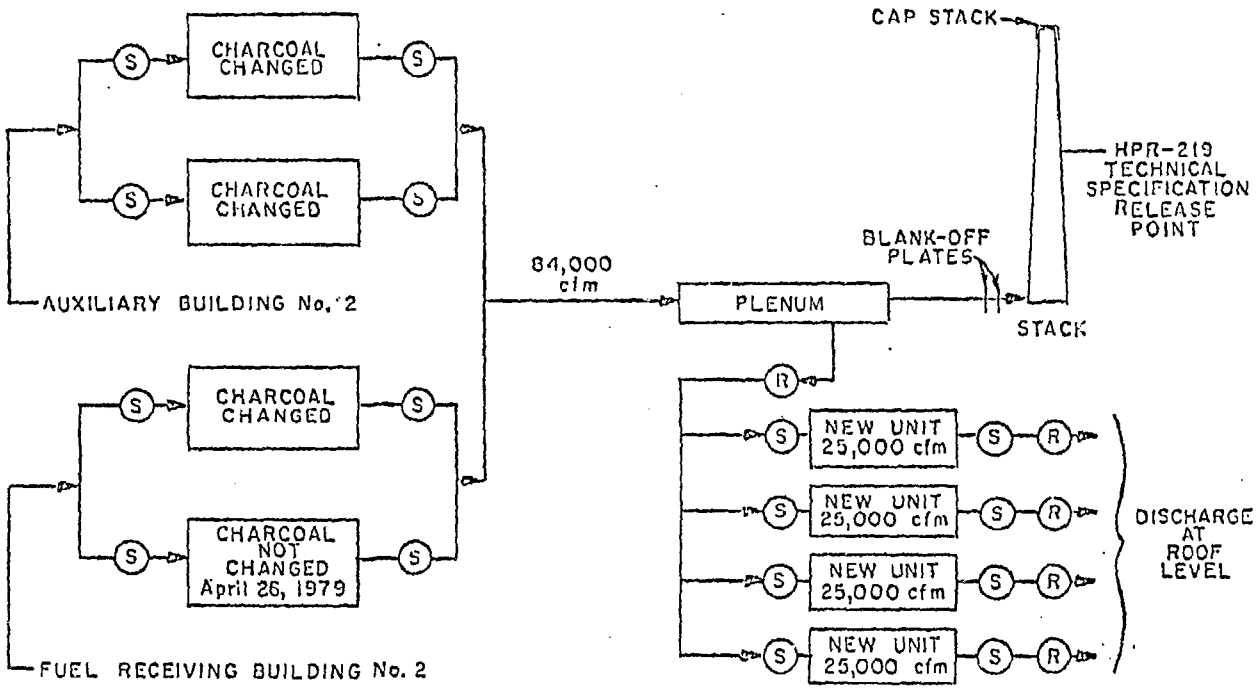

Fig 2. Off-gas system modifications.

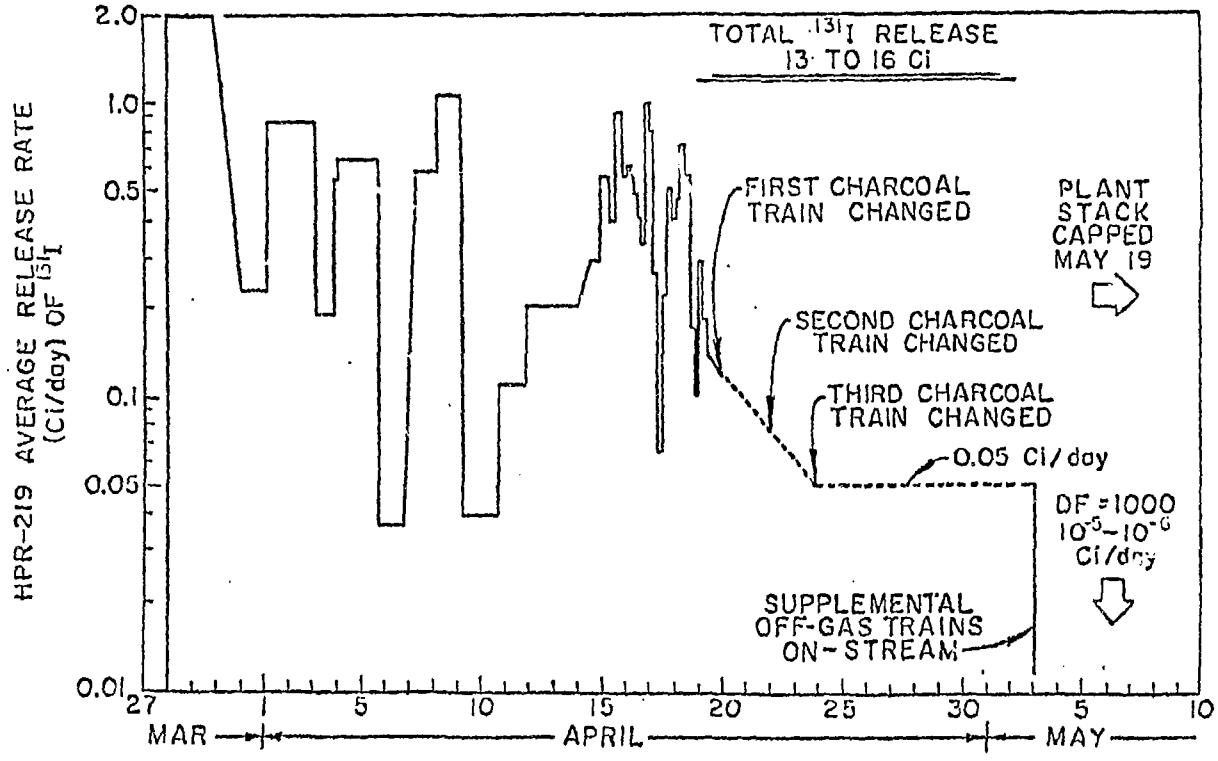

Fig. 3. ^{131}Iodine release data.

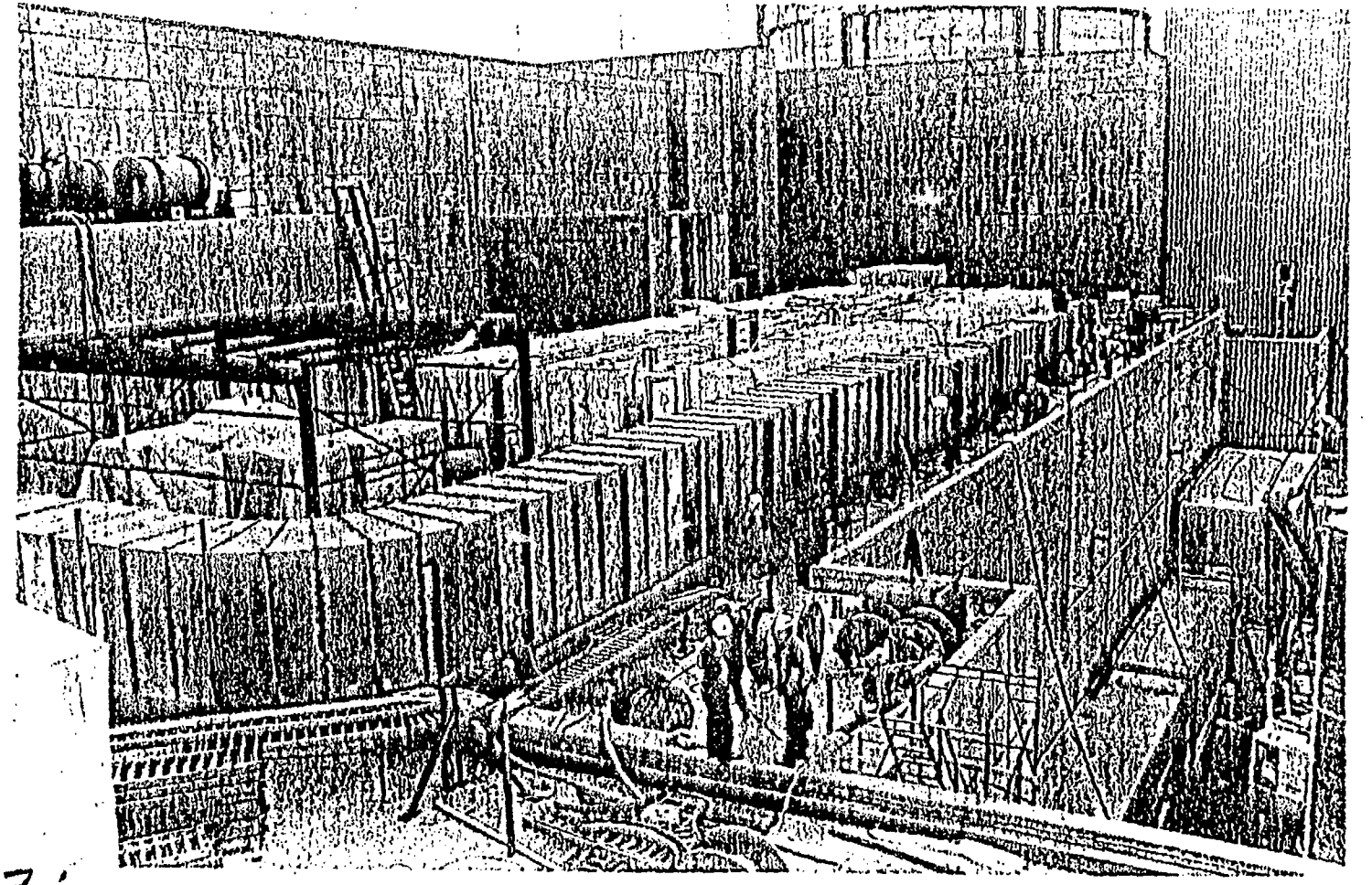

Fig. 4. New charcoal adsorbers during installation at TMI Unit 2.

