August 25, 1971

Memo to File (GE Water Reactors)

DRL/GE MEETING ON MEANS TO CONTROL COMBUSTIBLE GASES FOLLOWING A LOCA, AUGUST 13, 1971, BETHESDA, MARYLAND

Purpose: GE requested this meeting to discuss a proposed means to control H_2 buildup following a LOCA for those seven plants where GE has the back-fit responsibility (Oyster Creek, Millstone, Monticello, Dresden 2 and 3 and Quad Cities 1 and 2).

Attendees

AEC

S. H. Hanauer, DR

V. Benaroya, DRL
H. N. Berkow, DRL
G. Burley, DRL
H. Denton, DRL
B. Grimes, DRL
G. Lainas, DRL
G. E. Lear, DRL
S. Miner, DRL
G. Owsley, DRL
J. Riesland, DRL
J. F. Stolz, DRL
M. A. Taylor, DRL
R. L. Tedesco, DRL
M. J. Wetterhahn, DRL
F. Williams, DRL

GE Company

R. Ascherl
P. W. Ianni
L. S. Gifford
N. Horton
I. Stewart

ACRS Office

R. F. Fraley, Staff

Presentation and Discussion - Mr. Stewart noted that the fix being proposed at this meeting is only for the seven plants where GE has the backfitting responsibility on this matter. GE considers it a suitable technical fix for all BWRs but the owners are responsible for recommending a fix on other GE BWRs.

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The proposed change involves the addition of a large, activated charcoal filter in the Standby Gas Treatment System (SGTS) in lieu of a recombiner. The system for atmospheric monitoring (described in Special Report No. 14 for Dresden Unit 3) would also be installed. GE considers this a better system than the addition of a recombiner since it:

a. minimizes costs
b. is readily available and no R&D is required
c. has characteristics acceptable for licensing as an engineered safety feature
d. results in low doses even when based on the Staff safety guide calculations. (GE noted that the dose values calculated were based on the assumptions and models of the AEC Safety Guide except for credit taken for "washout" from sprays and bubbling the vented gases through the suppression pool. There were apparently some other differences however (e.g., a containment leak rate of 1.6% by GE vs. 2.0% by Staff) to account for the variations in GE values vs. Staff values (factor of approximately 5). The details of the calculations were to be discussed in a separate meeting.

Mr. Ianni summarized the differences in GE/Staff figures regarding hydrogen generation, effects and control as follows:

Item	GE Assumptions in Special Report No. 14	AEC Guideline Assumptions	Effect
% MW reaction	2	5	If MW > 2% must inert
Flammability Limit	~8%	4%	If MW > 2% vent flow inc from 10 to 110 cfm and vent time dec from 150 to 3 hr.
Core γ	5%	10%	cfm inc from 10 to 20, vent time dec from 150 to 70 hr.
Pool G_H	0.2	0.44	cfm inc from 10 to 20, vent time dec from 150 to 50 hr.

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The effects that these assumptions have on system design is:

1. If all assumptions are per Special Report No. 14:

   Don't need to inert
   Venting rate is 9 cfm
   Initial venting time is 156 hr.

2. If AEC Guideline Assumptions are used:

   Must inert
   Venting rate is 52 cfm
   Initial venting time is 10 hr.

GE feels that the recombiner system:

-- Introduces some incremental risk (due to introduction of H_2 and flame into the containment)

-- Involves lengthy and expensive implementation

-- Needs a test for rigorous review

-- Has limitations on testability

Mr. Ianni described GE plans for a test program to:

1. Determine H_2 concentration limits for reactor conditions
2. Develop data important to the inerting question
3. Confirm the margin for the H_2 control system

GE considers available data regarding hydrogen flammability, etc. inadequate since it is based on small scale experiments. They have a contract with Fenwall Incorporated to perform a series of tests in a 6 ft. dia. sphere to investigate variations in hydrogen concentration, humidity, initial temperature, and ignition location. Preliminary results are expected in November '71, final results in December '71, and documentation will be provided by March '72.

A comparison of the doses for various schemes was presented as follows:

	2 hr. dose rem*	LPZ (30 day)* dose rem
Leakage only (based on TID-14844 assumptions)	33	68
Leakage and venting with present SGTS	33	215
Leakage and recombiners	33	68
Leakage and venting with improved SGTS	3.3	22

(The above doses are based on AEC Guideline assumptions applied to the Dresden Plant.)

*Thyroid dose: the whole body dose is negligible.

