

ISOTOPES - HEAVY WATER

see subsequent material - to Canada

Isotopes Heavy Water

Date	To	From	Class	Pgs. No.	To	From	Class
1	6-19-64	AEC 983/3	Lease of Heavy Water to Other Government Agencies Sale of Heavy Water to Other Government Agencies Heavy Water to Other Government Agencies	skw			
2	5-22-64	AEC 983/4	Small Heavy Water Sales	skr			
3	4-2-65	AEC 274/35	Savannah River Heavy Water Production at Savannah River				
4	4-9-65	Ramey, Commission		ves	s	8	
5	9-8-65	AEC 274/36		st			
6	10-1-65	AEC 274/37		st			
				st			

TITLE

Isotopes 3 Heavy Water

N	DATE	TO	FROM	CL.	PG.	NO.	DATE	TO	FROM	CL.	PG.
1	8-4-58	AEC 983/1	Heavy Water for use in Reactors, Lease of								
				skw	ouo						
2	10-16-58	AEC 983/2	Lease of Heavy Water for use in Power Reactors								
				skw	ouo						

Copy - *Isotopes - Bernhart, Ows*
Heavy Water
~~Reproduction Branch~~

UNITED STATES GOVERNMENT

Memorandum

TO : File *W. B. McCol*

FROM : W. B. McCol, Secretary *W. B. McCol*

SUBJECT: AEC 274/41 - OPERATION OF HEAVY WATER PLANT

SECY:JCH

DATE: June 24, 1966

1. At Information Meeting 595 on June 17, 1966, the Commissioners approved staff's plan to include in the FY 1968 Budget, funding for continued operation of the heavy water plant at the current one-third capacity. Details on this matter are contained in Mr. Dowling's June 9, 1966 memorandum, circulated as AEC 274/41. Commissioner Ramey suggested the plan be discussed with the Division of Industrial Participation.

2. We have been informed that the matter has been discussed with the Director of Industrial Participation who indicated no objection, and that the Division of Production is taking the required action.

- cc:
- Commissioners
- General Manager
- Deputy General Manager
- Assistant General Manager
- Exec. Asst. to Gen. Mgr.
- Asst. Gen. Mgr. for Admin.
- Asst. Gen. Mgr. for IA
- Asst. Gen. Mgr. for Plans & Prod.
- Asst. Gen. Mgr. for Reactors
- Asst. Gen. Mgr. for R&D
- General Counsel
- Dir., Ind. Participation
- Dir., Inspection
- Dir., IA
- Dir., Military Application
- Dir., Operations Analysis
- Dir., Production
- Dir., RD&T
- Controller

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GENERAL INVESTIGATIVE
DIVISION
JUL 1 1966

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JUL 1 1966



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6-24-66

Isotope-Heavy water

JUN - 1 1966

R. E. Hollingsworth, General Manager
THRU: John A. Hall, AGMIA

Myron B. Kratzer, Director
Division of International Affairs
Original signed by
Abraham S. Friedman

SALE OF 20,000 POUNDS OF HEAVY WATER TO AECL, CANADA

We are in receipt of a request from Atomic Energy of Canada Limited (AECL) for the sale of 20,000 pounds of heavy water valued at \$490,000 for use as make-up requirements for the Chalk River reactors (NRX, NRU and NPD).

The Division of Production has assured us that the above quantity of heavy water is available at Savannah River. Its transfer to AECL pursuant to our Agreement for Cooperation is within Commission policy.

The quantity of heavy water involved exceeds the 1,000 pound limitation in my delegation of authority, AECLM Chapter 0103-114 (d). I, therefore, recommend that you approve the sale of 20,000 pounds of heavy water to AECL.

With your approval, this Division will negotiate and execute the required sale contract.

APPROVED:

R. E. Hollingsworth
General Manager

JUN 2 1966
Date

MAY 26 1966
MAY 23 1966

bcc: GM (2)

AGMIA
Secretariat (2)
J. Downing, DIA
W. Yeomans, DIA
R. Moore, PROD
C. Lovejoy, OC

Ex Assn
To GM

Is this of sufficient importance that JCAE should be informed? Yes No
If "yes", indicate status and target date of JCAE notification.

