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RECIP.NAME RECIPIENT AFFILIATION
STELLO,V. Ofc of the Executive Director for Operations

SUBJECT: Responds to Questions 471.5 - 471.12 re App A exemption request for worker respiratory protection apparatus.

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JUNE 23 1988

L-88-280
10 CFR 20.501
10 CFR 20.7

Mr. Victor Stello, Jr.
Executive Director for Operations
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Dear Mr. Stello:

Re: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Request for Additional Information - 10 CFR 20
Appendix A Exemption Request for Worker Respiratory
Protection Apparatus (TAC Nos. 67138 and 67139)

By NRC letter dated March 16, 1988, the Staff requested additional information relating to the above subject for St. Lucie Plant, Unit Nos. 1 and 2.

The purpose of this letter is to provide the second set of responses. The first set of responses was provided in Florida Power & Light Company's letter L-88-209, dated May 5, 1988. This submittal provides responses to Questions 471.5, 471.6, 471.7, 471.9, 471.11 and 471.12.

Should there be further questions, please contact us.

Very truly yours,

W. F. Conway
Senior Vice President - Nuclear

Enclosures

WFC/MSD/gp

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

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QUESTION 471.5

Provide a description of the SCOTT 631-TEDA-H canister including particulate filter, sorbent and percent TEDA. Address the question of the potential toxic hazard to the respirator user from inhalation of TEDA desorbed from the SCOTT 631-TEDA-H canister. Describe the criteria for use of these SCOTT canisters at St. Lucie (e.g., radioiodine concentration, canister labeling, prevention of canister reuse).

RESPONSE

A. Description of SCOTT 631-TEDA-H Canister

The 631-TEDA-H chin style gas mask canister is constructed using a 12 x 20 mesh (U. S. Sieve series) activated carbon, impregnated with 5% by weight triethylenediamine (TEDA), and a high efficiency particulate air (HEPA) filter. Figure 1, attached, depicts the canister construction.

The sorbent in the canister is batch certified to meet the ASTM D3803 and D4069 radioiodine performance requirements. The volume it occupies within the canister is 340 cc's.

The HEPA filter is a radially pleated high efficiency filter with greater than 99.97% removal efficiency against a 0.3 micrometer dioctylphthalate (DOP) aerosol. Canisters are 100% tested for DOP removal efficiency at the time of manufacture per NIOSH respirator certification requirements of 30 CFR Part 11.

B. Potential Hazard from Desorption of TEDA

Studies have been performed on the desorption characteristics of TEDA from impregnated activated carbons. It has been found that the desorption rate of TEDA is not a function of the linear flow rate or sorbent bed depth within the canister. However, desorption rates are linearly related to temperature on a semi-log plot. At 48.9°C (120°F) a maximum TEDA desorption rate of approximately 2 mg/m^3 has been measured (1).

There is no toxicological data available for TEDA, however, there are similarities between other amine type compounds. A sample of several compounds and their threshold limit values are given below (2):

	(mg/m^3)	(ppm)
Ethylamine	18	10
Diethylamine	30	10
Triethylamine	40	10
Ethylenediamine	25	10
Diethylene/triamine	4	1

The 2 mg/m^3 desorption value at 48.9°C is well below the lowest threshold limit value for similar type substances and therefore should not present a toxic hazard to the user.

C. Use of SCOTT Canisters at St. Lucie

FPL does not plan to reuse the canisters after initial use. All canisters will be removed after use and discarded to prevent any further use. The canisters will not be used when the radionuclide concentrations of radioiodines, particulates or a combination of each exceed 50 times the applicable limit for the radionuclides in question in 10 CFR 20 Appendix B, Table I Column 1 as described in 10 CFR 20.103.c.1. FPL does not plan on any labeling outside the labeling required to show compliance to NIOSH/MESA requirements.

QUESTION 471.6

The FPL submittal includes tabular summaries of test conditions and test results provided by SCOTT for the SCOTT 631-TEDA-H canister but contains no other information on these tests or on the means for ensuring the reliability of the tests and test results. Provide a complete description and discussion of the test program (including apparatus used), the means for ensuring the reliability of the tests and the test results, and the basis for your acceptance of the test results. Include the complete name and address of the manufacturer (SCOTT) and the identification of the organization or group that actually performed the tests, if other than SCOTT.