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The improved SGTS consists of an additional charcoal filter (see pages 6-9 of attachment) installed so it filters both the primary containment leakage and the gases vented for H_2 control. This results in reduced thyroid dose as noted above. (See page 10 of the attachment for detailed tabulation.)

Specific Regulatory concerns, expressed in previous reviews, have been resolved as follows:

DRL Concern	Solution
Gaskets	No gaskets used
Settling	15" bed depth
Corrosion	Amercoat or stainless steel will be used
Non-removable forms of iodine	Equally effective for HOI - No other forms known
Concentration Effects	~ 1 mg/m^3: other test results show no concentration effects for 10^{-3} - 10^3 mg/m^3

Filter Efficiency:

Dose calculations are based on a 90% efficiency. This provides a factor of 10^3 margin for the test bed depth to be provided.

It was noted that the cost of this system vs. the hydrogen recombiner is as follows (for seven plants):

$ 5 million for monitoring systems
$11 million for H_2 recombiners
$ 6 million for the improved SGTS

The total cost is therefore $11 million vs. $16 million for the seven plants involved.

General Discussion

The Regulatory representatives asked several questions as noted below:

Q - How will the filter be tested periodically? Its large size may present a problem

A - The Freon test presently in use for charcoal filters would probably be used.

Q - Channeling may be a problem in this "pancake" design. How will channeling be precluded?

A - Channeling has not been a problem in the filter tests conducted to date.

Q - What means will be provided to prevent a charcoal fire?

A - Water spray/cooling will have to be provided.

Original Signed by
R. F. Fraley

R. F. Fraley
Executive Secretary

Attachment:

Hydrogen Control (handouts)

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HYDROGEN CONTROL

WHY WE'RE HERE

- Turnkey's - GE Responsibilities
  - Requesting Special Consideration
- Plants Built
  - Looking at alternates to recombiner
  - Atmospheric Monitoring Committed

SCOPE OF DISCUSSIONS

- Applies to Turnkeys only

WHAT WE DID

- Selected Alternate
- Groundrules
  - Minimize Costs - simplicity
  - Readily Available - No R+D
  - Characteristics acceptable for licensing
  - Engineered Safeguard
- System Selected
  - Augmented SGTS
  - Doses Small

Special Report #14

Summary

Item	Assump Recommended in Sp. Rep 14	Guideline Assump.	Effect
• % M.W.	2	5	MW > 2% = Inert
• Flammab.	~8%	4%	MW > 2% = Inert CFM: 10 → 110 Init. T.: 150 → 3 h
• Cored	5%	0%	CFM: 10 → 20 Init. Ti 150 → 70 h.
• Pool G_H	.2	.44	CFM: 10 → 20 Init. T: 150 → 50 hr

- IF ALL Assumptions per Spec. Rep 14:
  - No Inert 9 cfm 156 hr Init. Time
- IF ALL Guide line Assumptions:
  - Inert 52 cfm 10 hr Init Time
- Recombiner sized for Guideline Assumption.

- Recombination Schemes share to varying degrees:
  - Introduction of incremental risks
  - Lengthy & expensive implementation
  - Need for a test for rigorous review
  - Limitations on testability

- Dose Comparisons Summary

	2 hr Dose Rem	LPZ Dose Rem
Leakage only TID etc (Base)	33	68
Tot. Dose Venting	33	215
Tot. Dose Recombiners	33	68
Tot. Dose Proposed Syst	3.3	22

Hydrogen Test

Purpose:

Find H_2 limits for reactor conditi

Data important to inerting issue

Confirm margins on H_2 control syst.

History:

Current limits based on small scale

Committed test in Supplement 14 (May

Selected Facility & let contract (Aug

Facility:

6' Dia. sphere - Personnel & Lab Availab
Fenwall Incorp. - Fire & Explosion detect
& suppression systems. manufacturers

Variables:

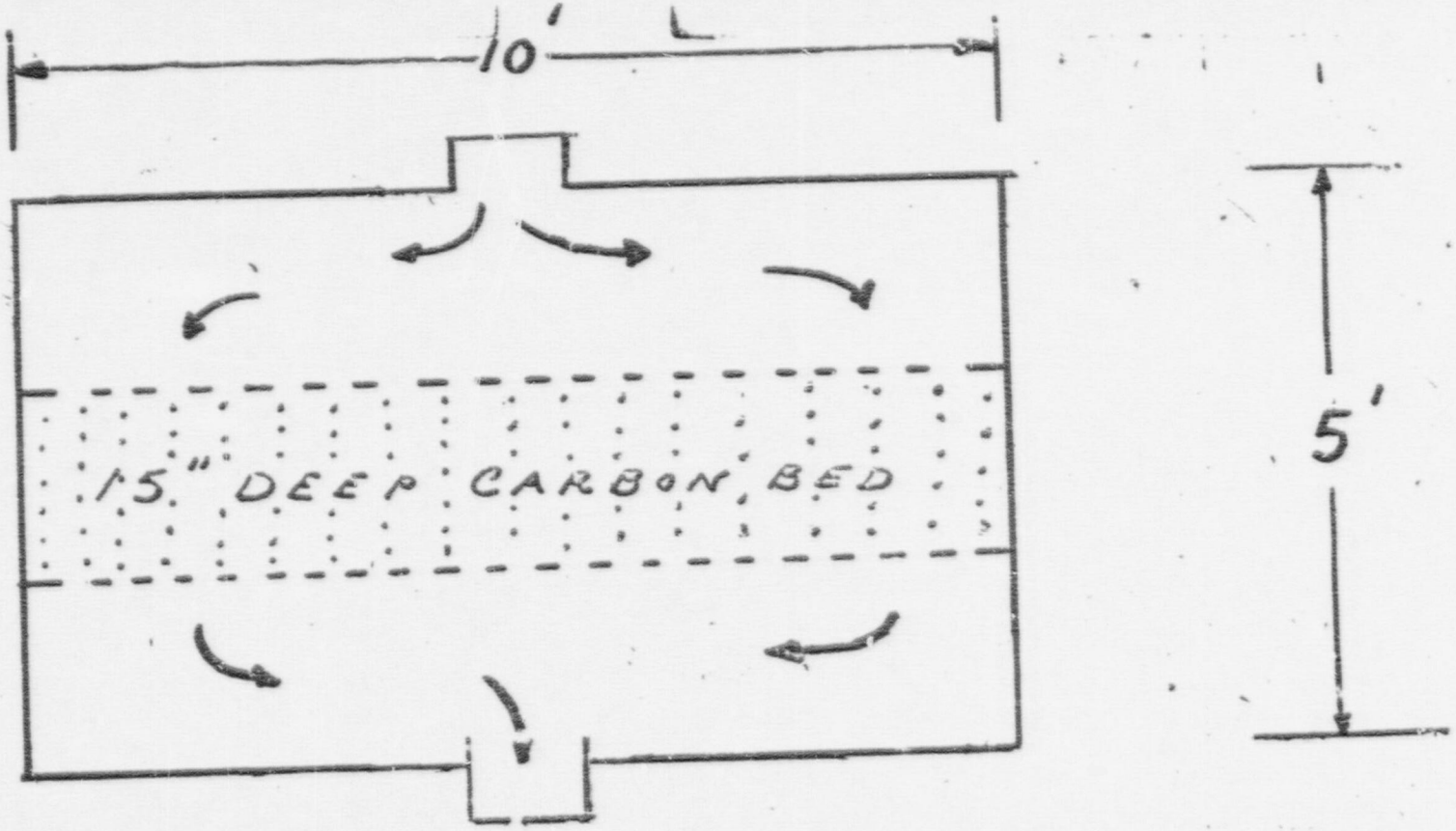
% H_2; Humidity; Initial Temp;