CONTAMINATED WATER TREATMENT

Contaminated water was continually being generated at TMI following the accident because of leakage through pump seals, flushing of sampling systems, and flushing of contaminated floor areas. The major concern relative to this water was that the quantity to be accumulated might exceed the storage capacity. There was also concern that the water level in the Containment Building might rise high enough to render inoperative some vital instruments. The eventual need to treat all of the liquids, including the primary coolant and all decontamination solutions, was considered throughout the planning for water handling.

Status of TMI Water Following the Accident

The status of the liquid handling systems as of April 1, 1979, is shown in Fig. 9. The primary reactor coolant loop contained 87,000 gal of highly radioactive coolant with an ^{131}I inventory of about 6,000,000 Ci. In addition, the Reactor Containment Building was estimated to contain about 225,000 gal of water which had been contaminated by a large volume of the radioactive reactor coolant. Some instruments were inoperative, probably because they were submerged. The tanks in the Unit 2 Auxiliary Building were becoming full, and floor areas had become flooded with water that had overflowed or leaked from the tanks. Portions of this water were contaminated to varying degrees by water that had been transferred from the Containment Building sump before the Containment Building had been isolated, and subsequently had been transferred within the Auxiliary Building system during post-accident operations. The Unit 2 Reactor Building went into containment approximately 4 hr after the accident and has remained in this state ever since.

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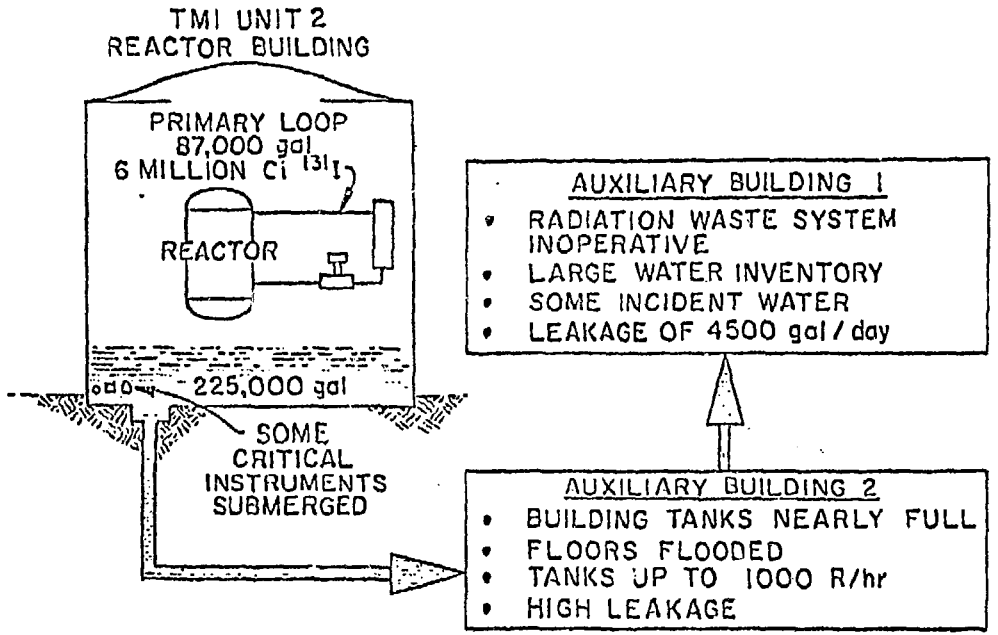

Fig. 4. Status of liquid at TMI after accident.

The Unit 1 Reactor, which had been shut down for refueling prior to the accident, was being brought up to operating temperature by the reactor coolant pump energy input prior to going critical. The available tankage within the Unit 1 Auxiliary Building was becoming filled with water due to normal leaks.

None of the Unit 2 water could be treated. The Unit 2 reactor coolant letdown stream could not be treated because of mechanical problems in the Unit 2 reactor coolant letdown evaporator. The other liquid wastes originating in Unit 2 are normally treated in the Unit 1 miscellaneous waste evaporator, which was out of service because a demineralizer bed was being changed. In any case, the transfer of Unit 2 post-event water to the Unit 1 Auxiliary Building was considered to be undesirable.

Water inventories in both Auxiliary Buildings were increasing. There was an urgent need for additional storage and/or water treatment facilities.

Treatment of Low-Activity-Level Water

The location of the varied water sources on the TMI site is presented in Fig. 10. Low-activity-level water (LALW) was originally defined as all water from Unit 1 and any pre-event water, as confirmed by analysis, in Unit 2. However, when analysis of the Unit 1 water revealed that some Unit 2 post-event water had inadvertently been transferred into the Unit 1 Auxiliary Building vessels, the definition of LALW was modified to include any water that had an ^{131} activity of less than 0.1 μCi/ml and contained no actinides. F-10

A demineralizer system (Fig. 11) consisting of a filter followed by a mixed-bed demineralizer for activity removal was set up on the west side of the Unit 1 Fuel Handling Building to process Unit 1 LALW. This system F-11

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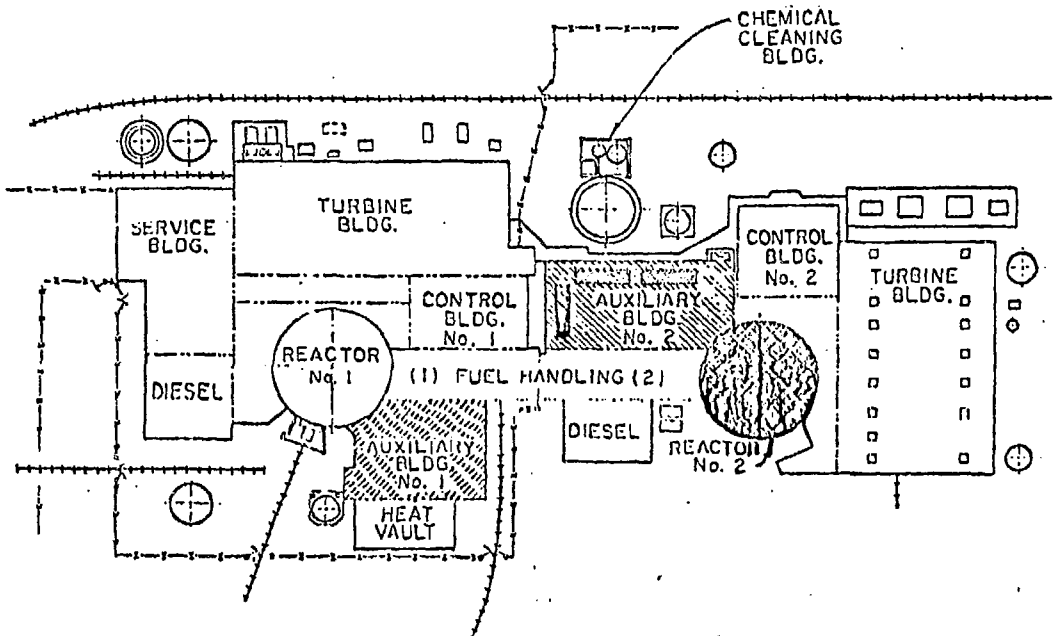

