INTER-OFFICE MEMO **TENNECO CHEMICALS, INC.**

TO DISTRIBUTION AT DATE July 7, 1980

FROM D. Goodman AT Piscataway COPY TO

SUBJECT NEW DEVICE TO REMOVE VCM FROM LOW CONCENTRATION EFFLUENT AIR STREAMS

Avco Everett Research Laboratory, Inc. has an interesting prototype apparatus which is claimed to remove low concentrations of VCM from wet air streams. Avco's projected commercial intention is to manufacture and license a device to treat and remove VCM from dryer exhaust effluent streams in VCM and PVC production plants. Avco states that it would rather work directly with industrial companies than with EPA; however, there is an implied threat that they may choose to exploit their technology by demonstrating to government agencies that further improvements may be made in VCM removal with their process. In effect, that a "best available technology" exists for industry to continue to lower VCM effluents.

Avco's process involves an electron beam radiation device which ionically attacks VCM selectively to yield "innocuous" byproducts. Avco is looking for a commercial PVC producer to undertake a joint pilot plant project to demonstrate the efficacy of this approach. A description of a recent presentation by them is attached to this memo.

Avco estimates that there may be still lower allowable VCM emissions required from VCM and PVC manufacturing plants (e.g., 10 ppb at boundary and 50g/hr. from source according to California AQB-1980). Carbon bed entrapment and incineration are claimed to be economical only for high concentration streams. Avco's "AERL" (electron beam radiation) removal may be significantly more economical at low concentrations.

The Avco unit has been tested on lab streams containing from 3 to 500 ppm VCM in dry and wet air, nitrogen, and argon. The ionization products are HCl (~70%) and PVC. The system has not been tested for copolymer in which there may be vinyl acetate monomer and trichloroethylene present.

The case is given on page 10 of the attachment that for an air flow of 50,000 cfm containing 5 ppm VCM in order to treat the effluent to reduce VCM to <0.1 ppm, an irradiation chamber 7.5' x 2' x 2' is required. Effluent residence time is 36 millisec at a gas velocity of 56 ft/sec, using 300 kV of electron beam voltage. The capital required is $510,000 with annual costs of about $180,000 including power, maintenance and 5 yr. amortization at 15%.

If there is sufficient interest in this proposal, Dr. D. H. Douglas - Hamilton of Avco would be available to make a more detailed presentation to us. His primary interest is to find a PVC producer who will join Avco in setting up a small production prototype. Please contact me if you would like such a meeting.

Don

D. Goodman

DG/nm
Attachment

D. Goodman July 7, 1980

NEW DEVICE TO REMOVE VCM FROM LOW
CONCENTRATION EFFLUENT AIR STREAMS

DISTRIBUTION:

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VINYL CHLORIDE REMOVAL*

D. H. Douglas-Hamilton

May 30, 1980

AVCO EVERETT RESEARCH LABORATORY, INC.
a Subsidiary of Avco Corporation
2385 Revere Beach Parkway
Everett, Massachusetts 02149

*Patent Pending

AVCO EVERETT RESEARCH LABORATORY, INC.

PERSONNEL : PhD LEVEL: 100
TOTAL : 700

EXPERTISE :
GAS DYNAMICS
LASER RESEARCH
ELECTRICAL DISCHARGES IN GASES
ATOMIC & MOLECULAR KINETICS
MHD
OPTICS
HEART ASSIST BALLOON PUMP
INDUSTRIAL LASERS

CURRENT INTEREST: APPLICATION OF OUR BACKGROUND IN PHYSICS TO SOLVING PROBLEMS IN INDUSTRY

J5186

VINYL CHLORIDE MONOMER

- SOURCE: VCM AND PVC MANUFACTURE

EMISSION LIMITS TO ATMOSPHERE :