Action
2399

OGC

	DIA:OPNS Downing	DIA:EUROP Yeomans	PROD: Moore	OC: Lovejoy	DIA:ADTI Hoyle	OGC: [Signature]	DIA:EAR [Signature]	DIA:DDI Friedman
OFFICE	DIA:OPNS	DIA:DIR	AGMIA	AGM	DGM	GM		
SURNAME	Rebol	Kratzer	Hall					
DATE	5/18/66							

6-1-66

AEC 274/40

May 9, 1966

COPY NO. 58

ATOMIC ENERGY COMMISSION

REPORT OF THE AD HOC COMMITTEE ON
HEAVY WATER PRODUCTION

Note by the Secretary

The General Manager has requested that the attached April 29, 1966 letter from W. Kenneth Davis transmitting the AIF Report on Heavy Water Production, be circulated for the information of the Commission.

W. B. McCool

Secretary

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AEC
274
40

5-9-66

ATOMIC INDUSTRIAL FORUM INC.

850 THIRD AVENUE • NEW YORK 22, N. Y. • PLAZA 4-1075

OFFICE OF THE PRESIDENT

April 29, 1966

Mr. Robert E. Hollingsworth
General Manager
U. S. Atomic Energy Commission
Washington, D.C. 20545

Dear Bob:

I am attaching a copy of a report of the Forum's Committee on Heavy Water Production in response to the request contained in your letter of May 14, 1965. Additional copies are going forward under separate cover for distribution as you may see fit.

It has taken us somewhat longer to complete our study than was initially anticipated. I hope, however, that this report will reach you in time to be of some help in your future planning.

With best regards,

Sincerely,

Ken
W. Kenneth Davis

April 1966

REPORT
OF THE
Ad Hoc COMMITTEE ON HEAVY WATER PRODUCTION

At the request of the Atomic Energy Commission the Atomic Industrial Forum studied the position of heavy water manufacture in the United States. The ad hoc committee appointed to make this study arrived at the following conclusions and recommendations regarding the points raised by the Commission:

Conclusions and Recommendations

1. Because of the limited domestic market and competition from government-assisted foreign production plants, it seems unlikely that a private company would be willing to assume the risk of building new heavy water production facilities in the United States at the present time.

2. In order for a new commercial heavy water plant in the United States to be profitable under current conditions, government assistance in the form of low interest rate loans and guaranteed purchase contracts would be required to match conditions present in foreign countries. In the light of plans for new production facilities abroad, the limited domestic market, and the close association of the overseas market with Canadian vendors, the Committee does not see that any vital purpose would be served at this stage by such assistance from the U.S. Government.

3. While operation of the heavy water unit still in production at Savannah River might be economically possible by a private company if the facility could be leased from the government at essentially no cost, this option does not appear to be very attractive because any significant need for replacement or new facilities would seriously damage this unit's ability to produce heavy water at competitive prices.

4. The present 195 tons/year production capacity of the Savannah River plant appears adequate to meet annual domestic commitments and expected requirements, military and civilian, for the next ten years. Assuming that the AEC has not already acquired a substantial stock of heavy water, and that production costs, exclusive of fixed charges, are below international selling prices, it seems prudent to keep the plant in operation for the next several years rather than to write off the remaining depreciation as a complete loss. Continued operation of one unit through 1968 would result in a modest accumulation of stocks which should eventually find a market and would maintain U.S. technical capability in the heavy water field. By that time the future international supply and demand situation should be much clearer.

Introduction

On May 14, 1965, Mr. R. E. Hollingsworth, General Manager of the Atomic Energy Commission, wrote to the Forum requesting its comments regarding heavy water (D₂O) manufacture in the United States. He suggested a study that would include consideration of the following points:

1. The prospects for a private commercial heavy water production activity in the U.S.
2. The need for, and possible scope of, assistance by the Government in establishing such a commercial activity.
3. The role the AEC Savannah River heavy water plant might play in establishing a commercial activity.
4. If the market uncertainty precludes commercial interest at this time, the need for the Government to maintain a technical capability until the future direction is better defined.

