TEXAS ENGINEERING EXPERIMENT STATION
THE TEXAS A&M UNIVERSITY SYSTEM
COLLEGE STATION, TEXAS 77843-3575

NUCLEAR SCIENCE CENTER
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28 January 1987

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Mr. H. Dean Chaney
Radiation Specialist
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive
Arlington, Texas 76011

50-59

Dear Mr. Chaney:

The following is in response to telephone conversations with Mr. Blaine Murray and Mr. Dean Chaney on January 22 and 23, 1987 regarding documented evaluations of the irradiations of Bromo-Phenanthrene (powder form) for the production of ^{82}Br against Tech. Spec. 3.6.3 for an accidental release of generated bromine gas during irradiation.

1. Irradiation of Bromo-Phenanthrene (powder), as well as other samples irradiated in the NSCR, are evaluated against 3.6.3 by a process of applying engineered safeguards and making comparisons to previous evaluations of accidental releases of radioactive gases having large gross activity values (usually greater than 1 Ci). Often laboratory experiments are performed on smaller samples to determine production and identify physical changes to samples during irradiation. For example an experiment was conducted on Bromo-Phenanthrene which indicated approximately 30% of the total Br-82 production was in gas form. Such knowledge is applied by the technical services group, reactor supervisors, and health physicist in determining encapsulation and handling procedures and approvals for irradiation. Engineered safeguards provide the greatest protection against accidental releases and carry the heaviest weight in the evaluations of accidental releases of radioactivity. Typical engineered safeguards used in meeting the requirements of 3.6.3 review are:

    a. Encapsulation and irradiation devices such as the long tube irradiator, as described in the attached material provides a large volume for the collection of gases should sample encapsulation fail. These gases are vented to the central exhaust system under controlled conditions for detection to determine if corrective measures are necessary before handling an irradiated sample. Such devices provide for first time irradiations of unknowns.

    b. The 108,000 gallon pool water capacity becomes a large factor in preventing gaseous releases of soluble materials.

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RESEARCH AND DEVELOPMENT FOR MANKIND

c. Shutdown of the facility exhaust and air handling system upon reaching alarm levels as monitored by building exhaust detector systems prevents uncontrolled off-site releases.

d. Chemical filtering of experiments such as the chem lab hood air exhaust system reduces the possibility of large releases of radioactivity to the building exhaust system.

2. An analysis of ^{41}Ar which is non-soluble and non-filterable (using conventional methods) is an excellent selection for the comparison to ^{82}Br which is soluble and easily filtered. As an example an evaluation of ^{41}Ar activity of 4.3 Ci, if accidently released to the reactor building, is provided in NSC Staff Meeting #368 which is attached. The 4.3 Ci is in comparison to 40 mCi of ^{82}Br generated in the December 2, 1986 irradiation. As seen in both the initial evaluation and the revised evaluation, the accidental release of 4.3 Ci of ^{41}Ar does not result in a release that exceeds limits when averaged over 1 year as allowed in 10CFR Part 20 and as stated in 3.6.3.a.

3. The documentation of evaluations made in 1981 for the first time irradiation of Bromo-Phenanthrene material is not available. Records containing detailed procedures and evaluations made by the technical staff involved in the experiment dating that far back have not been located. However, minutes of NSC Staff Meeting #290 (attached) documents authorization to conduct the experiment and provides general procedures.

The NSC staff feels that sufficient action has been taken over the past 25 years of operation to satisfy the requirements of 3.6.3, however, evaluations of sample failure during irradiation resulting in comparatively small accidental releases could be reviewed for improved documentation. The establishment of written guidelines for making evaluations against 3.6.3 could aid documentation and decision-making regarding authorizations to perform experiments.

Sincerely,

Donald E

Donald E. Feltz
Director

DEF/ym

Attachment

cc: Mr. Blaine Murray, Nuclear Regulatory Commission, Region IV
Dr. J. A. Reuscher, Director, Nuclear Research Reactor Programs
Mr. J. L. Krohn, Manager of Reactor Operations
Mr. C. Meyer, Senior Health Physicist

NSC Staff Meeting #290
30 September 1981

Attending: Randall, Feltz, Waldrep, Land, Deigl

This meeting was called to discuss the Ar-41 production and transfer experiment for Teledyne Isotopes, Inc. The irradiation container design was reviewed and approved. The transfer apparatus was also reviewed as well as the procedures for its use. Authorization was given to begin construction of the gas transfer device and to complete the fabrication of the irradiation canister. There were several unanswered questions involving the shipment of the radioactive Ar-41 which Herb Deigl will address and report back on.