– EPA (1976)	:	10 ppm AT STACK
– CALIFORNIA AQB (1980)	:	10 ppb AT BOUNDARY
		50 g/hr FROM SOURCE

- CONVENTIONAL REMOVAL:
  - CARBON BED
  - INCINERATOR

  } ECONOMICAL ONLY FOR HIGH CONCENTRATION

- AERL REMOVAL:
  - ION–CATALYSED DESTRUCTION *

  } ECONOMICAL ONLY FOR LOW CONCENTRATION

*PATENT PENDING

J5184

CARBON BED

FLOW	< 500 cfm
INPUT CONCENTRATION	~ 38,000 ppm VCM IN N_2
OUTPUT CONCENTRATION	~ 5 ppm VCM IN N_2
RECOVERED PRODUCT	90% VCM AS VAPOR
COST	$293,000

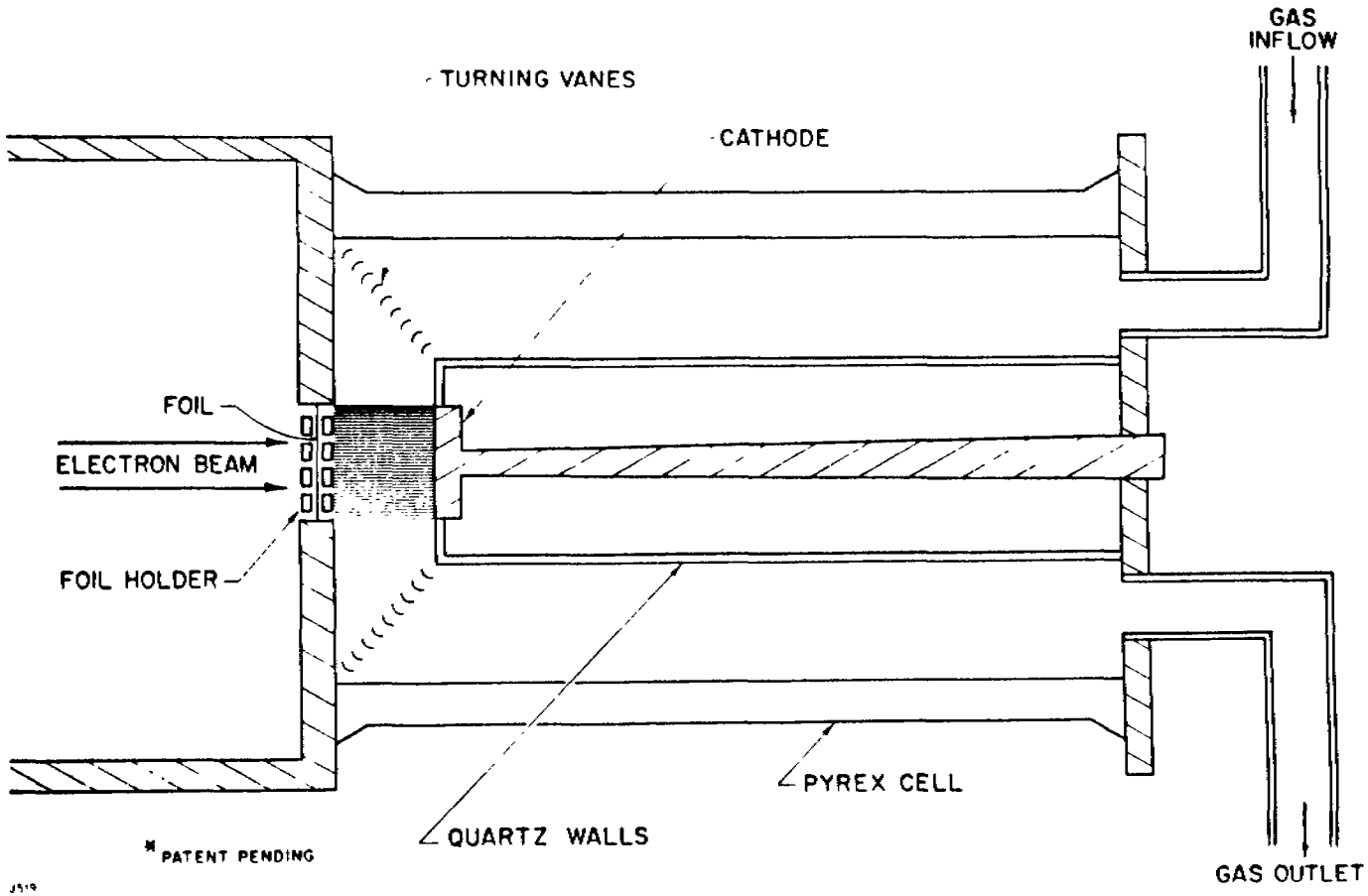
FOR 50,000 cfm COST WOULD BE ~ $5M

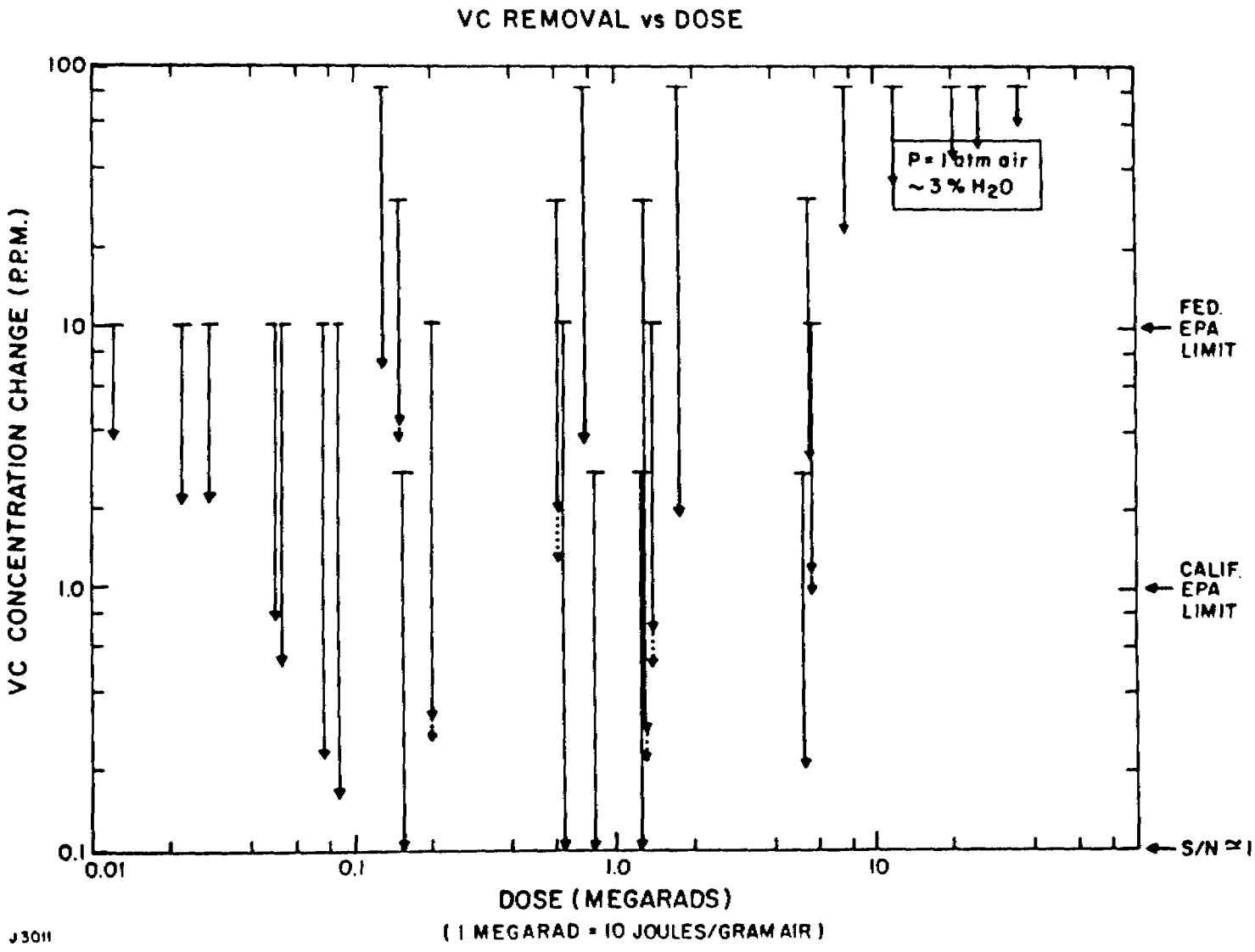
INCINERATOR

FOR 50,000 cfm, ANNUAL FUEL COST WOULD BE ~ $5.5M

J5183

DISCHARGE CELL*





REACTION PRODUCTS

GAS:	VCM IN N_2		
