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# MONSANTO RESEARCH CORPORATION

*Inter-Office Correspondence*

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DATE : November 26, 1963

THIS IS COPY 7 OF 9A

SUBJECT : TR-119 - To attend the Research Materials Coordination and Planning Meeting sponsored jointly by the ORNL Isotopes Development Center and the USAEC - November 14 and 15, 1963 - W. J. Haubach and R. E. Vallee

REFERENCE : MOUND LABORATORY-MONSANTO Central File No. 63-12-43

TO : Dr. G. R. Grove



This two-day meeting was held to bring the AEC sites up to date on the availability and need of special materials and services by having a representative from each site give a resume of the special materials and services at that site which could be made available or that were needed. At the end of the meeting, Phil Baker proposed that all of the sites send him a list of new materials and services available or needed for inclusion in the section entitled, "Available Materials and Services" in the technical progress review entitled, "Isotopes and Radiation Technology" which he, Art Rupp, and associates prepare on a quarterly basis.

Harry Willard of the Cross Section Committee said that they were interested in obtaining 100-gram quantities of 99.99 per cent carbon-12.

W. J. Haubach spoke to Jim Garrett of the Division of International Affairs concerning overseas helium shipments. He was in agreement that the old arms embargo on helium-4 was outdated and no longer needed. However, nothing would likely be done on the problem at the Washington level unless people like us requested it. He said that there is a good chance that we could get helium-3 exempted from the arms embargo and that the person to write concerning this matter is A. A. Wells, Director of the Division of International Affairs.

It was not until the introductory remarks at 9 A.M. on Thursday, November 14, that those in attendance, including the speakers, knew precisely of what they were expected to speak. Two or three speakers were unaware that they were speaking until Thursday morning.



GROUP 1

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Following is a list of the topics and speakers and a brief resume of each topic.

1. Electromagnetic Separations - L. O. Love (ORNL)

   Leon Love discussed the electromagnetic (Calutron) facilities which were in use and additional units which could be made available if needed. Some of the Calutrons have been adapted for use on alpha emitters and are being used to separate plutonium isotopes. A total of 110 personnel, including clerical, technicians, and graduate school students, are engaged in this activity.

2. Thermal Diffusion - W. R. Rathkamp (ORNL)

   A brief review of their past work on noble gases and a description of their column design was presented.

3. $B^{10-11}$, $Li^{6-7}$, Low-T Deuterium, $N^{15}$, $O^{17-18}$ - J. S. Drury (ORNL)

   John Drury noted that $B^{10}$ was in short supply and that which is still available is part of the original 1250 kilograms made by Hooker Electro Chemical during 1954-56 at the Niagara Falls Plant. This material is 92-96 per cent $B^{10}$, both crystalline and amorphous, and sells from between $3.50 and $9.25 per gram. Some boric acid of 99.99 per cent $B^{10}$, produced by Calutron separation, is available at $11.75 per milligram. ORNL has designed a plant using chemical exchange which is capable of producing five kilograms of 95 per cent boron-10 per day.

   J. Drury said that his water distillation plant had now been in operation for 78 weeks and the $O^{17}$ content was about 1.2 per cent. At equilibrium, which is estimated to be two years, they expect to produce 80

milligrams per day of oxygen enriched to 50 per cent in oxygen-17 in addition to larger quantities of oxygen enriched to 98 per cent in oxygen-18.

4. $D_2O$ - Clark Ice (SRO)

Clark Ice briefly described the process used at Savannah River to produce $D_2O$. Their present production rate is 540 tons per year of 99.75 per cent $D_2O$ containing $10^{-12}$ to $10^{-13}$ per cent tritium.

5. Helium-3 and Isotopes of Other Gaseous Elements - W. J. Haubach (Mound)

Flow sheets were presented of all the separating systems on the inert gas isotopes and carbon-13. Also presented was an inventory of all the separated isotopes and their composition on hand at Mound.

6. $Pu^{238}$, $U^{234}$, and Naturally Occurring Radioisotopes - R. E. Vallee (Mound)

A description of the processes and purities of $Pu^{238}$, $U^{234}$, and $Ac^{227}$ and of the availability of $U^{234}$ and $Ac^{227}$ were presented.

7. Chemical Processing and Special Separations of EM Isotopes - H. R. Gwinn (ORNL)

Herb Gwinn described the facilities utilized to prepare samples and to chemically process separated isotopes which are a part of the Calutron operations. Herb emphasized the importance of high purity chemicals and operation techniques to maintain high isotopic purity.