Fig. 5. Distribution of contaminated liquid

Figure 10

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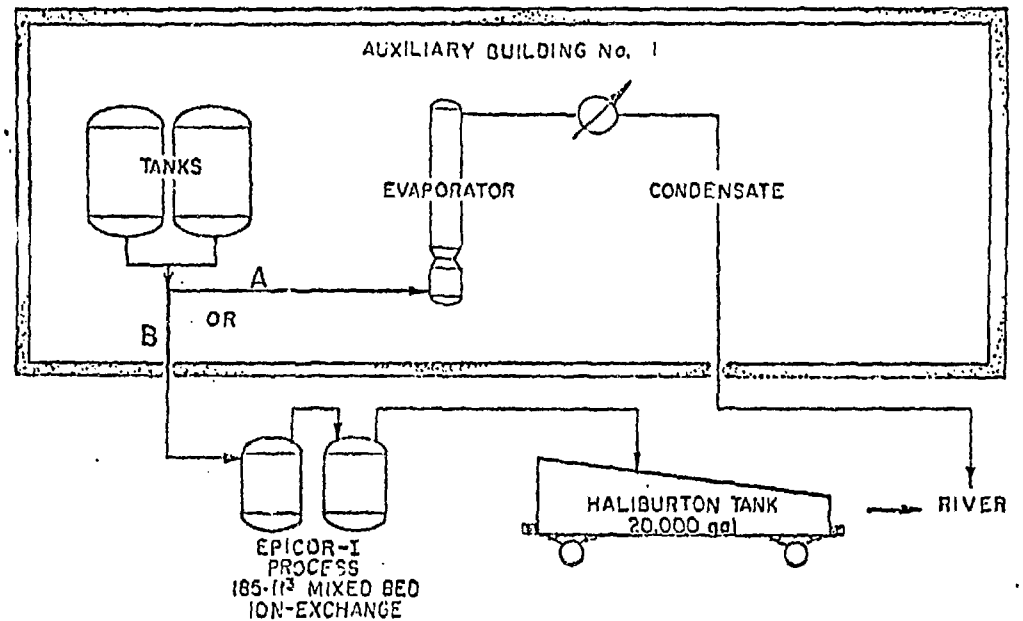

Fig. 6. Epicor-I (Cap Gun-I) demineralizer system.

was referred to as Epicor-1 (initially Cap-Gun-1) because it was being operated by Capolupo & Gundal, Inc. Two 20,000-gal Haliburton tanks were available for the decontaminated water. The first-pass decontaminated water went into one Haliburton tank and was sampled. If the water had not been decontaminated sufficiently to permit release in one treatment cycle, the filter and mixed demineralizer beds were changed and a second decontamination run was made. The second-pass decontaminated water was routed to the second 20,000-gal Haliburton tank.

The first batch of water treated by this system required two passes to meet the technical specifications for release to the Susquehanna River. All subsequent batches required two cycles of treatment. The first batch of water that was successfully treated was released to the Susquehanna River beginning on the night of April 11, 1979. By June 6, a total of 103,500 gal of water had been treated and released to the river.

Treatment of Intermediate-Activity-Level Water

As the result of the accident, a significant quantity of radioactive water was generated and collected in the Unit 2 Auxiliary Building tankage. For the most part, this solution can be characterized as "intermediate-activity-level" water, which can be defined as water containing ^{131}I and ^{137}Cs at concentrations greater than 1 μCi/ml but less than 100 μCi/ml.

Quantity and characteristics. The wastewater in this category was produced from the following four sources: (1) an inventory of wastewater (130,000 gal) that existed in the Unit 2 Auxiliary Building tankage prior to the accident; (2) contaminated water from the Reactor Containment Building sump that had been transferred to the Auxiliary Building and collected in

various tanks (4200 gal) during the early phases of the accident; (3) letdown water from the reactor coolant system, which resulted in a net increase in the inventory; and (4) normal leakage from system components in the Auxiliary Building.

As can be seen from Fig. 12, the total volume contained in the Auxiliary Building tankage is approximately 279,000 gal. Figure 12 also gives the concentrations of the principal radionuclides present in the various solutions contained in the tanks. F-12

Processing justification. Although the Auxiliary Building is of sufficiently high integrity that contaminated water can be positively controlled for an indefinite period, there are several significant reasons why the decontamination of this water is beneficial. Available capacity of the tanks in the Auxiliary Building is required in the event that the water has to be pumped from the Reactor Building in order to protect the operability of Reactor Building components which maintain continued safe shutdown of the facility. The wastewater in the Auxiliary Building continues to be a source of exposure to personnel needing entry into the Auxiliary Building. The continued safe shutdown of TMI Unit 2 depends on the operability of original plant equipment located in the Auxiliary Building and the use of additional equipment being installed in the course of completing the modifications now in progress. The surveillance and personnel exposures associated with these actions are adversely affected by radiation levels associated with the stored liquid.

The removal of the stored contaminated water will also provide additional benefit to the surface decontamination effort currently under way in the Auxiliary Building--now precluded by high radiation levels.

VOLUMES OF SOLUTION AND CONCENTRATIONS OF PRINCIPAL NUCLIDES IN AUXILIARY BUILDING TANKS

TANK	VOLUME (gal)	CONC. OF PRINCIPAL NUCLIDES[a] (μ Ci/ml)					
		^{131}I	^{134}Cs	^{136}Cs	^{137}Cs	^{140}Ba	^{3}H
REACTOR COOLANT BLEED TANK A	77,250	1.9	6.5	0.28	28	0.09	0.23
REACTOR COOLANT BLEED TANK B	77,250	2.8	7.6	0.29	35	0.3	0.27
REACTOR COOLANT BLEED TANK C	77,250	3.0	7.7	0.28	35	0.29	0.29
NEUTRALIZER TANK A	8,780	0.15	0.56	0.01	2.5	0.01	—
NEUTRALIZER TANK B	8,780	0.18	0.72	0.02	3.3	0.03	—
MISC. WASTE HOLDUP, AUX. BLDG. SUMP AND TANK, MISC. SUMPS	13,500	1.0	2.4	0.08	10.1	0.80	0.98
WASTE EVAPORATOR COND., CONTAMINATED DRAIN TANKS	16,200	<0.1	<0.1	<0.1	<0.1	<0.1	—
TOTAL	279,010						

a. CORRECTED FOR RADIOACTIVE DECAY TO JUNE 15, 1979

Process description. The process to be employed for the treatment of intermediate-level water is an extension of that used for low-level water decontamination (Epicor-I) and is based on existing commercial technology currently in practice at numerous nuclear power plants. This process, designated as Epicor-II, uses a liquid radwaste processing system supplied by Epicor, Inc., and is designed to decontaminate radioactive water contained in the Auxiliary Building tanks via filtration and ion exchange.

A simplified schematic flow diagram of the Epicor-II system is presented in Fig. 13. Contaminated water is pumped from the miscellaneous waste holdup tank in the Auxiliary Building to a prefilter in the process which removes particulate radioactive materials and suspended solids. This prefilter also contains a cation exchange resin which is highly effective for removing resin and other cationic radionuclides from the water (removal efficiency, approximately 90%). Following the prefilter, the solution is passed through two demineralizers placed in series. The first demineralizer also contains cation resin which further decontaminates the solution from cation-sorbing nuclides. The second demineralizer contains mixed resins (cation and anion) which are efficient for both cationic and anionic radionuclides, including cesium and iodine. After processing, the water is collected in a clean water-receiving tank which has a capacity of 133,000 gal. Should analysis indicate that the radionuclide content of this tank is above specifications, the water can be transferred to an off-specification vessel (95,000 gal) for rework. Product water below the predetermined limits contained in the plant's technical specifications will be transferred to the TMI Unit 1 or 2 liquid waste management system to be held for ultimate disposition.