The Bromine irradiation was also discussed. These irradiations will be done using Bromo-phenanthrene powder irradiated in three 1 gram samples encased in poly vials. These vials will then be put into aluminum sausage cans and using T.I. type holder will be irradiated. The poly vials will then be removed from the aluminum cans and transferred to the chem lab using the dumb waiter. The samples will then be put into the glove box, which will be vented into the chem lab hood. The vials will be placed upright in shielding blocks and 3 cc of benzene will be injected into each using a syringe. The samples will then be left overnight to allow the bromine to dissolve into the benzene. After the samples has dissolved it will then be transferred to the containers provided by Teledyne again using a syringe. The container valves will be shut, handles removed and then packaged for shipment.

Respectively submitted,

Gary Waldrep

Gary Waldrep
Reactor Supervisor

EXPERIMENT DEVICE: Long Tube Rotisserie (Shell pipe rotisserie)

PURPOSE: Originally designed to irradiate Shell pipe. Now has evolved into a general irradiation device accommodating several different types of experiments.

DESCRIPTION:

Aluminum tube 6 1/2' x 3"(2 11/16" I.D.). Eight rotisseries available. Each uses two "O-rings" to seal the cap ___ one, size 041, and one, size 235. Each numbered tube has a similarly numbered cap. Long tube rotisseries require long extension shafts stamped "Long tube" at the top. Used on A3, A5 and A7 only.

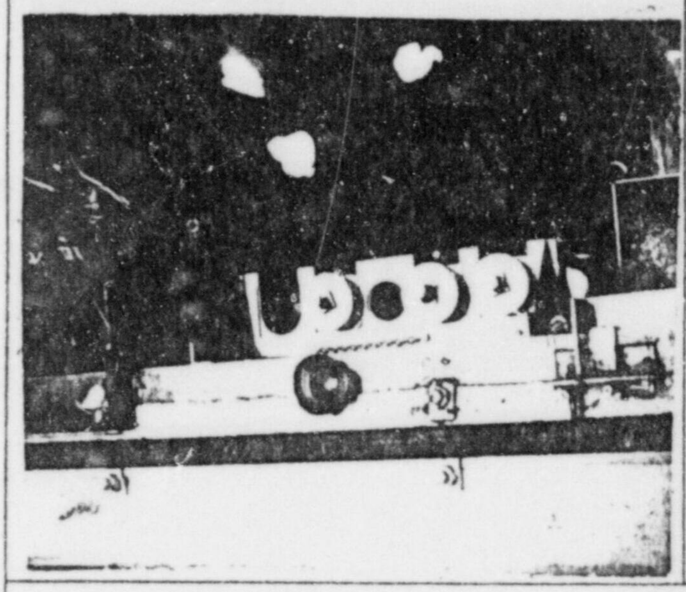

FIG. 1

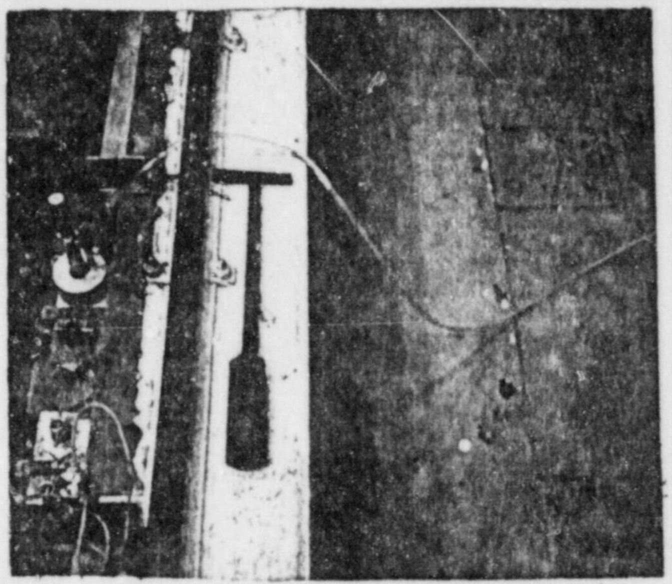

FIG. 2

INSTRUCTIONS: Select "coolest" rotisserie. Place in long tube rack (Figure 1). If rotisserie is empty remove the cap using the special tool shown in Figure 2. If the rotisserie contains a sample you must first attach the vent hose (Figure 2) and open the vent valve. Monitor the Facility Air Monitors during venting. Close the vent valve and remove the cap. Extract the sample.

To load aluminum cans: place the cans in a long tube canister (Figure 3), using appropriate spacers to center the sample on the reactor, and drop the loaded canister into the long tube. (See also chapter on "Sample Encapsulation in Aluminum Cans"). The canister will fall to the bottom coming to rest upon the cone-shaped pipe centering spacer.