RESPONSE

A. Canister Test System Description

A sketch depicting the test system used to determine the performance of the SCOTT 631-TEDA-H canisters against methyl iodide is shown in Figure 2. The primary

components and key features of the system include:

- Detection System:

  Gas chromatograph equipped with an electron capture detector for measuring methyl iodide concentrations in the canister effluent. The chromatograph is calibrated against CH_3I using two independent techniques. The first technique employs a permeation tube while the second technique was by volume dilution. Excellent agreement between the two methods was realized.

- Temperature/Humidity/Flow System:

  A modified Miller-Nelson (MN-301) airflow, temperature and humidity controller is employed for generation and control of the humidified air. The MN-301 unit delivers air at the desired temperature and flow rate to a humidity vessel. As the air passes through the water vapor laden headspace of the vessel, air-stream humidification and final air heating is accomplished. The temperature and humidity of the air stream is monitored using an optical dew point hygrocomputer. The hygrocomputer is located in the thermal enclosure for monitoring the air immediately prior to entering the canister inlet.

- Methyl Iodide Generation:

  A syringe pump is used to generate the methyl iodide challenge concentrations of interest. Capability for generating challenge concentrations using this method was verified using a Miran 1A infrared analyzer and the gas chromatograph. Concentrations generated throughout the test program are verified using volumetric displacement measurement techniques and by use of the chromatograph.

- Challenge Atmosphere Delivery:

  Due to the high temperature and water vapor concentration of the airstream, in-line condensation in the transfer tubing was eminent unless appropriate measures were taken to prevent this condition. A heated enclosure was utilized to contain the canisters, the stream selector valve (which selected the appropriate air stream to be sampled) and the hygrocomputer. Temperature of the enclosure is set and controlled to the same temperature as the challenge airstream (i.e. 120°F or 100°F). Water vapor condensation is thereby eliminated. No temperature gradients were observed in the thermostated enclosure. A radial manifold is used

for distribution of the flow to the test canisters. Three solenoid valves controlled by an electronic timer unit allows for 192 lpm airflow delivery to each canister for 0.82 seconds and 0 lpm flow for 1.64 seconds (equivalent to a 64 liter minute volume). A pressure vs. time history of each flow segment is used to verify system pressure symmetry (i.e. flow), correct operation of the solenoid valves and "squareness" of the pulsed waveform. A fast response pressure transducer is used for these pressure measurements.

- System Control:

The "brain" of the system is the computing integrator which controls information flow in the instrument network loop (INET). A basic program was written and loaded into the integrator for control of the INET system operation. The program dictates which canister is to be sampled and at what time. The sampler event control module positions the stream selector valve to the appropriate location for canister effluent sampling. After the sample is processed by the chromatograph, the integrator computes the amount of methyl iodide in the air and stores the information. At the end of the test, the stored data is loaded into the IBM PC/AT for further analysis, presentation and storage.

B. Discussion of the Test Program

As a result of the symmetry in the pulsed cycle (flow for 0.82 seconds, no flow for 1.64 seconds), this pattern lends itself to simultaneous testing of three canisters. In some instances, data from one or more of the test stations (i.e. number 1, 2 or 3) is not reported in the data tabulations as they related to either empty stations or stations which were used to evaluate prototype product.

Another important feature of the test program was that the detector in the chromatograph was calibrated routinely to monitor and correct for deterioration of the cell. The cell deterioration is caused by oxygen present in the sampled air stream from the canister effluent.

C. Reliability of Test Results

Data on the performance characteristics of various air purifying respirator cartridges or canisters for methyl iodide exists (3,4). However, data on the performance of the SCOTT 631-TEDA-H canister at the test conditions of interest has not been previously reported. Therefore by comparison of the data enclosed in this exemption request with previously published data, a correlation can be

established which substantiates the SCOTT results. These conclusions are summarized below:

- Test data on the SCOTT P/N 600252-75 canister which contained 305 cc of 8 x 16 mesh, 5% TEDA carbon, tested with air at 64 lpm constant flow, 25°C, 97% R.H. was greater than 6 hours to 1% penetration.

  The SCOTT 631-TEDA-H canister with 340 cc of 12 x 20 mesh, 5% TEDA carbon provides 25 hours duration to 1% penetration. Test conditions were 64 lpm constant flow, 48.9°C, 90% R.H.

  Due to the increased sorbent volume and smaller sorbent particle size distribution, improved canister performance has been realized in the 631-TEDA-H canisters.