By letter of June 18, 1965, Mr. Robbins replied with the suggestion that a small committee of Forum members meet with AEC representatives for a discussion of what might be gained by such a Forum study and how it might be carried out. This meeting was held on August 18, 1965, and on September 28, 1965, Mr. W. Kenneth Davis, President of the Forum, wrote Mr. Hollingsworth and agreed to his May 14 proposal.

In preparation for this report an ad hoc Committee on Heavy Water Production was formed with two subcommittees, one to study future heavy water requirements and the other to study the available heavy water production capability, the costs of heavy water production and the various processes that might be used. On the basis of the studies made by these subcommittees the Committee offers the following analyses:

Commercial Prospects

Demand: As indicated in Exhibit A, there are modest U.S. requirements for heavy water for research purposes. These requirements, combined with military requirements, result in a demand of something less than 100 tons/year with little prospect for substantial growth. The major requirement for D₂O stems from the construction of nuclear power reactors, moderated, and in some cases cooled, by heavy water. The Canadian nuclear power program is confined to the construction of heavy water (CANDU) reactors and it is for this program that the bulk of the Free World requirements is generated during the next five years. Other countries, including Sweden, France, Switzerland, Germany, India and Pakistan, have built or are building heavy water reactors but, except in the case of India, no long range heavy water reactor construction programs have been announced. The USAEC has a development program underway which is intended to lead to the construction of a prototype heavy water moderated organic cooled reactor (HWOOCR) by about 1972. Substantial heavy water requirements for this program are not expected, however, until after 1975. Heavy water requirements through 1972, depending mainly on the announced Canadian program, can be called "reasonably firm" while requirements after 1972 are uncertain since they depend on the success of the various heavy water reactor concepts as well as factors of national policy and economic growth rates.

In addition to the initial D₂O inventory requirements for nuclear power plants, make-up requirements for D₂O lost during operation have been considered.

However, since losses are expected to be less than 2% per year, requirements for make-up are not substantial until about 1975 when a fair number of heavy water reactors may be in operation. There is also a demand for facilities to upgrade D_2O which has become diluted with H_2O during reactor operation but this factor is minor in comparison to that for new D_2O .

As will be noted in Exhibit A, the estimated domestic demand for heavy water for research plus foreign commitments of the U.S. Government, power reactor requirements and miscellaneous uses, averages about 200 tons/year until 1975. The total Free World demand, if various national plans proceed as presently contemplated, could rise to 1000 tons per year in 1970 and 2000 tons per year in 1975.

Supply: At the present time, the only large D_2O production plant in the world is the one at Savannah River producing 195 tons/year. The entire Savannah River plant comprises three units, one in operation and two in deactivated condition. Reactivation of one of these two idle units could increase production to about 430 tons/year using improved equipment when reconditioning, and reactivation of the second would result in an increase to 500 tons. Lack of sufficient steam capacity limits overall output to the 500 ton figure. Reactivation would, however, cost some 20-30 million dollars, and it is understood that the U.S. Government does not plan this.

An additional 200 tons/year will become available soon upon completion of the Deuterium of Canada, Ltd. plant at Glace Bay, Nova Scotia. On February 4, 1966 the Canadian Government announced that it was negotiating with Deuterium to increase the capacity at Glace Bay to 400 tons/year, and that negotiations were continuing with Canadian General Electric for the construction of a new 400 ton/year plant.

The Indian Government plans a 200 ton/year plant for operation by 1970 and has indicated it will install additional D_2O production capacity to match its reactor construction program.

In February 1966 France announced the start of construction of a small D₂O production plant at Mazingarbe. This pilot plant is being built to determine the feasibility of large-scale production by a hydrogen-ammonia exchange process which would use ammonia produced in synthetic ammonia plants. If France builds heavy water power reactors, it is expected it will also produce the necessary heavy water.

Last fall the Canadian AECL approached the AEC to explore the AEC's capability to supply AECL's long-term heavy water requirements. In AECL's exploration of this matter they inquired as to various quantities for various periods. Some of the cases discussed, which were basically short-term requirements, could have been provided from AEC's current production capability at the current \$24.50 per pound price. Other cases would have required reactivation of other sections of the Savannah River plant and would have enabled AEC to quote prices below its current \$24.50 per pound price. AECL advised the AEC after extensive discussion between the two groups that it was not interested in obtaining its long-term heavy water requirements from the AEC.