F-13

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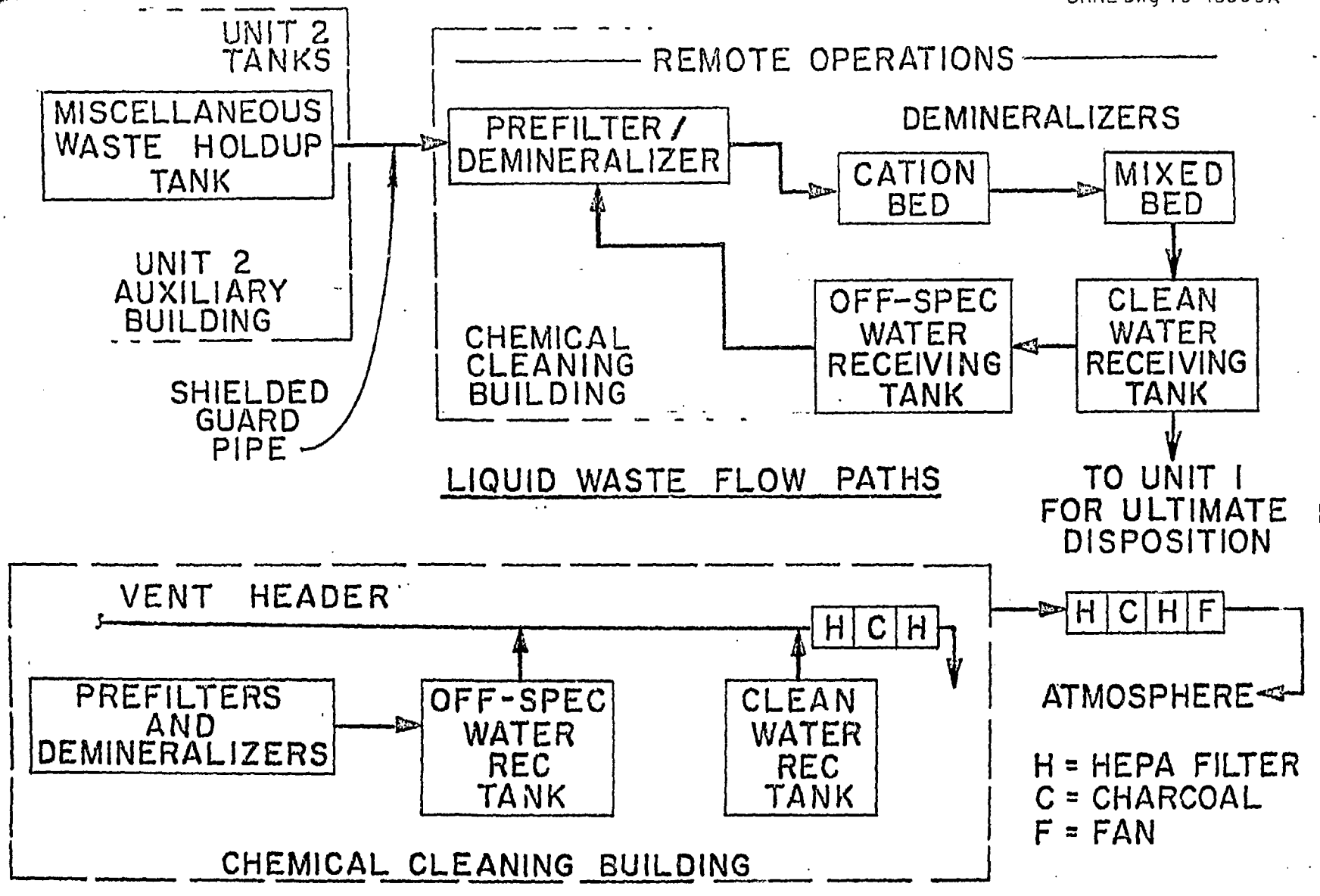

FLOW SCHEMATIC OF EPICOR-II PROCESSING SYSTEM

Thus far, no decision has been made of the ultimate disposition of this water (to the Susquehanna River, for example) because of political concerns.

The Epicor-II processing of intermediate-activity-level water will be done in the Chemical Cleaning Building, which has been modified to ensure the safety of workers and the general public as the result of more stringent radiation controls. Basically, the modifications to this building were made in the general area of radioactive material containment. The Chemical Cleaning Building has been converted into a low-leakage confinement area and has been equipped with an exhaust system to maintain the building at a negative pressure. HEPA and charcoal systems have been provided on the ventilation system, which will discharge through a localized stack. All effluents from the process will be subjected to both gaseous and liquid release monitoring. The processing system will be operated entirely by remote means, except for infrequent tasks such as sampling and chemical additions. All remote system operations are controlled from the TV Monitor Control Building, which is located adjacent to the Process Building. The remote transfer of spent filters and resins from this position in the Processing Building into shielded casks for removal to the solids staging area can be accomplished and has been incorporated into the design.

Treatment of High-Activity-Level Water

The largest volume of water generated from the accident may be regarded as "high-activity-level water," which may be defined as water with a radionuclide concentration in excess of 100 μCi/ml based on the ^{137}Cs content.

Quantity and characteristics. Water in this category is primarily from two major sources. The first source (90,000 gal) is the water contained in the primary loop coolant circuit which is used to maintain the reactor in a safe condition by removing heat in a natural convection mode. The second source (540,000 gal) includes (1) the water contained in the reactor containment structure which resulted from the release of water from the primary coolant circuit during the early phase of the accident, (2) the volume of liquid transferred into the building through the containment spray system, and (3) a large volume of water which was released through miscellaneous equipment (pump seals, space coolers, etc.) during the post-accident period. Depending on the fission product removal efficiency of the Epicor-II treatment system, the water in the three reactor coolant bleed tanks may be processed later, if necessary, in this system.

In addition to the increased radioactivity contained in this water, the ionic contamination mandates that the water be given special treatment. The major ionic constituent is boron, present at levels up to approximately 2600 ppm, which is used as a neutron poison in the coolant circuit. In addition to this element, sodium is also present as the result of spray activation with NaOH solution. Figure 14 presents significant information related to the chemical and ionic characteristics of the high-activity-level waste solution. F-14

Necessity for emergency tankage. Soon after the accident, it was recognized that additional tankage would be required to receive the high-activity-level water accumulating in the Reactor Containment Building. There was

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PRELIMINARY
PRIMARY COOLANT ANALYSIS
APRIL 11, 1979

BORON >500 ppm (2600 ±200 mg/ml)

pH 8.0

U <10 ppb

Pu ND*

FISSION PRODUCTS	ACTIVITY (μCi/cc)
^{99}Mo	179
^{131}I	8.2×10^3
^{132}I	<20
^{134}Cs	82
^{137}Cs	330
^{136}Cs	108
^{140}Ba	290
^{140}La	160
^{89}Sr	600
^{90}Sr	50
^{103}Ru	ND*
^{144}Ce	—
^{95}Zr	ND*
^{97}Zr	ND*

*DID NOT BECAUSE OF ph

Figure 14

considerable concern that the water level in the building might rise high enough to flood and theret prevent operation of some of the vital instruments that monitor and control the reactor. These instruments had not been designed for operation in a hostile environment of high radiation fields and submergence in liquids. Subsequently, a tank farm was designed and installed in the fuel storage pool A contained in the Unit 2 Fuel Handling Buidling.

The design of the tank farm incorporated six tanks with a total capacity of 110,000 gal (Fig. 15). Two 25,000-gal tanks were installed near the bottom of the pool and connected to each other with a standpipe for which devices were to be designed later for sampling and solution transfer. Four 15,000-gal tanks, installed above the 25,000-gal vessels, were connected to a second standpipe. Shielding for all vessels was provided by installing concrete slabs on the top of the pool structure. An independent off-gas treatment system was also installed on top of the tanks to decontaminate any gaseous effluent that might be evolved during tank operations. A photograph of the bottom tanks during installation is presented in Fig. 16. F-15 F-16

Fortunately, the tank farm system was not needed for its original purpose. This eliminated the potential risk of transferring additional liquid out of the Containment Building (into the tank farm) and, thereby, increasing the inventory of iodine in a structure external to the reactor system. The decision had been made not to disturb the solution in containment so the 8-day ^{131}I could decay to safe limits.

The tank farm will be utilized as an integral part of the high-level water treatment system.

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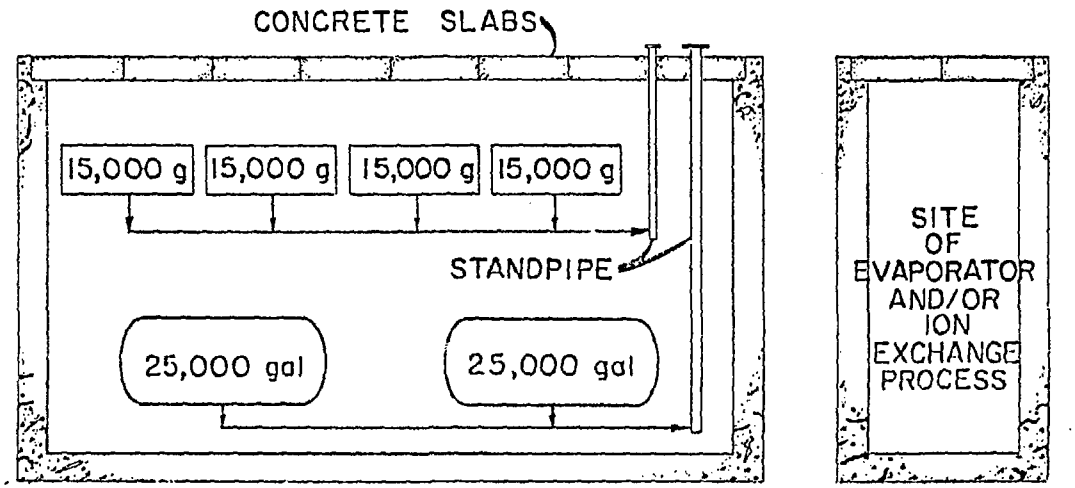