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8. Transplutonium Elements - Present Availability - J. S. Lichliter (LRL)

Stu said that LRL had recently sent six micrograms of californium to ORNL. They have about 60 micrograms of the same material being used at Berkeley.

9. Transplutonium Elements - Future Availability - A. Chetham-Strode (ORNL)

Al summarized the present and future availability of Cf and Bk. At present, there is about 100 micrograms of Cf and 40 micrograms of Bk in use. These quantities will be increased to 1 milligram of Cf and 0.4 milligram of Bk in 1965 and to 100 milligrams each of Cf and Bk in 1966.

10. ORNL Curium Program - E. Lamb (ORNL)

Gene said that their curium plant could presently produce 100 grams per year of curium-242. This rate requires a 600-gram per year Am-241 burn-up. Based on $600 per gram for Am-241, the price of curium-242 is about $170 per watt. The price of Am-241 is currently 2 to 6 times the $600 figure. During the next two-and-a-half years, they expect to produce 3 kilograms of curium-244.

11. $Pa^{231}$ and $U^{232}$ - D. E. Ferguson (ORNL)

Of the original 25 grams of $Pa^{231}$ that were received from England in trade for 500 grams of $U^{233}$, about 8.2 grams still remain in the Research Pool. The 50 grams of $Pa^{231}$ that was loaned to us by the British was given a 10-hour irradiation (to keep the $U^{233}$ content low) and produced 32 milligrams of $U^{232}$. They next irradiated for 10 days and obtained about 1 gram of $U^{232}$ which contained about 0.7 per cent $U^{233}$.

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12. Accelerator-Produced Isotopes - J. J. Pinajian (ORNL)

John described the cyclotron services at ORNL and discussed their advantages in certain applications over reactors in production of small quantities of isotopes.

13. Present Status of Am-241 - A. Williams (Dow, Rocky Flats)

Al Williams said that they are producing about 360 grams per year of Am-241 at about $1500 per gram. They use 3/8-inch lead shielding, lead gloves, and PVC or glass equipment. They are designing to produce 3600 to 5000 grams per year at about $140 per gram and if the plutonium recovery is not charged to the Am-241 program and $500 per gram of the plutonium recovery is charged to the Am-241 program. By late 1967, they expect to be producing 500 grams per year of Am-241.

Someone in the audience added that Hanford would be producing 55 grams per month starting in August 1964 and continuing for 18 months and then 15-20 grams per month thereafter.

14. Proposed Radionuclides Separations Laboratory - A. F. Rupp (ORNL)

This proposal, which has been pending for several years, is for expansion of their Calutron facilities. The total project cost is 5.5 million dollars.

15. Stable Isotopes Procurement - P. V. Arow (ORNL)

16. Research Pools - F. N. Case (ORNL)

Neal said that there are at least five separate

research pools. These are:

(a) The Cross Section Research Pool (C.S.P.)
This pool consists of stable isotopes only and is controlled by George Rogosa.

(b) The Heavy Elements Research Pool (H.E.R.P.)
This group consists chiefly of radioisotopes and is controlled by T. R. Jones.

(c) The Civilian Application Research Pool (C.A.P.)
This consists primarily of the sale of U-238 to industry.

(d) Special Pools
A number of special pools exist such as C-14, Tc-99, Np-237, B-10, and B-11.

(e) The Sales Pool
This pool is the most nebulous of all and covers the distribution of any material that is not covered by one of the other pools for distribution to any of the users that would not be covered by any of the other pools.

17. Research Samples Program - L. K. Hurst (ANL)

Len stated Argonne's policy which, in general, is that they are not interested in performing any routine work for any other site. If a need exists which only Argonne is in a position to fulfill, they are willing to cooperate.

18. Pure Rare Earths - J. E. Powell (Ames)

Jack stated Ames' policy on selling rare earths; namely, if you cannot obtain the purity required from commercial sources, Ames can supply it.

19. Research Materials Information Center - J. W. Cleland (ORNL)

This center has been established to collect and

organize available information on ultra pure materials of interest in solid state research.

20. Old Lead; Armorplate - P. S. Baker (ORNL)

Phil discussed the isotopic distribution of lead isotopes in lead material from various sources. ORNL uses some of this material as feed for their Calutron separations.