- It has been reported in the published data that service life of air purifying canisters decrease with increased relative humidity of the air stream. Performance of the 631-TEDA-H canister was 13.7 hrs. at 90% R.H and 23.9 hrs. at 60% R.H. (48.9°C, pulsed flow conditions, C_o = 10 ppm). This trend is also consistent with the published data.

- Under steady flow conditions, time to a 1% penetration fraction is greater than under cyclic (pulsed) flow conditions for equivalent minute volumes. For the 631-TEDA-H canister, steady flow conditions provided times approximately 2 times greater than pulsed flow tests. This result is also consistent with the published data.

- Other tests were performed by SCOTT (not reported in the exemption request) under steady flow conditions, with various methyl iodide challenge concentrations and with a 60 cc sorbent bed volume. The test results demonstrated that for steady flow, removal efficiency was independent of the challenge concentration. Penetration fractions with time remained identical over the 0.5 - 3.0 ppm concentration range of interest. This result has also been previously reported in the literature.

Therefore, by correlation of SCOTT test results with previously reported data, reliability of the SCOTT results has been demonstrated.

D. Test Location

All the methyl iodide tests were performed by SCOTT Aviation, 225 Erie Street, Lancaster, NY 14086.

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QUESTION 471.7

Describe how the quality and function of the SCOTT 631-TEDA-H canisters will be verified by Florida Power & Light Company (FPL). It is the utility's responsibility to ensure that canister performance and quality are fully adequate through such measures as verification of vendor quality assurance/quality control (QA/QC) and through development of utility/site QA/QC procedures which provide a continuing assurance of canister quality. (a) Include a general discussion of any vendor audits performed, or outline the basis for your acceptance of vendor QA/QC controls for the SCOTT 631-TEDA-H canisters. (b) Cite general controls and procedures related to SCOTT 631-TEDA-H canister QA/QC to be utilized at St. Lucie by FPL. (c) Clarify the "Equilibration" entry for the "SCOTT RADIOIODINE PROPOSAL" in Table A of Attachment 1 of the FPL submittal. Clarify how and by whom the "Quality Control Lot Acceptance Plan..." (Attachment 3 of the FPL submittal) has been and is to be used; verify that only the SCOTT 631-TEDA-H canisters from lots accepted under this MIL-STD 414 acceptance plan will be used at St. Lucie by FPL.

RESPONSE

A. Quality Control Lot Acceptance Plan

The Q.C. lot acceptance plan will be employed by SCOTT Aviation on each manufacturing lot of 631-TEDA-H canisters produced. Therefore, all canisters consumed by FPL will have been tested per the requirements of the Q.C. plan.

MIL-STD-414, level II, AQL 1% will be used to determine the number of canisters needed for testing based on lot size with acceptability criteria based on canister performance results. The canister test conditions would be as follows:

Air Temperature, % Relative Humidity	:	120F /90% R.H.
Airflow rate conditions	:	192 lpm for 0.82 seconds
	:	0 lpm for 1.64 seconds
Contaminant/Concentration	:	CH_3I/10 ppm
Test Duration	:	8 hours
Performance Criteria	:	1% maximum penetration

An improved test procedure and lot acceptance plan is

being investigated. The improved test procedure will be devised with the intent of being capable of verifying the acceptability of a manufacturing lot of canisters. However, the test conditions will not be as severe as the qualification test conditions. Future work will be directed toward constant flow and high methyl iodide challenge concentrations. Correlation between the qualification test results and the new test condition results will be accomplished.

B. QA/QC General Controls

FPL will accept only those canisters that have been certified by SCOTT as meeting the acceptance criteria of the MIL-STD 414 acceptance plan. FPL will perform a receipt inspection of each shipment of the canisters to verify lot number, expiration date of the canisters and physical integrity of the canisters. SCOTT will be required to provide to FPL the results of the acceptance testing for each lot of the canisters that FPL purchases from SCOTT.

C. Equilibration

The SCOTT test program tested canisters without pre-conditioning air flow through the canister.

QUESTION 471.9

The FPL submittal states that the SCOTT canisters are to be stored in sealed, humidity barrier packaging, but does not specify whether the canisters are hermetically sealed nor does it specify the conditions of storage. Specify whether or not the canisters are to be stored in hermetically sealed packaging. Identify the specific procedures that will be used to control canister storage, indicate the range of temperature and relative humidity allowed in the storage area(s), and describe where these canisters will be stored at St. Lucie. Specify the shelf life of the canisters and testing to verify shelf life.