SPENT FUEL STORAGE POOL
(65 x 25 x 40 ft)

CASK HANDLING POOL
(35 x 25 x 40 ft)

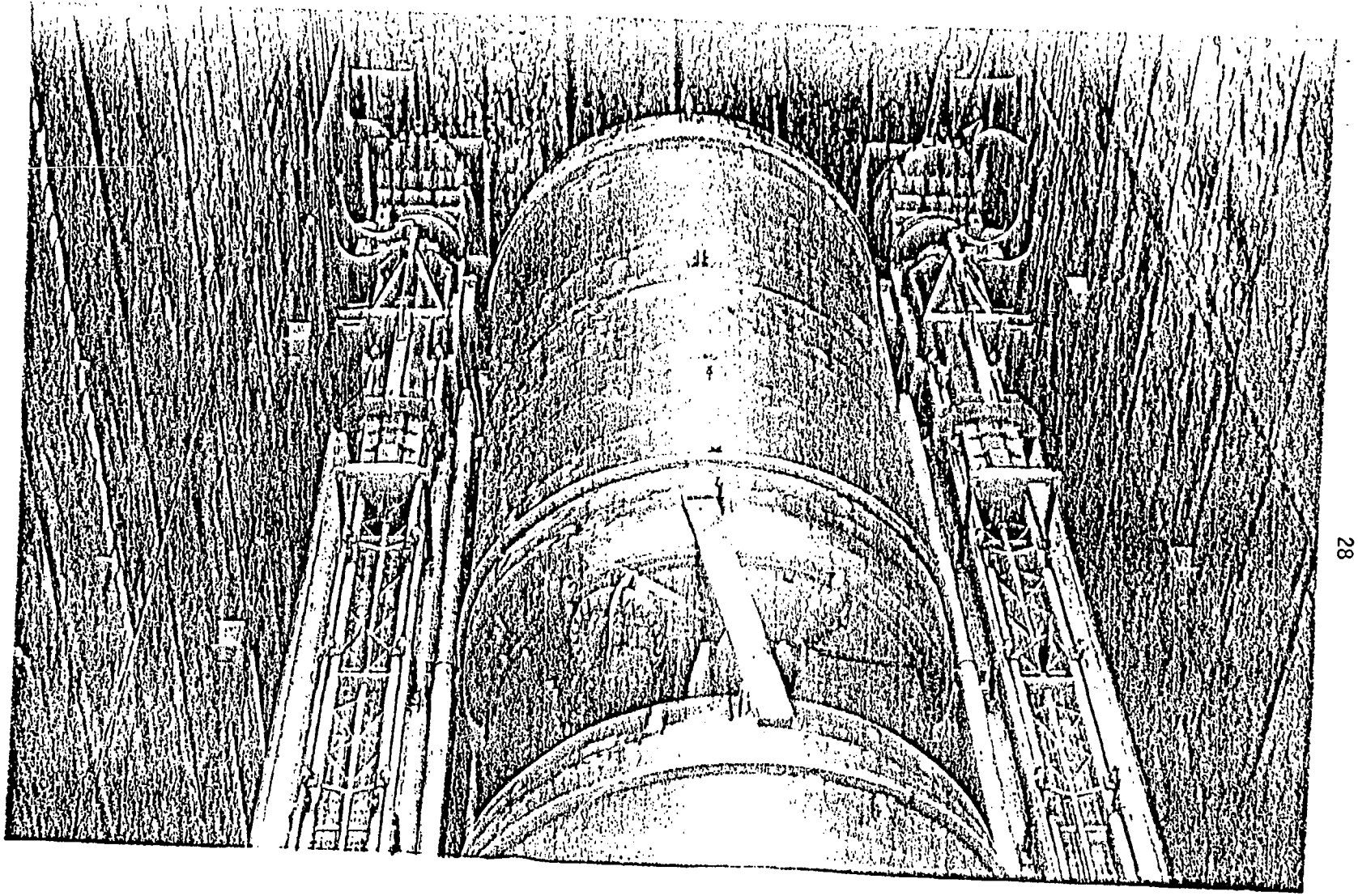

Fig. 8. Tank farm in the TMI-2 fuel storage pool during installation.

Processing justification. In order to proceed with the recovery of the reactor system, the liquid being held in the Containment Building will require removal and treatment. Currently, this liquid is standing at a depth of approximately 7-1/2 to 8 ft and is covering several components, including instruments. Although the leakage of water into the containment area has been minimized, the possibility for increased leakage continues to exist. In the early phases of the accident, the water in containment had ^{131}I concentrations estimated to be of the order of 10^4 μCi/ml. Because of this factor, every effort was made to avoid disturbing this solution until the radioiodine had been allowed to decay. Figure 17 F-17 shows the fission product decay curves, based on the analysis of primary coolant, for the radioactive nuclides that were of greatest concern with regard to treatment of the solution and indicates the most desirable processing period.

Flowsheet development. Because of the unique nature of the water to be decontaminated, certain phases of the development of a flowsheet were required. The first phase of the flowsheet development work involved the selection of a suitable exchange medium for the processing of this solution. Limited samples of actual TMI primary loop water were tested in an ORNL hot cell to establish the characteristics of sorbents believed to be selective for the predominant $^{134-137}Cs$ and $^{89-90}Sr$ isotopes. A total of seven materials, both organic and inorganic ion exchange sorbents, were tested (Fig. 18). Results from these tests established that one of the zeolites, F-18 AW-500 (an inorganic exchanger), was highly selective for the cesium isotopes under the conditions prevailing at TMI and that Dow HCR-S, an organic resin, would be suitable for selection of the strontium isotopes. Following

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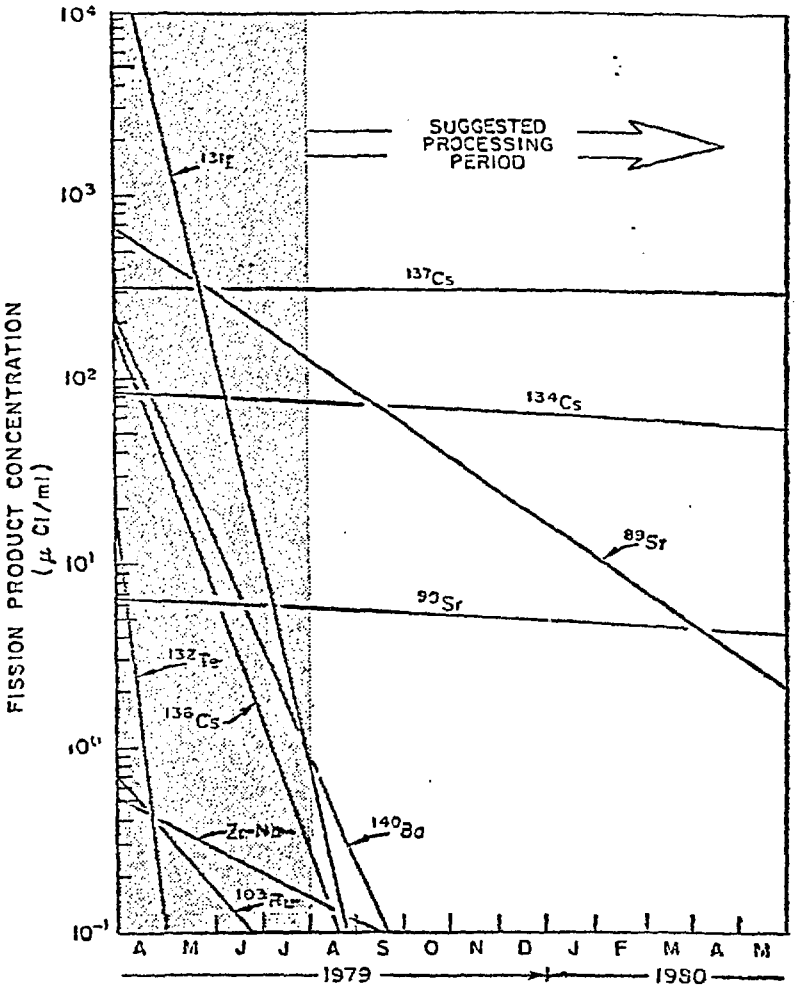

Fig. 9. Fission product decay in the TMI-2 primary loop.