21. Discussion of Euratom Statement and Target Preparation Center - E. H. Kobisk (ORNL)

It seems that Euratom is essentially a bureau of standards located in Belgium. This bureau prepares and certifies standards for use in neutron physics to $\pm$ 0.1 per cent.

22. Preparation of Special Isotopes and Other Services at Brookhaven - L. G. Stang (BNL)

BNL has quite an assortment of radioisotopes available for distribution. They distribute F-18, Mg-28, Se-47, Ar-38, and Xe-128 directly and prepare "generators" of various short-lived species. These "generators" consist of a parent adsorbed on an alumina column from which the short-lived daughter can be milked as needed.

| Parent | Half-Life | Daughter | Half-Life |
|---|---|---|---|
| Mo-99 | 66 hours | Tc-99m | 6 hours |
| Sr-90 | 28 years | Y-90 | 64.2 hours |
| Mg-28 | 21.3 hours | Al-28 | 2.30 minutes |
| Te-132 | 78 hours | I-132 | 2.3 hours |
| Y-87 | 80 hours | Sr-87m | 2.8 hours |
| Ge-68 | 280 days | Ga-68 | 68 minutes |

Lou Stang added that they are preparing a catalog listing such items and that if we send in a request they will send us a copy when it is printed.

23. Cyclotron Services - J. E. Beaver (ORNL)

The cyclotron described by Joe Beaver has vertical Dees which can readily be removed from the pole pieces for servicing via an overhead crane. This vertical Dee arrangement enables them to irradiate horizontal targets. For example, gallium, which would liquify at the temperatures created by proton bombardment, will not run off the target as it would in a conventional cyclotron having horizontal Dees. Most of their irradiations consist of (P,n), (P,2n), and (P,$\alpha$). They also irradiate capsules and powders, P,n only.

24. Calutron Services - W. A. Bell (ORNL)

This was essentially a continuation of the talk of L. O. Love.

25. Production Quantities of Isotopes by Gaseous Diffusion, Molecular Distillation, and Chemical Exchange - S. A. Levin (ORGDP)

The K-25 plant has 750 stages available in the gaseous diffusion facility for experimental use. They have considered separation of the isotopes of tungsten and molybdenum as the halides and xenon and chlorine as the gaseous elements. They have calculated that with 670 gaseous diffusion stages they can prepare 400 kilograms of separated xenon isotopes per year at about $450 per kilogram.

Since the K-41 content of natural potassium presents problems in potassium-cooled reactors, they have

designed a molecular distillation unit for producing K-39 of 99.93 per cent isotopic abundance at the rate of 2,000 pounds per year at a cost of $560 per pound.

They have also made some calculations on boron-10 enrichment using chemical exchange between $BF_3$ and its anisole complex. The Niagara Falls plant used exchange between $BF_3$ and its methyl ether complex. Their calculations indicate 1800 kilograms per year of 95 per cent B-10 can be produced at $450 per kilogram. This is in comparison with the Niagara Falls plant costs of about $3,000 per kilogram of 92 per cent B-10 with a rate of ½ to 1 kilogram per day.

26. Gas Centrifuge - E. C. Evans (ORGDP)

Evans pointed out that about three years ago, the increased interest in centrifugation was stepped up for two primary reasons; (1) the availability of better high-strength materials of construction which was an out-shoot of other programs and, (2) Zippe had demonstrated a much improved and simpler centrifuge.

ORNL presently has a 35-centrifuge cascade at K-25. Evans gave the following list of physical properties desired of a gas for centrifuge work:

(a) The vapor pressure should be greater than 1.5 mm Hg at 25°C.
(b) The vapor pressure should be less than $10^{-5}$ mm Hg at temperatures obtainable by mechanical refrigeration.
(c) It should be thermally stable at 100°C.
(d) It should be non-corrosive to aluminum, copper, nickel, and brass at 100°C.
(e) As a compound, it should not contain any interfering isotopes. This is why fluorides are good compounds.