RESPONSE

A. Humidity Barrier Packaging

The 631-TEDA-H line canisters are sealed at time of manufacture using a paper backed, heat sealable, aluminum foil laminate. The seals when applied to the canisters, produce an essentially hermetic seal which inhibits water

vapor transmission through the seals. Once the seals are removed by the user, they cannot be reinstalled.

B. Shelf Life of Canisters

The manufacturer of the TEDA carbon sorbent used in the 631-TEDA-H canister suggests a shelf life in excess of 3 years under normal room temperature storage conditions in sealed containers. The 631-TEDA-H canister with the foil-lined hermetic seals provides such a satisfactory container. A product shelf life under room temperature storage conditions is therefore taken to be 3 years.

Methyl iodide removal efficiency tests performed on 631-TEDA-H canisters stored in a 70-75°F, 30-70% R.H. environment for 6 month periods displayed no performance degradation characteristics. Studies are underway to better define high temperature storage conditions on product shelf life.

C. Storage of Canisters at St. Lucie

Health Physics Procedure HP-62 "Inspection, Maintenance, and Quality Assurance of Respiratory Protection Equipment" will be used to control canister storage. Long term storage of large quantities of the canisters will be in one of the plant store rooms. The environmental conditions found in the store rooms to be used for canister storage is that normally found in an air conditioned office type of environment. The general temperature ranges are from approximately 70-80°F with a relative humidity of 30-80%. Short term storage of the canisters will also be in an air conditioned environment in the plant's respiratory protection equipment issue rooms. This short term storage is designed to maintain a stocking level adequate to meet the immediate needs of ongoing work in the plant. Environmental conditions in the equipment issue rooms are generally the same as the plant store rooms. There may be instances when the temperature may reach 85°F for short periods of time, however, should not affect the performance of the cartridges.

QUESTION 471.11

The FPL submittal states that the canisters are not to be used in challenge concentrations of total organic iodide, including "nonradiometric" (nonradioactive?) iodide, greater than 1 ppm. Describe the methods and particular procedures that will be applied to prevent the use of the SCOTT canisters in the presence of challenge concentrations of

total organic iodides and other halogenated compounds greater than 1.0 ppm, including nonradioactive compounds.

RESPONSE

There are no known sources of nonradioactive organic iodides or halogenated compounds to which the canisters would be exposed, either in storage or during use. The only other source of exposure of the canister to organic iodides would be the exposure to the radioactive iodides while the canister is in use. Calculations have been performed for selected radioiodines found in the reactor coolant system to determine the atmospheric concentration equivalent to 1.0 ppm of the radioiodines. The results of the calculations indicate that the atmospheric concentrations would be in excess of 1.0 E+09 times the maximum permissible concentrations listed in 10 CFR 20 Appendix B. These atmospheric concentrations are far in excess of the limitations of the respirators which provide a protection factor of 50 times the 10 CFR 20 Appendix B concentrations. The calculations are contained in Attachment 1.

QUESTION 471.12

The FPL submittal states that the SCOTT canisters are not to be used in environments greater than 120°F but does not provide a limit on the relative humidity. Specify a limit on the relative humidity for canister use and provide the basis for this limit. Specify how compliance with the limits for temperature and humidity will be demonstrated.

RESPONSE

A. Maximum Conditions of Use

The performance of the 631-TEDA-H canister has been characterized at various conditions which include 37.8°C/48.9°C temperatures and 60/90% relative humidity. The ability to extrapolate test results from one set of humidity conditions to another humidity level has been demonstrated (3). Using data at the 48.9°C temperature, a log-log plot of breakthrough time vs. % relative humidity has been prepared and is shown in Figure 3. Using a linear extrapolation, canister service life to a 1% methyl iodide penetration value is projected to be 12.0 hours.

Use of the 631-TEDA-H canister in a saturated air stream

at 48.9°C (120°F) should provide a nominal 12 hour duration to a 1% methyl iodide penetration.

REFERENCES:

(1) Wood, G. O.: Desorption of TEDA from Impregnated Respirator and Absorber Charcoals, Am. Ind. Hyg. Assoc. J 45: 622-625 (1984)

(2) American Conference of Governmental Industrial Hygienists: Threshold Limit Values and Biological Exposure Indices for 1987 - 1988, ACGIH, Cincinnati, OH (1987)

(3) Wood, G.O., F. O. Valdez, V. Gutschick, "Criteria and Test Methods for Certifying Air Purifying Respirator Cartridges and Canisters against Radioiodine", NRC FIN No. A 7041, Los Alamos National Laboratory, August, 1983.