To load a Shell pipe an electromagnet loading device is used (Figure 5). The pipes come wrapped as shown in Figure 4 and should not be touched by human hands. (They should be cleaned with alcohol while wearing plastic gloves). Before using the electromagnet loading device ascertain the device has a good battery. Pick up the pipe with the electromagnet, place the pipeinto the mouth of the long tube, then lower the pipe gently with the wire rope until the pipe settles on the cone spacer at the bottom of the tube. Turn off the magnet (switch in the mid, or straight up, position). Remove the loading device. Shavings corresponding to the pipe just loaded should be sealed in quartz and then placed in the special basket at the bottom of the positioning rod (See Figure 4). Lower positioning rod into the long tube until the cone spacer is inserted in the pipe. An aluminum wire attached to the top of the positioning rod enables one to remove the rod at time of unloading. Replace long tube cap and tighten with tool (Figure 2), using care not to overtighten. Ensure the long tube vent valve is closed before the tube is lowered into the water.

Other samples may be irradiated in a long tube canister with a certain amount of fabrication. Means of fabrication should be discussed with, and approved by, the SRO.

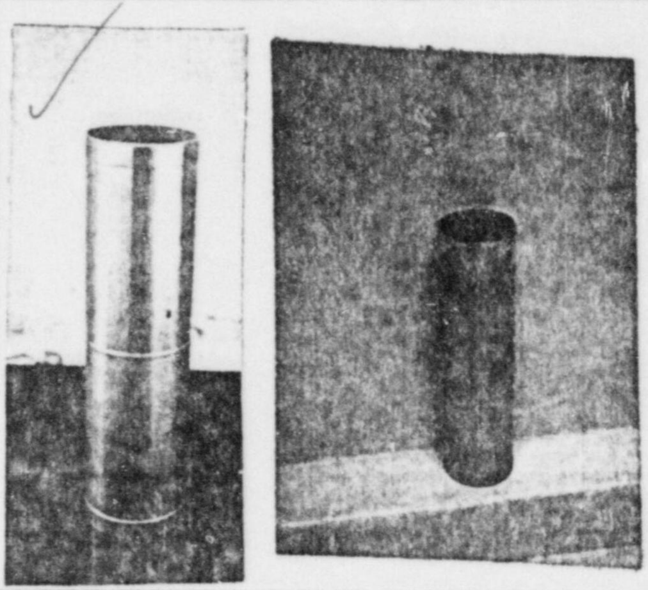

FIG. 3

LONG TUBE CANISTER. WILL HOLD 6 SMALL CANS OR THREE LARGE CANS.

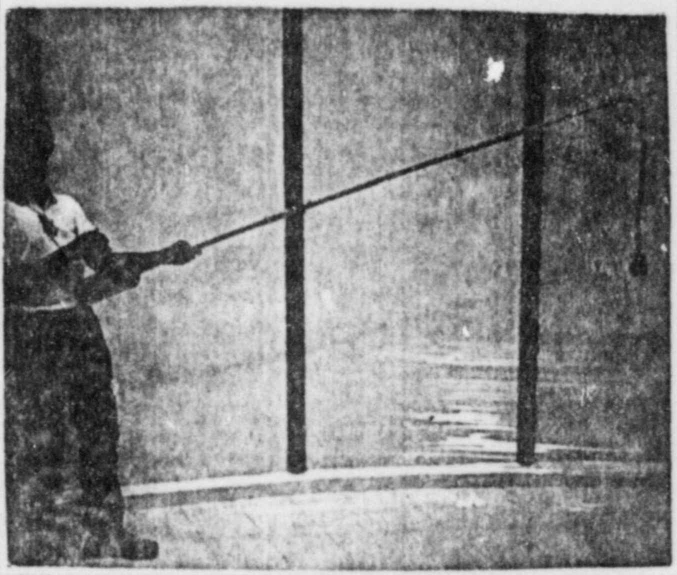

FIG. 5

ELECTROMAGNETIC LOADING DEVICE.

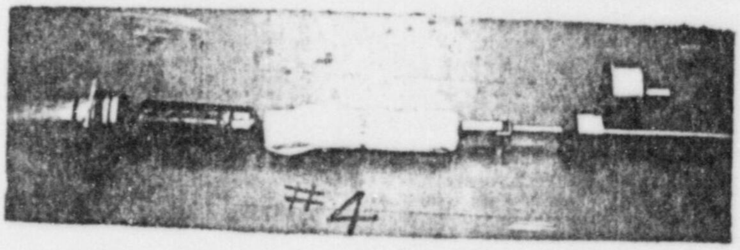

FIG. 4

Nuclear Science Center
Staff Meeting #368
3 December 1984

Attending: Feltz, Rogers, Sandel, Head, Petesch, Bartlett

A staff meeting was convened to review the procedures involved in the irradiation and handling of radioactive argon and xenon gas for calibration tests. The majority of the transfer and handling of samples will occur in the late afternoon and early evening when fewer individuals are present. The crushable quartz vials used for the radioactive xenon will contain a maximum of 50 mCi. Although 4.3 Ci of argon will be activated only a maximum of 250 mCi will be transferred and handled at a time. The calibration rig is located in the chemistry lab on the lower research level where most of the sample handling will take place.