Ignition location

Measure: P vs t T vs t

Schedule: Prelim Results Nov. '71
Final Results Dec. '71
Documentation March. 72

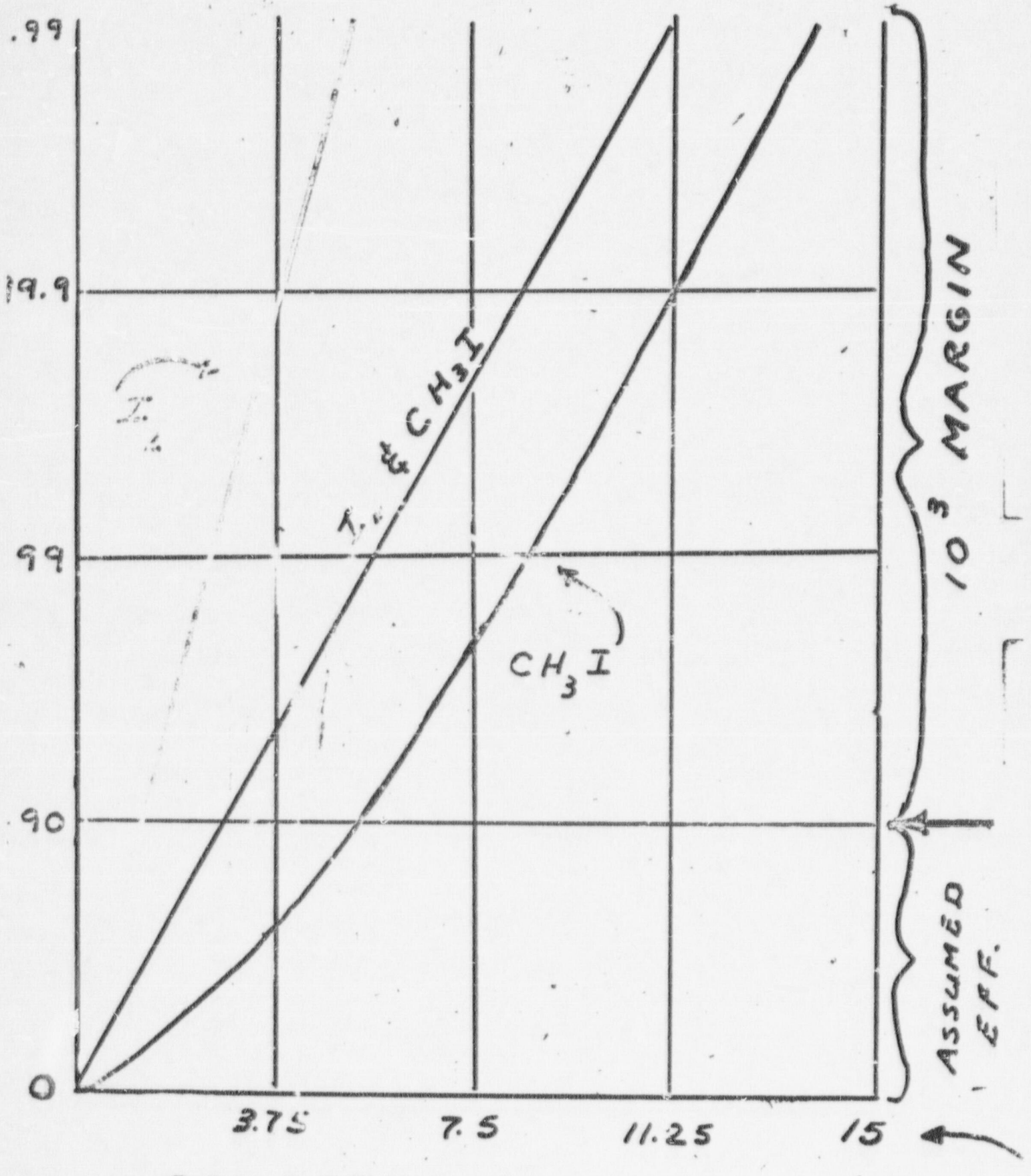
DRL CONCERNS	NEW FILTER
GASKETS	NO GASKETS
SETTLING	15" BED DEPTH
CORROSION	AMERCOAT #55
NON REMOVABLE FORMS OF IODINE	EQUALLY EFF. FOR HOI - NO OTHER FORMS KNOW
CONC. EFFECTS	~1 mg/m^3 - OTHER TEST RESULTS SHOW NO CONC. EFFECTS FOR 10^{-3} - 10^3 mg/m