(4) Wood, G. O., "Respirator Canister Testing for Radioiodine", Am. Ind. Hyg. Assoc. J. 42: 570-578 (1981)

FIGURE 1
SCOTT 631-TEDA-H CANISTER

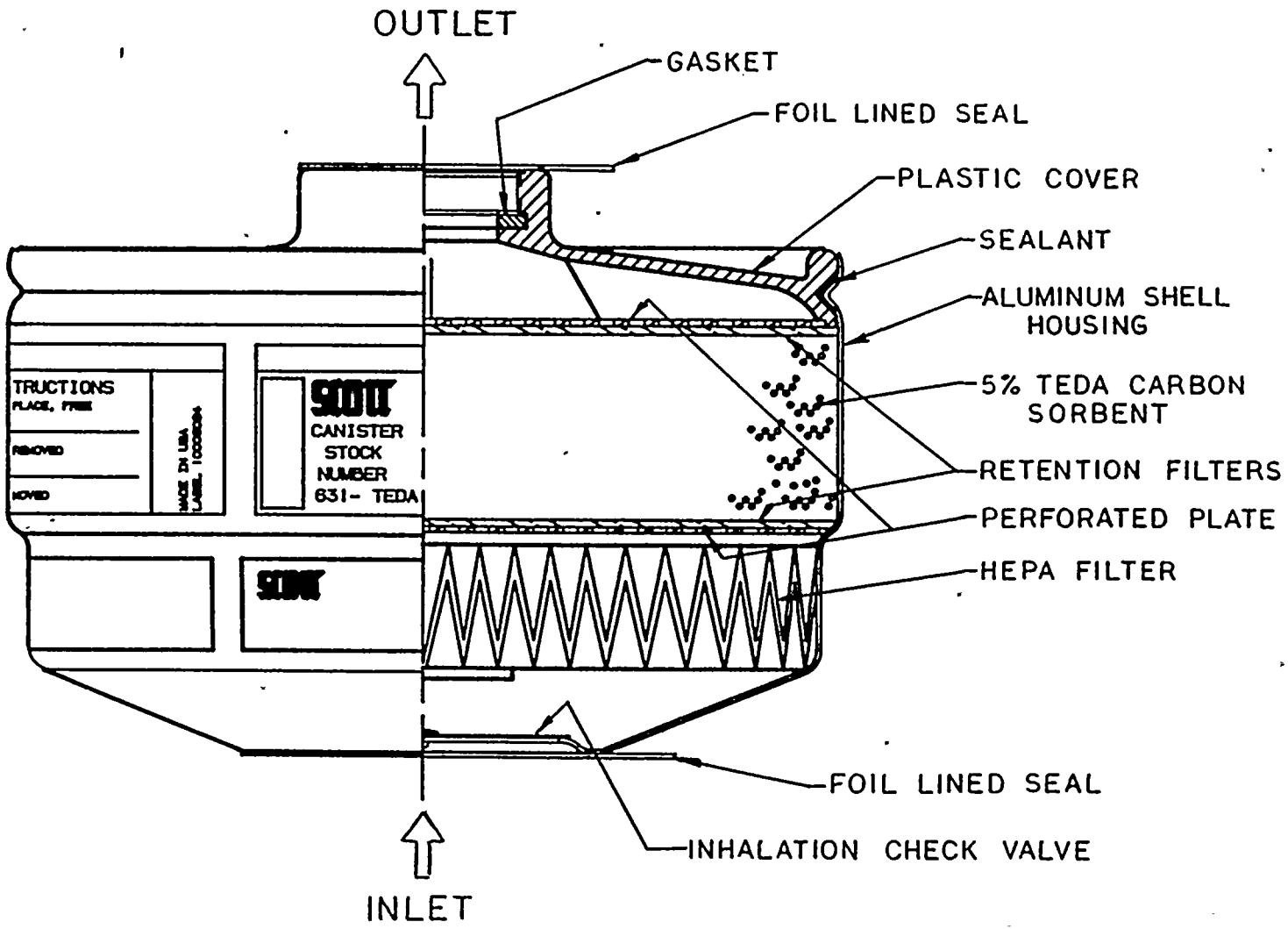
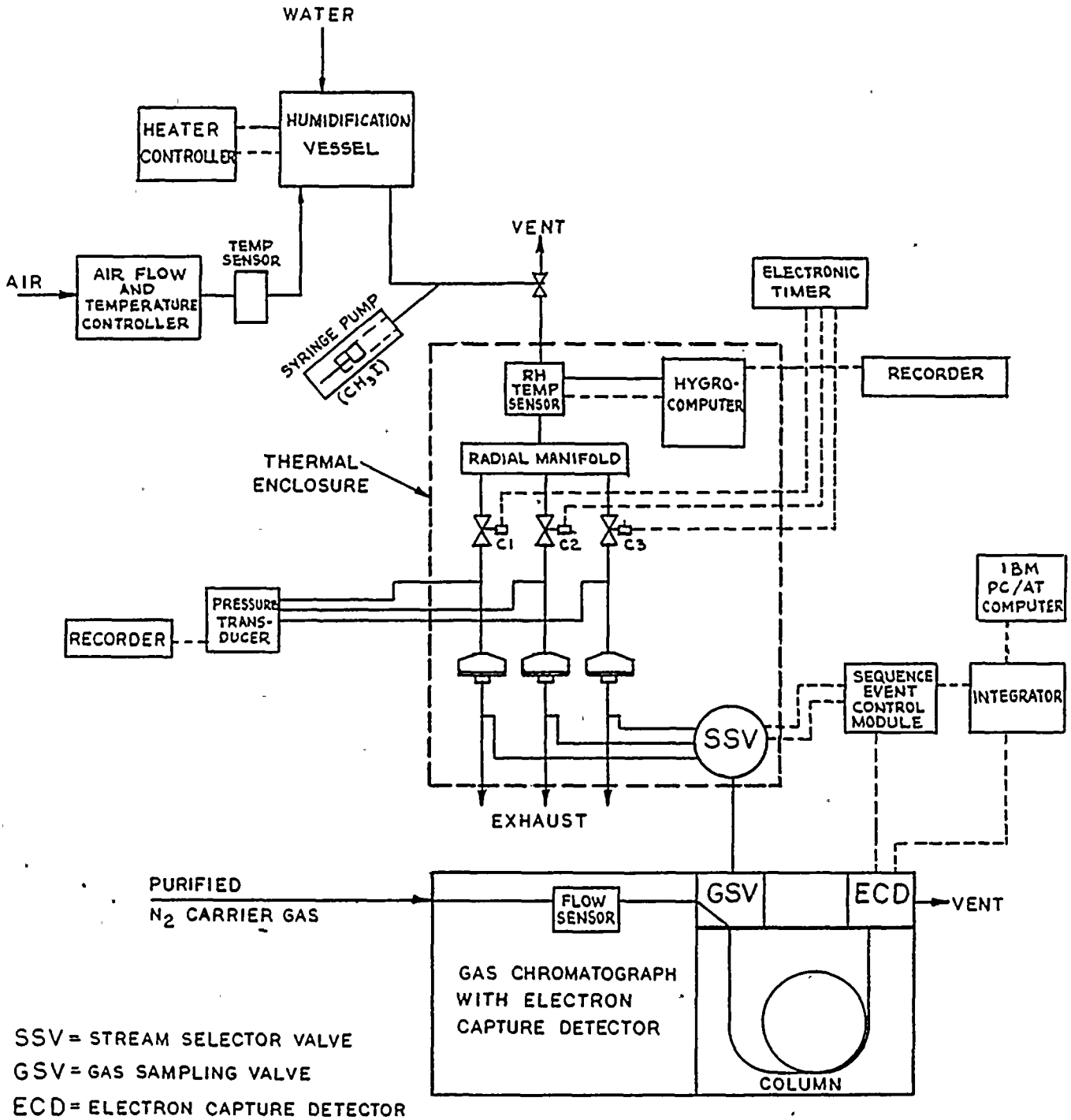