Calculations show that should a vial of xenon be dropped and broken the activity level in the chemistry lab would be approximately 9 MPC. When diluted throughout the entire building it is expected that this level would be much less than 1 MPC. Although the NSC facility air monitors would be unable to detect this leakage, the end window GM detectors in the lab are very sensitive and would provide quick detection. The staff concluded that there would be no health hazard involved under this worse case condition for the handling of xenon. There would be no significant release to the general public (200:1 dilution factor from stack to boundary fence), and the building dilution would be such that personnel evacuation from the confinement building would be unnecessary. Individuals in the chemistry lab could conceivably stay in the lab for up to 4 hours at that activity level; however, they will remain only long enough to isolate the leakage.

Argon-41 activity calculations are attached, and as can be seen approximately 1 MPC would be released from site should the entire 4.3 Ci escape from the sample. Based on this, the transfer will occur during reduced personnel hours, and the requirements stipulated in the attached sheet will be adhered to.

The staff approved this procedure under the limitations and procedural requirements discussed. The meeting was held in accordance with SOP's I-B-4 and I-F.

Respectfully submitted,

Dale Rogers

Dale Rogers
Assistant Director

TEC Project

12-3-84 ^{41}Ar Release Calculations

4.3 Ci maximum release from entire experiment
250 mCi in transfer tube

Volume of Containment Building ~ 185,000 cu ft
5.25X10^{9} cc

$2\times10^{-6}\ \mu Ci/cc$

$\frac{250\ mCi}{5.25\times10^{9}\ cc}$ = $4.76\times10^{-5}\ \mu Ci/cc$ in Bld. w/ (1100x MPC uncont.) $4\times10^{-8}\ \mu Ci/cc$
23x Ract. MPC

+5000 CFM exhaust rate

Release to stack (with 200/1 Dilution) would be at 2 MPC imm

$\frac{4.3\ Ci}{5.25\times10^{9}\ cc}$ = $8.19\times10^{-4}\ \mu Ci/cc$ in Bld. Release to stack
+5000 CFM Exhaust Rate
(with 200/1 dilution) would be at 1 MPC: 4

In case of release of ^{41}Ar all personnel should be evacuated from containment and ^{41}Ar allowed to vent to stack.

Requirements:

1. Set Channel 6 (Bld Gas Monitor at 1 MPC)
2. In case of alarm evacuate Containment until Channel 6 is below 1 MPC
3. In case of release of ^{41}Ar take transfer tube to cell and evacuate.

Philip S. Sandel
Senior Health Physicist

TEC Project <u>Revised</u>

12-3-84 ^{41}Ar Release Calculation

Maximum Activity to be produced 4.3 Ci
Each transfer tube 250 mCi

The exhaust rate of the stack exhaust is 5000 CFM
5000 CFM × 24 hrs = 2.04×10^{11} cc/24 hours

1. Assuming release of ^{41}Ar from transfer tube

$$\frac{250 \text{ mCi}}{2.04 \times 10^{11} \text{ cc}} = 1.22 \times 10^{-6} \mu\text{Ci/cc}$$ averaged over 24 hours @ point of release

Then using dilution factor allowed (200/1)
concentration = $6.12 \times 10^{-9} \mu$Ci/cc (Unrestricted MPC $4 \times 10^{-8} \mu$Ci/cc)

2. <u>Worst case assumption</u> release of all 4.3 Ci

24 hour concentration = $\frac{4.3 \text{ Ci}}{2.04 \times 10^{11} \text{ cc}}$ = $2.1 \times 10^{-5} \mu$Ci/cc

and then using 200/1 dilution = $1.05 \times 10^{-7} \mu$Ci/cc or
~ 2.6 times MPC ($4 \times 10^{-8} \mu$Ci/cc)

When averaged over 1 year as allowed by 10CFR20 the concentration would be much less than MPC.

In Case of release of ^{41}Ar all personnel should be evacuated from containment and ^{41}Ar be allowed to vent to stack

quirements
1. Set Channel 6 at 1MPC
2. In case of alarm evacuate containment until Channel 6 is below MPC.
3. In case of alarm (release) take transfer tube to cell and evacuate

Philip S. Sandel
SR. H.P.