PRODUCTS:	HCl	:	50% – 75%
	POLYMERIZED POWDER	:	> 1%
	CHLORINATED HYDROCARBONS	:	NEGLIGIBLE

NO MASS SPEC PEAKS DETECTED FOR M > 63

J5187

KINETIC EQUATIONS

$$\frac{d[VC]}{dt} = -k_1[e][VC] - \gamma_1[N_2^+][VC]$$

$$\therefore \frac{d[VC]}{dt} = -[VC]\left[k_1[e] + \gamma_1[N_2^+]\right].$$

ATTACHMENT AND CHARGE TRANSFER DOMINATE:

$$\therefore [e] = \frac{S}{k_1[VC] + k_2[Cl]} \quad , \quad [N_2^+] = \frac{S}{\gamma_1[VC] + \gamma_2[X]}$$

CONSERVATION OF MASS:

$$[VC] + [Cl] = [VC]_o$$

$$[VC] + [X] = [VC]_o$$

ASSUME $k_1 = k_2$, $\gamma_1 = \gamma_2$; EQUATION REDUCES TO:

$$\frac{d[VC]}{dt} \simeq -\frac{2[VC]}{[VC]_o} \cdot S.$$

HENCE: $\frac{[VC]}{[VC]_o} = e^{-kD/\psi}$, WHERE $\psi = [VC]_o$.