DISTRIBUTION COEFFICIENTS (K_d) FOR PRIMARY COOLANT

(PRIMARY WATER AS RECEIVED — 960 ppm Na)

EXCHANGER	Sr K_d			Cs K_d			FINAL pH	PHASE RATIO (ml/g)
	FIVE MIN	TWO HOUR	SECOND PASS	FIVE MIN	TWO HOUR	SECOND PASS		
HCR-S	50	230	20	3700	8700	>330	3.6	27
IR-200	120	290	28	85	200	250	8.3	71
Z-900	~0	50	39	280	1800	1400	--	144
AW-500	~2	100	-	180	1300	--	--	136
CLINO.	22	96	130	135	990	3000	8.6	67
GLASS	96	250	54	160	440	400	8.6	68
CHARCOAL	20	50	60	0	0.7	2	8.7	42

these studies, a series of small-scale column runs was made to verify sorbents using solutions adjusted to TMI's water conditions. Information resulting from these studies was then applied to a "scale-up" computer program at the Savannah River Laboratory to provide information on design on the ion exchange columns. Pertinent information yielded by these studies is presented in Figs. 19 and 20. F-19 F-20

Sampling of containment water. The original samples on which the flowsheet development work was based were withdrawn from the primary coolant circuit and were taken with some difficulty because of personnel exposure and equipment logistic problems. Daily detailed flowsheet work based on small, limited volumes of solution is a risky undertaking at best. It was recognized that sampling of the larger volume of water within the Reactor Containment Building was a necessity. Recommendations to sample this body of water have been made since the early days of the accident. Within the past months, a remote 3-in. hole was cut in a blanked reactor building penetration, located 2 ft from the surface of the liquid, and 30-ml samples were withdrawn from the top, middle, and bottom of the liquid on August 28. A photograph of these samples is presented in Fig. 21, following transfer from the steel containers. Samples ranged from 400-800 mR/hr at contact and had a yellow coloration. Significant quantities of solids were observed and analyzed in the bottom sample. The radiochemical results of these samples were slightly lower than predicted from estimates based on event chronology and analysis of the primary loop water (Fig. 22). NRC has recently concluded from these values that the damage to the core is less than anticipated. The most significant information revealed by the analysis would suggest that our earlier work on flowsheet development was valid. F-21 F-22

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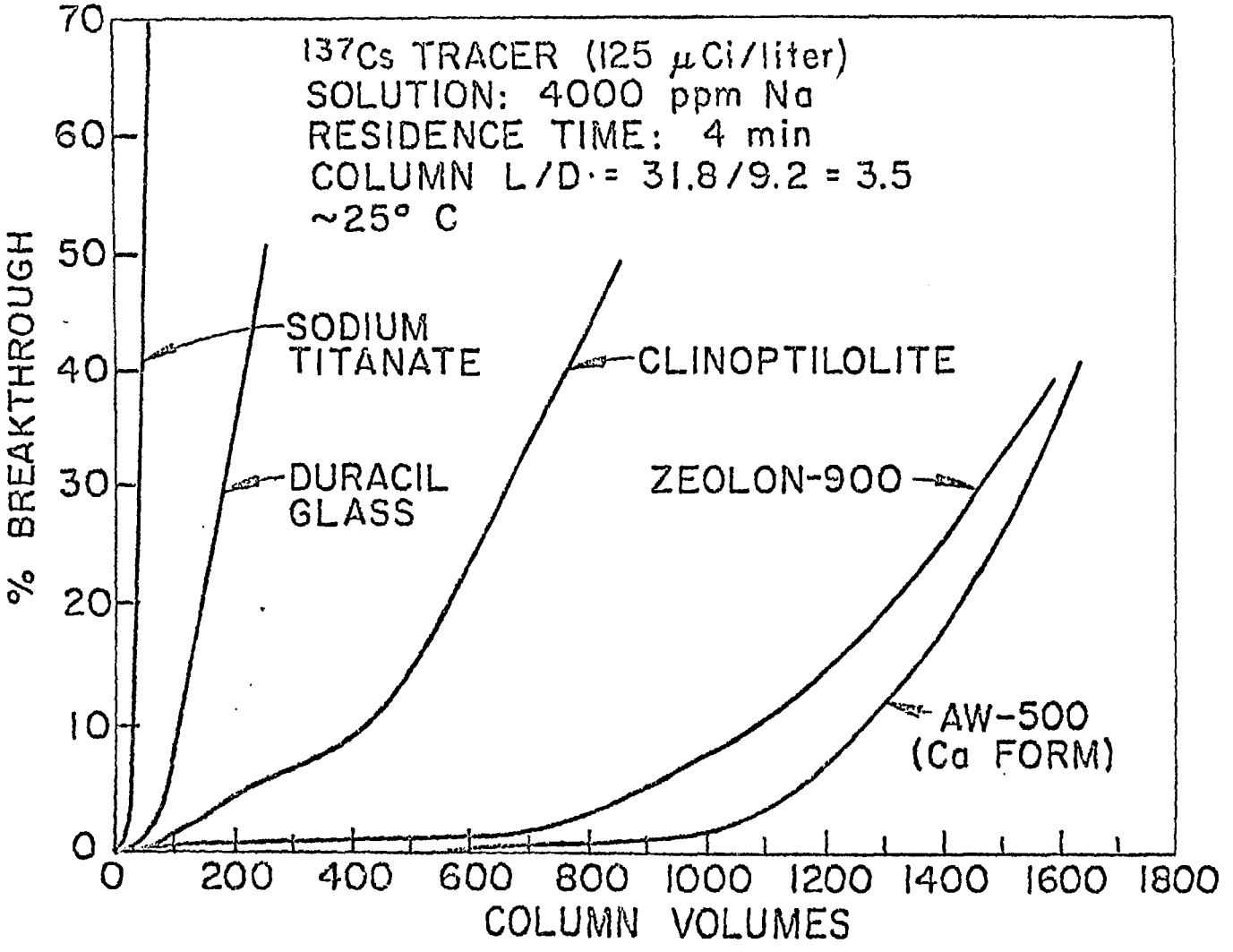
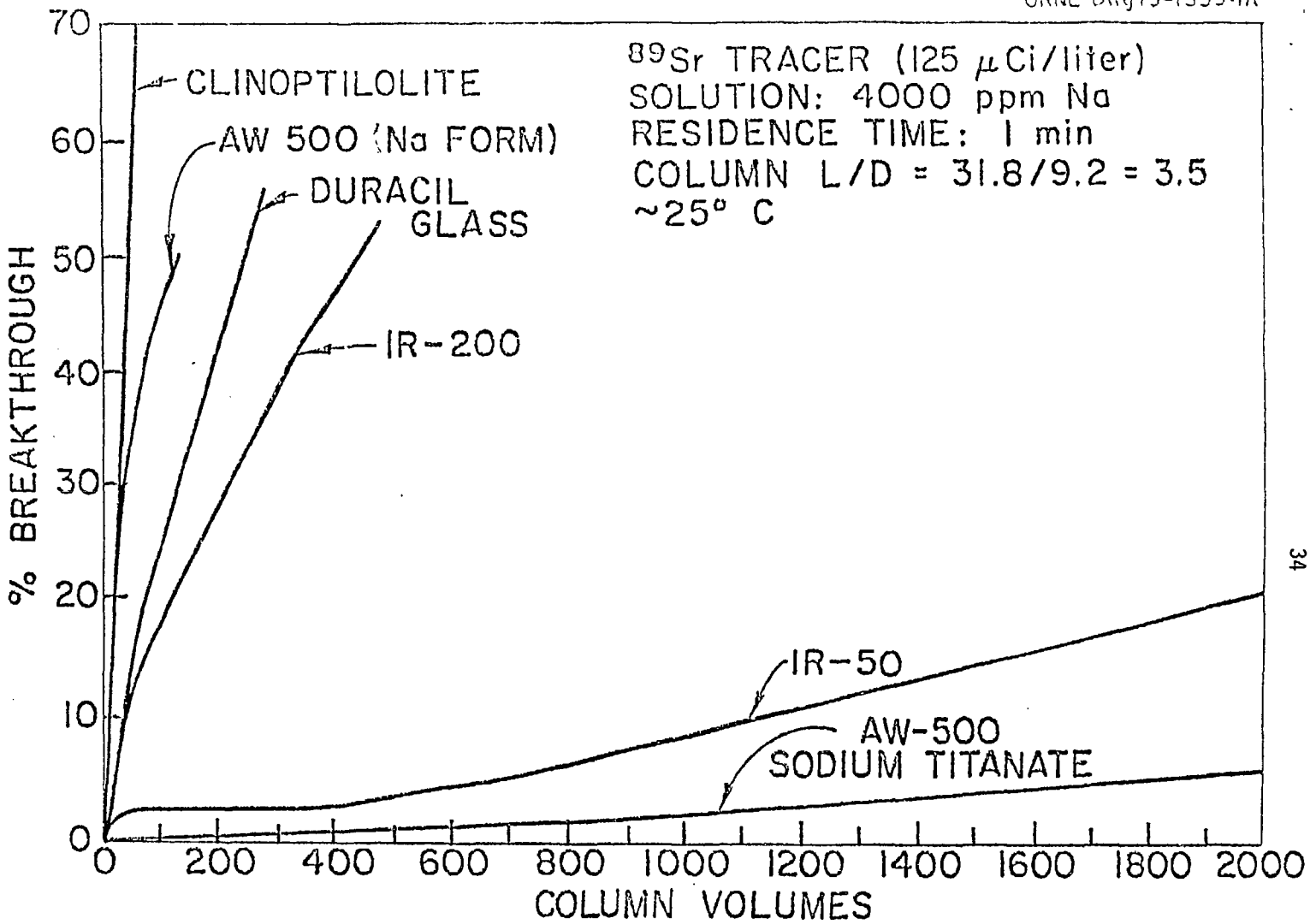