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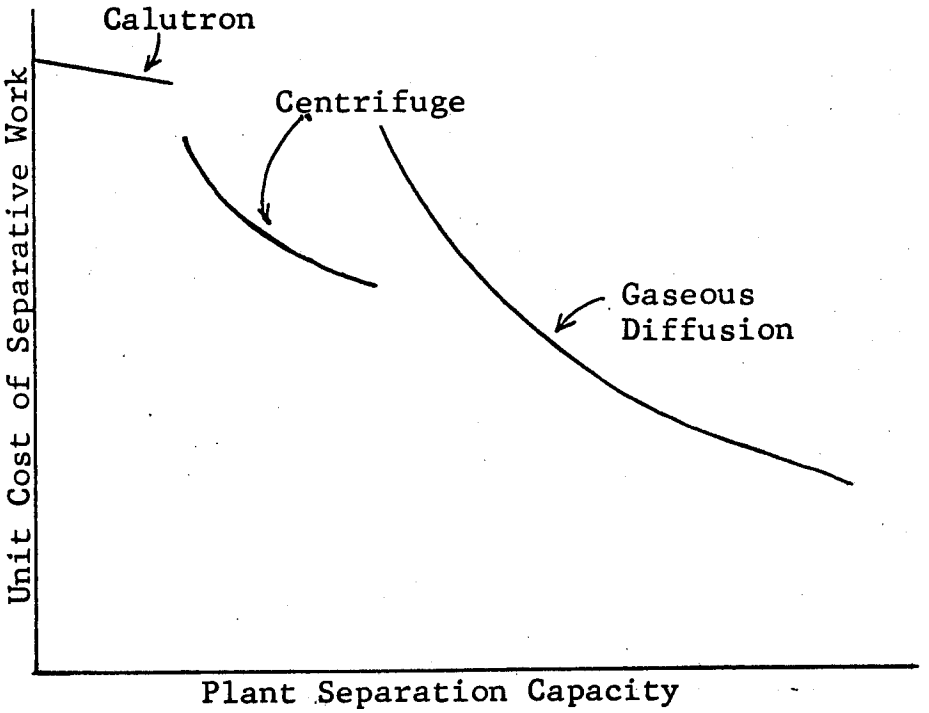
(f) The compound should have a molecular weight greater than 150 in order to get a high compression ratio for interstage pumping and the isotopic mass should be as large a part of the total mass as possible.

(g) The gas should be safe to handle, non-toxic, non-explosive, etc.



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27. Budgeting and Accounting - C. J. Conyers and L. S. Lenderman (OC - Office of Controller)

Lenderman announced that AEC Chapter 1701 and Appendix 1701 were issued last week and that they replace the four present chapters in the AEC Manual which describe pricing procedures. In general, prices are based on full cost recovery or current commercial costs, whichever is higher.

In regard to the research budget, he recommended that we read an account presented at a Conference on Scientific Information. This was held at Princeton this past September and was written by Mr. Carey from the Bureau of Budget. In this year's budget, the NSF allotment for basic research remained the same as last year. The supplemental hearings on the budget prepared a document about one-half inch thick and contains a good account of technological fall-out.

He said that currently the budget assumption that has the best chance of being supported by Congress is that of AEC work that accomplishes something for the rest of the country.

28. Distribution - H. A. Larsen (ORO)

Herb discussed the use of the AEC 375 and 391 forms which are used for purchasing or intracontractor transfer of isotopes.

29. International Affairs - J. A. Garrett, Jr. (DIA - Division of International Affairs)

Jim discussed the problems in obtaining permission to transfer material to scientists not in the States.

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The following comments were made by various representatives at the end of the meeting.

L. K. Hurst (ANL)

Len said that the following equipment at Argonne is available for use in preparing special samples:

(a) A 60-inch cyclotron
(b) A Swedish isotope separator
(c) A 100-inch mass spectrometer
(d) Specially equipped "hot" labs for trans-plutonium element separation

L. G. Stang (BNL)

Lou announced the need for some enriched uranium-235 containing less than 0.1 per cent uranium-234.

A. Slavsky (BNL)

Al announced that they have a deuterium plant at Brookhaven to supply the deuterium for their bubble chambers. They have some deuterium that has a T to D ratio of $10^{-13}$. They plan to supplement their plant output with material produced by Linde. Linde's plant produces 15 tons of hydrogen per day which gives about 600 STP cu.ft. of deuterium. BNL uses approximately 56,000 STP cu.ft. of deuterium per year of which they can produce about two-thirds. The bubble chambers in use at BNL and the quantity of deuterium in liquid liters required to fill the chambers are listed below.

| Diameter | Liquid Liters |
|---|---|
| 14" | 50 |
| 20" | 100 |
| 30" | 180 |
| 80" | 1800 |

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R. J. Moore (AEC Production Division)

Moore announced that 3 kilograms of curium-244 will be produced at the Savannah River Plant.

Walter J. Haubach

R. E. Vallee
Richard E. Vallee

/baj

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