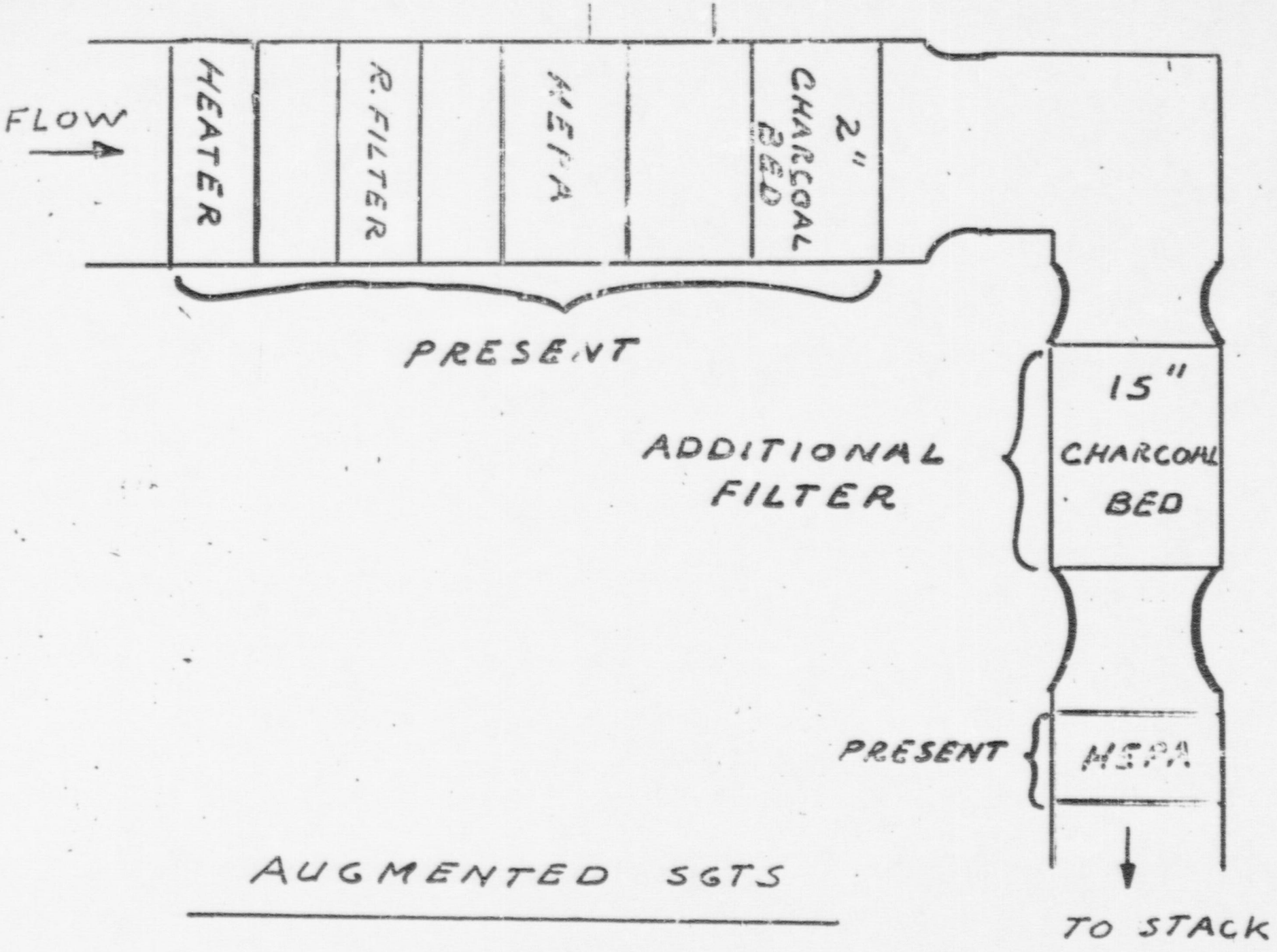


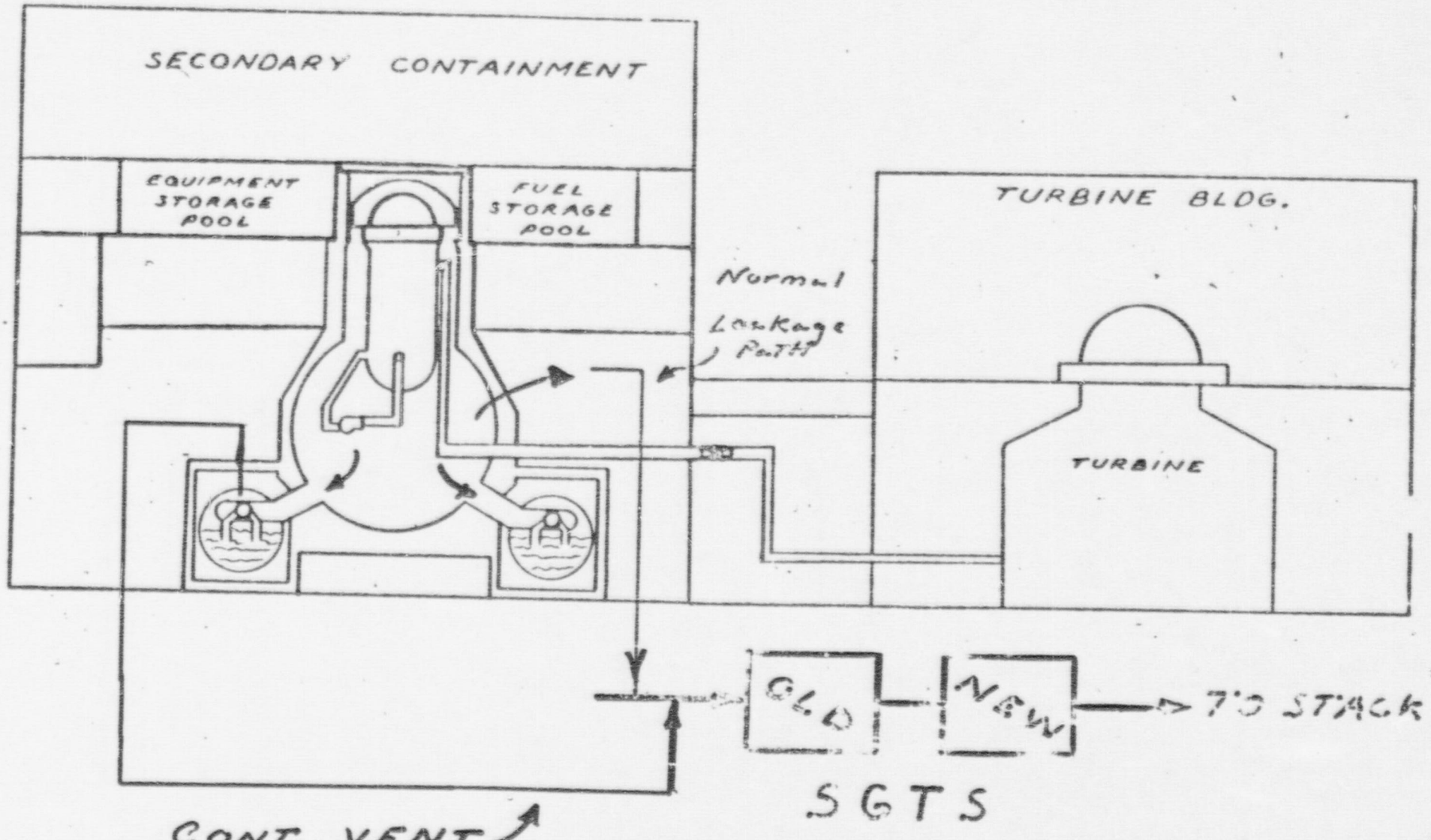
ADDITIONAL FILTER

CHARCOAL - ~800 # - 4x6 SIEVE - KI_3 IMP.

15" DEEP - 10' LONG


.99
19.9
99
90
0
3.75
7.5
11.25
15
BED DEPTH (IN.)
DESIGN DEPT.
I_2 & CH_3I
CH_3I
10^3 MARGIN
ASSUMED EFF.


FLOW
HEATER
R. FILTER
HEPA
2" CHARCOAL BED
PRESENT
ADDITIONAL FILTER
15" CHARCOAL BED
PRESENT
HEPA
AUGMENTED SGTS
TO STACK


SECONDARY CONTAINMENT
EQUIPMENT STORAGE POOL
FUEL STORAGE POOL
TURBINE BLDG.
Normal Leakage Path
TURBINE
SGTS
7'0 STACK
CONT. VENT

DOSE ANALYSIS (THYROID)

EXCLUSION AREA - 2 HR DOSE (REM)

	SPECIAL REPORT 14	AEC LETTER TO APPLICANT	AUGMENTED SGTS		AUGMENTED VENT. (3)
ACCIDENT LEAKAGE (1)	33	—	3.3	0.33	33
HYDROGEN CONTROL (2)	0	—	0	0	0
TOTAL	33		3.3	0.33	33

filter eff — 90% 99%

LOW POPULATION ZONE - 30 DAYS (REM)

ACCIDENT LEAKAGE (1)	68	—	6.8	0.68	68
HYDROGEN CONTROL (2) (venting)	147 *	100	14.7	1.47	14.7
TOTAL	215	—	21.5	2.15	82.7

EXCLUSION AREA — 30 DAYS (REM)

ACCIDENT LEAKAGE (1)	410	—	41	4.1	410
HYDROGEN CONTROL (2) (venting)	490 *	1040	49	4.9	49
	900	—	90	9	459

(1) ASSUMES TECH SPEC LEAKAGE 1.0%

(2) HYDROGEN RELEASE BEGINS AT 10 HOURS

(3) Silver Zeolite filter of vent gasses only (discarded by GE)

* takes credit for f=10 reduction due to washdown from containment sprays + bubbling through the suppression pool.