FIGURE 2

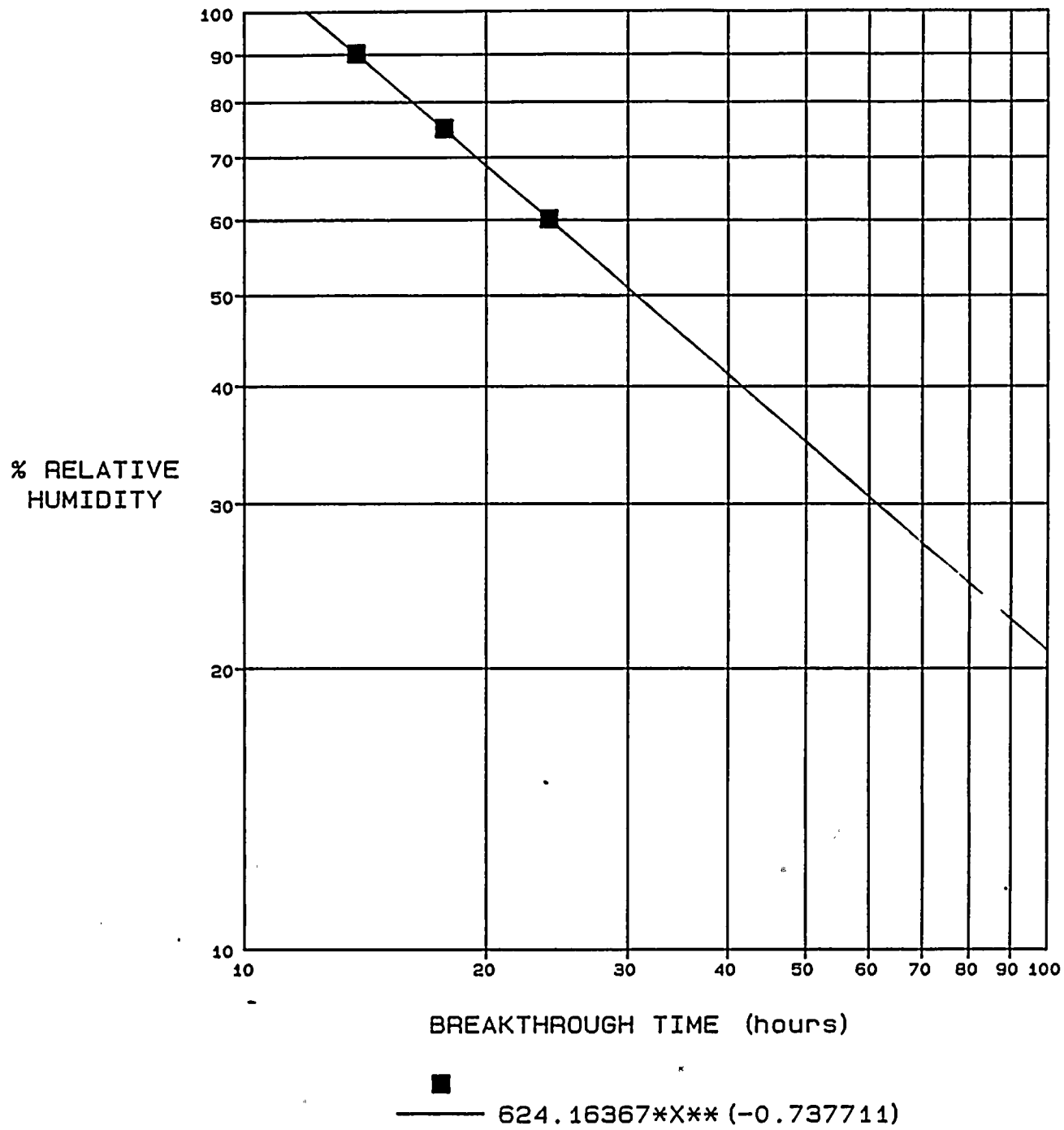
METHYL IODIDE TEST SYSTEM



SSV = STREAM SELECTOR VALVE
GSV = GAS SAMPLING VALVE
ECD = ELECTRON CAPTURE DETECTOR

FIGURE 3

RELATIVE HUMIDITY vs. BREAKTHROUGH TIME FOR THE SCOTT 631-TEDA-H CHIN CANISTER



TEST CONDITIONS:

CHALLENGE CONCENTRATION = 10 ppm METHYL IODIDE
BREAKTHROUGH CONCENTRATION = 0.1 ppm
PULSED FLOW (192 LPM FOR 0.82 sec., 0 LPM FOR 1.64 sec.)
TEMPERATURE = 48.9 C, VARIABLE % RELATIVE HUMIDITY