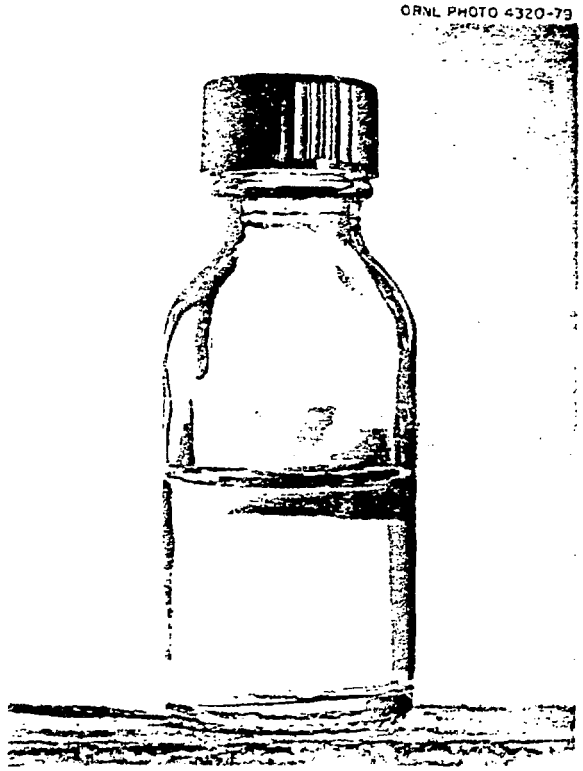
SMALL-COLUMN LOADING TESTS OF ION EXCHANGE MATERIALS WITH SYNTHETIC TMI-2 PRIMARY LOOP WATER AND ^{137}Cs TRACER



SMALL-VOLUME LOADING TESTS OF ION EXCHANGE MATERIALS WITH SYNTHETIC TMI-2 PRIMARY LOOP WATER AND ^{89}Sr TRACER

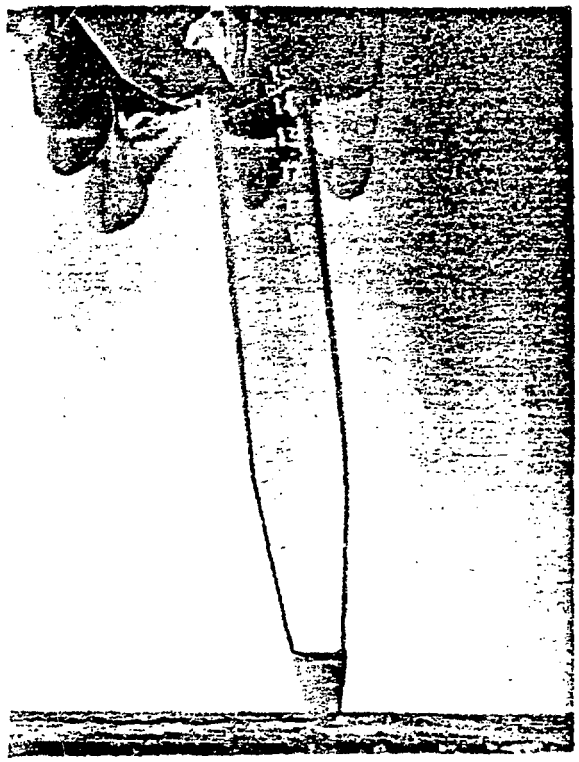
ORNL PHOTO 4320-79

TOP



MIDDLE

BOTTOM



CENTRIFUGED SOLIDS

LABORATORY MEASUREMENT*

ISOTOPE	TOP SAMPLE	MIDDLE SAMPLE	BOTTOM SAMPLE	PREDICTED VALUES
^{137}Cs	176	179	174	200–260
^{134}Cs	40	40	39.6	30–40
^{140}La	0.09	0.078	0.014	0.25–0.49
^{3}H	1.03	1.05	1.01	1.0–1.5
^{131}I	0.012	0.012	0.013	0.015–0.044
^{90}Sr	2.70	2.90	2.83	10–18
^{89}Sr	43.6	40.6	42.1	171–228

* μCi/ml

Based on the early flowsheet development work, Chem Nuclear Systems Corporation and the Allied Chemical Corporation entered into a contract with the General Public Utilities Service Corporation to provide an engineering scale flowsheet for the treatment of high-activity-level water. A schematic of the proposed flowsheet is presented in Fig. 23. F-23 Basically, the flowsheet consists of a series of filters to remove solids, tankage in the tank farm mentioned earlier, followed by 3 stages of zeolite sorption of ^{137}Cs followed by cation exchange for ^{95}Sr-^{89}Sr sorption. A commercial mixed bed unit will be placed down stream to serve as a polisher. The system will be operated by remote means by installing all equipment under water to provide for shielding. A layout of the proposed system is presented on Fig. 24. F-24

Conclusions and Status

In conclusion, I would like to summarize the status of TMI at this time (Fig. 25). With regard to the release of radioactivity from TMI via F-25 the air pathway, the iodine no longer presents a hazard to the environment as the result of engineered systems and the natural radioactive decay of this isotope. Recently, the Metropolitan Edison Company released information pertaining to the controlled release of the krypton gas presently accumulated in the Reactor Containment Building. Following an assessment of the alternatives that could be used to remove this 10.4 year half-life material, it was concluded that the safest approach would be to release the gas, after filtration, over a period of 51 days. This release is expected to be below the plant's normal operation technical specifications and within NRC legal and federal limits.