J5190

EXPERIMENTAL RESULTS

1. FOR INITIAL CONCENTRATION $3 < \psi <$ 500 ppm :

   VCM IS REMOVED FROM

N_2	DRY & WET
AIR	DRY & WET
ARGON	DRY

2. GAS TEMPERATURE RISE $\Delta T = 1\,^{o}C$ FOR REMOVAL 5 ppm VCM

3. REACTION PRODUCTS : HCl (~ 70%) AND POLYMERIZED POWDER

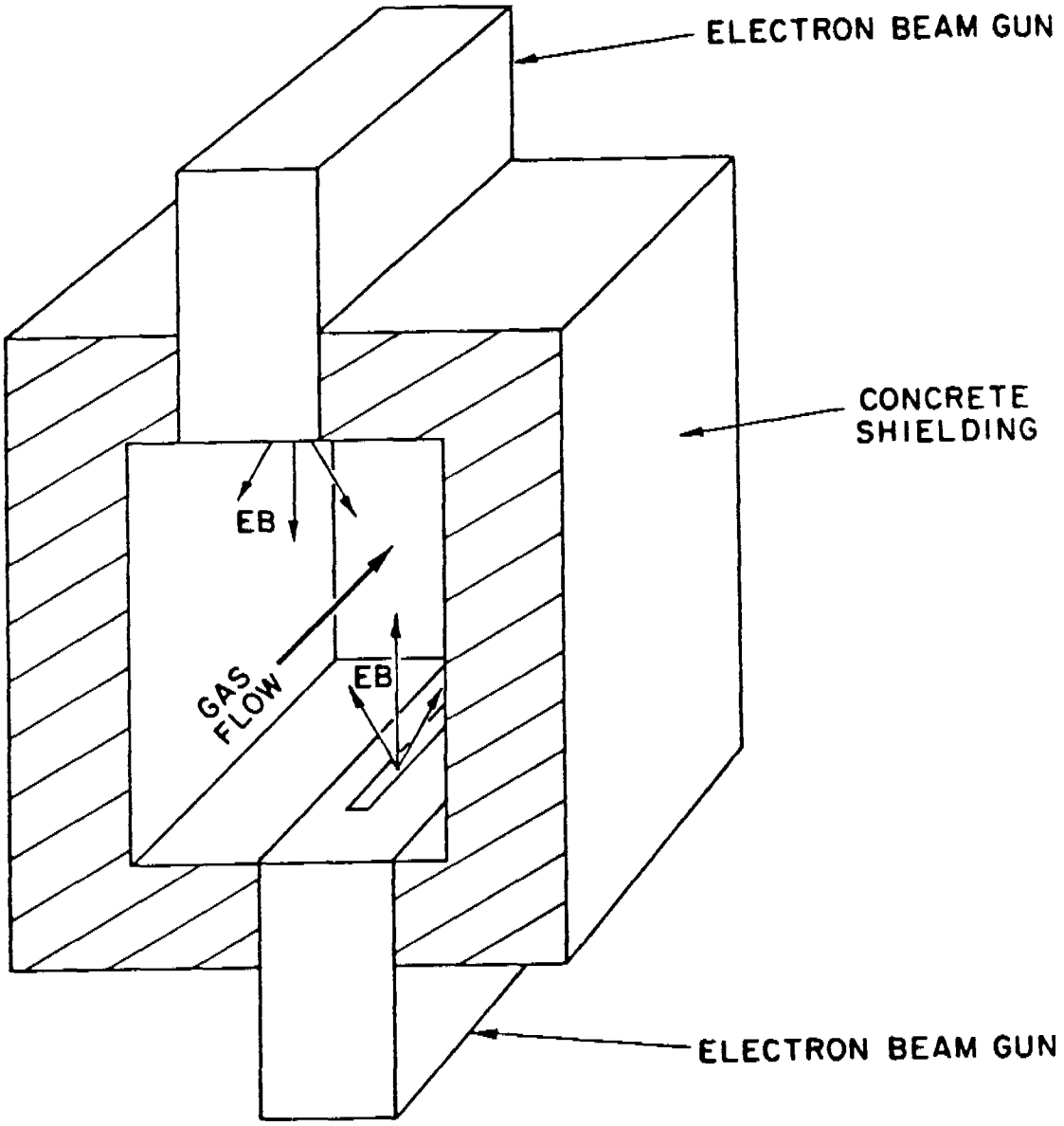
4. FRACTION REMAINING AFTER D MEGARADS IS

   $$x = e^{-kD/\psi}$$

   WHERE k = 269 ppm PER MEGARAD

J5189

EB INCINERATOR*
IRRADIATION CELL



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*PATENT PENDING

REMOVAL OF VCM

1. POINT DESIGN

AIR FLOW	:	50,000 cfm
INPUT VCM	:	5 ppm
OUTPUT VCM	:	< 0.1 ppm

2. EBI SYSTEM

IRRADIATION CHAMBER	:	7.5' x 2' x 2'
RESIDENCE TIME	:	36 millisec
GAS VELOCITY	:	56 ft / sec
EB VOLTAGE	:	300 kV
EB SHIELDING	:	BUILT-IN LEAD LAYER
EB POWER	:	50 kW

3. COSTING

CAPITAL $510,000

INCLUDING
- CHAMBER
- DUCTING
- EB SYSTEM
- SHIELDING
- CONTROLS

ANNUAL $180,000

INCLUDING
- POWER
- MAINTENANCE
- AMORT. (5 YR., 15%)

NOTE: CAPITAL AND ANNUAL COSTS INCREASE AS LOG_e [INPUT VCM]

E.G.: FOR INPUT VCM = 50 ppm, COSTS INCREASE ~2.6 TIMES

J5188

SUMMARY

1. DEMONSTRATED ECONOMICAL PROCESS* FOR REMOVING VCM IN LOW CONCENTRATION FROM LARGE FLOWS

2. DEMONSTRATED PREDICTABILITY FOR SCALE-UP OF PROCESS

3. PRELIMINARY COST ANALYSIS PERFORMED

4. POTENTIAL APPLICATIONS IN PVC PLANT DRIERS AND FUGITIVE EMISSIONS

J5185

*PATENT PENDING