ATTACHMENT 1

ATMOSPHERIC CONCENTRATIONS EQUIVALENT TO 1.0 ppm OF RADIOIODINES

In order to determine the atmospheric concentration of the radioiodines at 1.0 ppm equivalent, a two step approach is necessary. The first step is to determine the specific activity of each radioiodine. The second step is to determine the mass of each radioiodine that is equal to 1.0 ppm and to determine the concentration in uCi/ml from the specific activity and the mass. The calculations are as follows:

SPECIFIC ACTIVITY

Specific Activity = SpA = $X \lambda N / 3.7$ E10 = Ci/gm

where $\lambda = \frac{\ln 2}{T1/2} = \frac{0.693}{T1/2}$

N = 6.023 E+23 atoms/gram atomic mass
Ci = 3.7 E10 dps

T1/2 I-131 = 6.96 E+05 sec
T1/2 I-132 = 8.14 E+03 sec
T1/2 I-133 = 7.31 E+04 sec
T1/2 I-134 = 3.12 E+03 sec
T1/2 I-135 = 2.40 E+04 sec

I-131

$$SpA = \frac{0.693}{6.96\ E05} \times \frac{6.023\ E+23}{131} \times \frac{1\ Ci}{3.7\ E10}$$

$$= 1.24\ E05\ Ci/gm$$

I-132

$$SpA = \frac{0.693}{8.14\ E03} \times \frac{6.023\ E+23}{132} \times \frac{1\ Ci}{3.7\ E10}$$

$$= 1.05\ E07\ Ci/gm$$

I-133

$$SpA = \frac{0.693}{7.31\ E04} \times \frac{6.023\ E+23}{133} \times \frac{1\ Ci}{3.7\ E10}$$

$$= 1.16\ E06\ Ci/gm$$

I-134

$$SpA = \frac{0.693}{3.12\ E03} \times \frac{6.023\ E+23}{134} \times \frac{1\ Ci}{3.7\ E10}$$

$$= 2.7\ E07\ Ci/gm$$

I-135

$$SpA = \frac{0.693}{2.40\ E04} \times \frac{6.023\ E+23}{135} \times \frac{1\ Ci}{3.7\ E10}$$

$$= 3.47\ E06\ Ci/gm$$

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CONCENTRATION EQUIVALENT TO 1.0 ppm IN AIR

The next step after the determination of the specific activity of the radioiodines is to determine the mass equivalent of 1.0 ppm in 1 ml of air and using that mass equivalent and the specific activity to determine the concentration in air.

- Molecular iodine exists as I_2 in the elemental state
- 1 gram mole of I_2 contains 6.023 E+23 molecules
- 1 mole of air occupies 22.4 liters at STP
- 1 mole of air contains 6.023 E+23 molecules of air
- 8.93 E-11 gm/ml = conversion factor
- SpA = specific activity

$$\frac{6.023\ E23\ \text{molecule air}}{22.4\ \text{liters air}} \times \frac{1\ \text{molecule } I_2}{1.0\ E06\ \text{molecule air}} \times \frac{1}{1000\ \text{ml}}$$

$$\times \frac{2(\text{gm } I_2)}{6.023\ E23\ \text{molecule}} = 8.93\ E\text{-}11\ \text{gm/ml}$$

Concentration Calculation

$$\text{uCi/ml} = 8.93\ E\text{-}11\ \text{gm/ml} \times \text{SpA}\ \frac{\text{Ci}}{\text{gm}} \times \text{Atomic Wt} \times 1.0E06\ \frac{\text{uCi}}{\text{Ci}}$$

I-131

8.93 E-11 gm/ml X 1.24 E05 Ci/gm X 131 X 1.0 E06 uCi/ci

= 1.45 E+03 uCi/ml

I-132

8.93 E-11 gm/ml X 1.05 E07 Ci/gm X 132 X 1.0 E06 uCi/ci

= 1.24 E+05 uCi/ml

I-133

8.93 E-11 gm/ml X 1.16 E06 Ci/gm X 133 X 1.0 E06 uCi/ci

= 1.38 E+04 uCi/ml

I-134

8.93 E-11 gm/ml X 2.70 E07 Ci/gm X 134 X 1.0 E06 uCi/ci

= 3.23 E+05 uCi/ml

I-135

8.93 E-11 gm/ml X 3.47 E06 Ci/gm X 135 X 1.0 E06 uCi/ci

= 4.18 E+04 uCi/ml

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