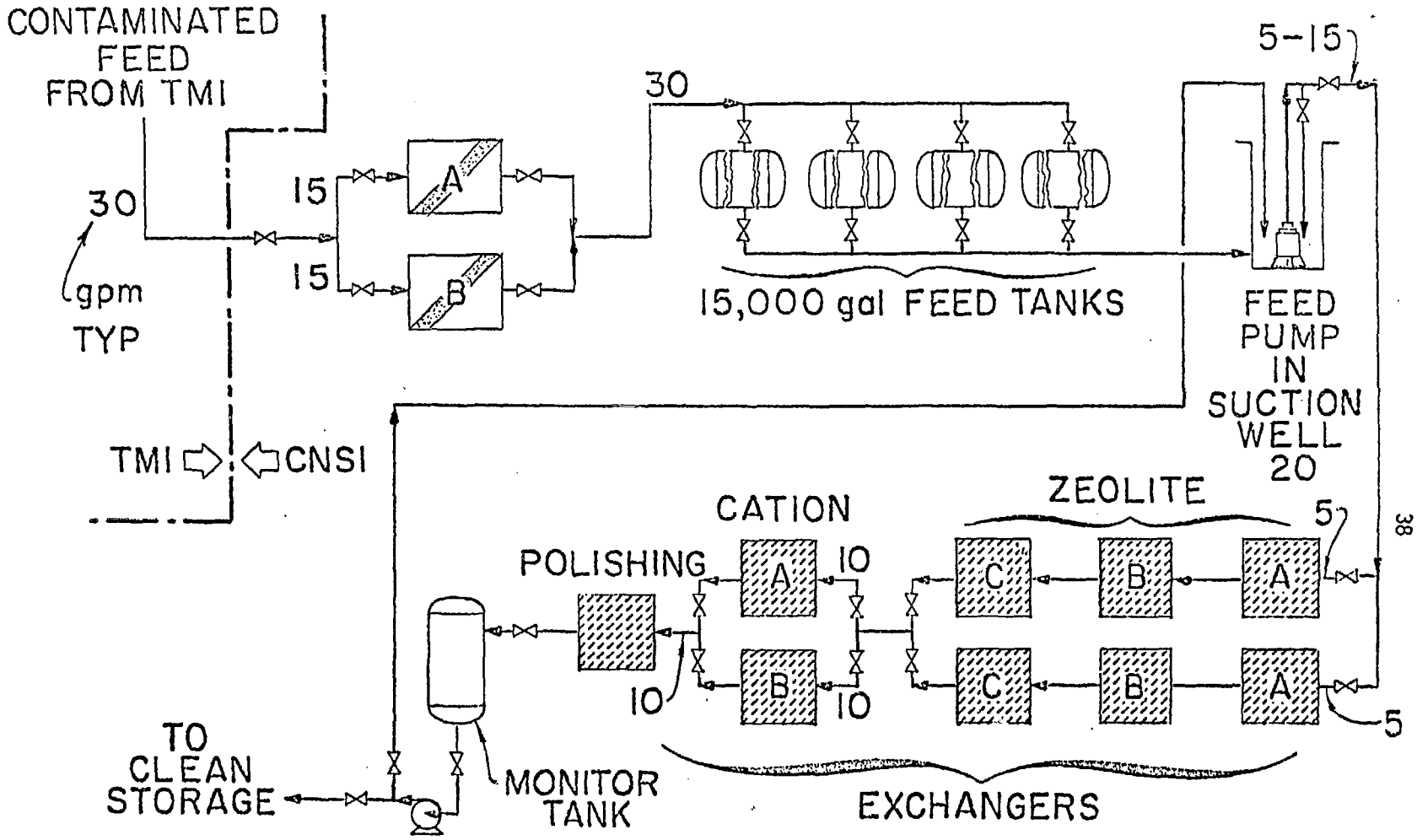


Fig. 12. Liquid waste decontamination flowsheet.

Figure 24 23

F FILTERS
M MANIFOLD
S SAMPLER
H HEPA
P PUMP
W WASTE
R ROUGHING FILTER
β β MONITOR
E EXHAUST BLOWER

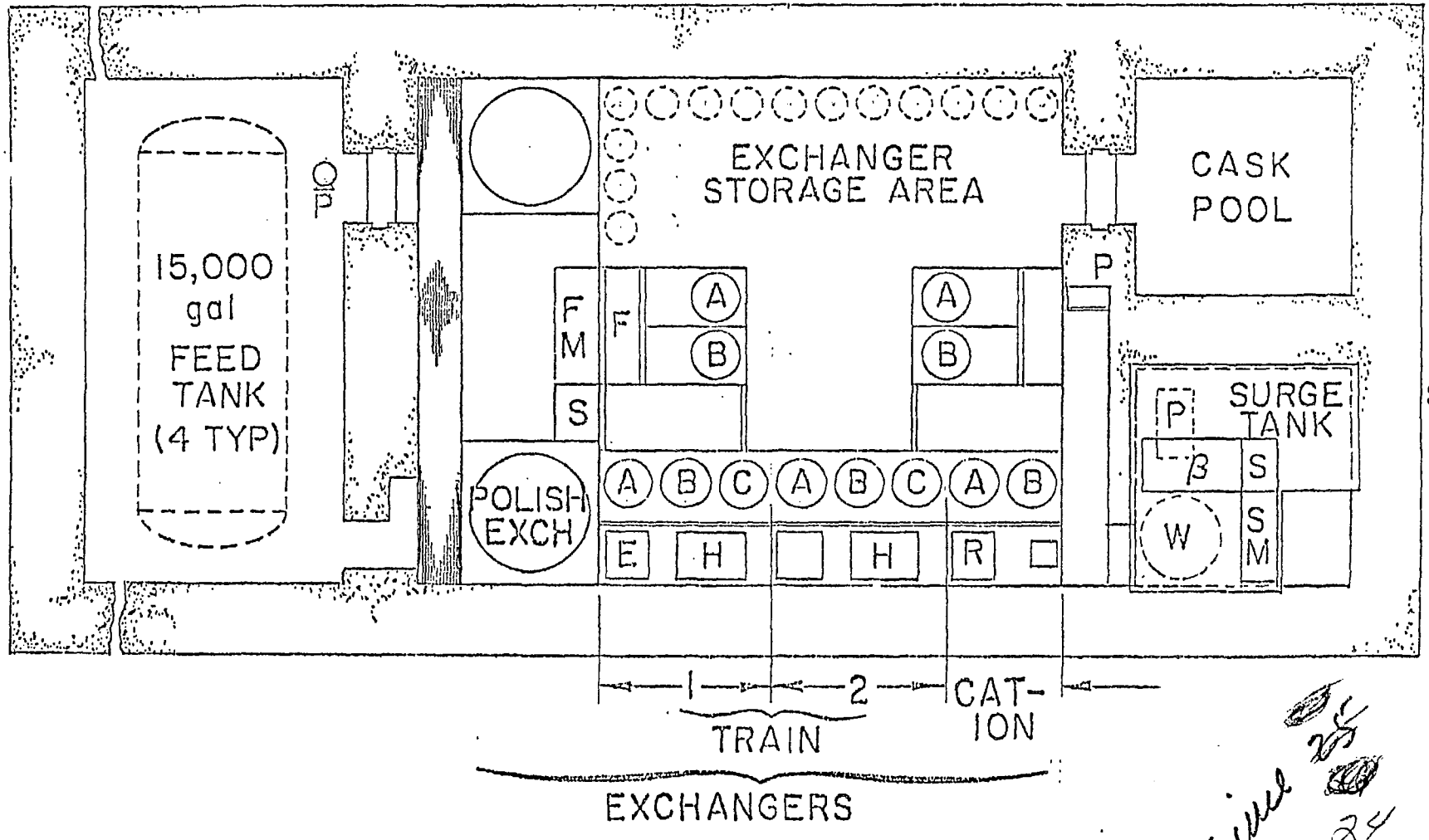


Fig. 15. Liquid waste decontamination equipment layout

TMI TECHNICAL STATUS

- AIRBORNE RELEASES
  - IODINE NO LONGER A CONCERN
  - ^{85}Kr RELEASE FROM CONTAINMENT UNDER STUDY
- WATER TREATMENT
  - LOW-ACTIVITY-LEVEL WATER PROCESSING COMPLETED
  - INTERMEDIATE-ACTIVITY-LEVEL WATER PROCESSING SYSTEM AWAITS APPROVAL
  - HIGH-ACTIVITY-LEVEL WATER PROCESSING SYSTEM BEING DESIGNED
- DECONTAMINATION AND RECOMMISSIONING
  - AUXILIARY BUILDING 80% COMPLETED
  - PLANS FOR CONTAINMENT BUILDING AND REACTOR UNDER STUDY

In the case of water treatment, the low-activity water has been treated without incident, and the product water has been discharged to the Susquehanna River. Product water from this treatment system was well below release limits.

The construction and installation of the intermediate-activity-level water treatment system have been completed and await NRC approval to proceed. In this instance, the NRC staff has submitted an environmental assessment, and the document awaits public comment. The environmental assessment concluded that this system posed no hazard to the human environment. Following the public comment period, the NRC Commissioners will decide whether or not to proceed.

In the case of high-activity-level water treatment, the system is currently being designed and equipment is being procured. Some limited flowsheet and unit operations development remain to be done, mostly in the area of flowsheet improvement. Of course, prior to operation of the system, the same NRC approval route must be done as was practiced in the intermediate-activity treatment system.

The decontamination of the contaminated surfaces of the Auxiliary Building 2 is approximately 80% completed. No major technological hurdles have been encountered as this work proceeds.

Preliminary plans to decontaminate the Reactor Containment Building and recommission the reactor have been drafted by the Bechtel Power Corporation for GPU. Basically, the plan anticipates an estimated 42-month period to accomplish this objective with an estimated expenditure of $300 million.

Many persons that are involved in the cleanup have expressed an opinion that would indicate that the cleanup problem at TMI is 80% political and 20% technical. Many of the answers necessary to solve problems of a technical nature are questioned in political sense.

Because of the lack of valid information passed on by the media in the early phases, the population in the area has been highly sensitized as the result of the accident. Both Metropolitan Edison and the NRC have been responsible in recent months to requests from the public and attempt to answer any and all questions in a forthright manner. Familiarizing the layman with the units used in measuring radioactivity, dose rates, and limits is a burdensome task at best.

Several organized anti-nuclear groups are extremely active in the surrounding area. These groups are active in the halls of the Capital and in small township meetings. In several instances, they have employed legal procedures to block remedial actions to technically sound procedures to be employed in the cleanup operation. The release of material (solid, liquid, or gaseous) from the island is severely restricted, even though the radioactive contents of the materials are below current dishcarge limits.

In addition to these groups, several communities, such as the city of Lancaster, have filed injunctions concerned with the release of any water to the Susquehanna River. Therefore, even though the treated water is below the levels of discharge prior to the accident, the water must remain on the island.

In the case of solid shipments, some difficulty with state governments has been experienced. The state of South Carolina has turned back one

shipment of pre-TMI accident low-level waste on its way to the Barnwell commercial burial site. Present plans call for the shipment of solid wastes to the commercial burial site at Richland, Washington.