In summary, the production capacity in the Free World should be about 400 tons/year in 1966, 1000 tons by 1969 and 1200 tons/year by 1970. This would be enough to handle the projected requirements of Exhibit A through 1974. If only the Canadian proposed plants are actually built, production should be sufficient to meet requirements through 1970.

Costs: Out-of-pocket operating costs of the Savannah River plant are approximately \$13.50 per pound of D₂O. Capital costs based on 10% total annual capital charges are \$14.50. On the basis of these costs heavy water was originally priced at \$28.00 per pound. By changing the depreciation from a 16 year to a 30 year base, it was possible for the AEC to reduce the price to the current one of \$24.50 per pound. The Canadian Government will pay \$20.50 Canadian per pound (\$19.00 U.S.) for the first 200 tons per year from the Glace Bay plant and presumably will be paying something less for the second 200 tons. Conditions

under which recent bidding on the new 400 ton/year plant was conducted indicate a likely price of \$18 - \$19 Canadian per pound for production from this plant. This price includes "designated area" treatment of invested capital to reduce financing costs for projects in areas needing development, and conventional financing would have the effect of adding several dollars per pound to this price.

In a study published in 1962* by Proctor and Thayer of the duPont Company it was estimated that a 200 ton per year heavy water plant could have been built in 1960 in an area of low cost natural gas fuel at a capital carrying charge of \$9.45 per pound based on 14% total capital charges, and an operating cost of \$7.90, for a total of \$17.35 per pound of D₂O (\$18.68 Canadian). The unit investment would presumably be reduced for a 400 ton/year plant, and the operating cost might now be somewhat lower. However, it is not likely that the 14% fixed charge rate would provide an attractive return on private investment, and as a result it does not appear possible for a private U.S. company to get any Canadian business (the only large near term business in sight). Not only is a Canadian operation likely to be financed at a considerably lower effective capital charge rate, but the normal desire of a nation to manufacture necessities in its own country, if this is possible without too great a cost differential, must be taken into account.

Alternate Processes

Although it seems likely that the GS Process (dual temperature H₂S/H₂O exchange) will continue to be relied upon by D₂O producers, the Committee has considered alternate processes. One possibility is the separation by distillation of D₂ from H₂ in liquid H₂ plants operated for the space program. At the current and foreseeable levels of liquid H₂ production such sources are too small, unreliable from a production viewpoint due to dependency on a space development program, and the process itself is of questionable economic value.

*Chemical Engineering Progress, April 1962

The Committee has also explored the possibility of recovering D_2O from commercial synthetic ammonia plants, as in the process being investigated by the French. The ammonia-hydrogen exchange process utilizes an ammonia production plant by stripping deuterium from the synthesis gas with a small amount of ammonia and recycling the ammonia through a decomposer for further enrichment. Although the output from any single plant is not of great significance, the large number of modern ammonia facilities now coming into production could in the aggregate provide a significant D_2O volume. However, the incremental capital addition to ammonia plants to permit D_2O production would be of such magnitude that private ammonia producers would need a guaranteed market at prices above those now prevailing to engage in D_2O production on an unsubsidized basis.

A third by-product source considered by the Committee is the recovery of D_2O by fractional distillation of methane. Where natural gas is liquified for transportation, storage or other purposes, separation of deuterium present in the methane might be attractive. The British-American Oil Company is developing such a process, based on the distillation of liquid natural gas under pressure with CH_3D becoming relatively more volatile than CH_4 as the pressure is raised. It is understood that the AEC is following the British-American process development and the Committee agrees that this should be kept under close surveillance.

Discussion

Considering the above cost estimates and prices, the projected demand for heavy water, and the present plans for the construction of new heavy water plants, the Committee does not believe that a private company is likely to be interested in investing money in new heavy water production facilities in this country in the near future. Furthermore, a lease of the Savannah River Plant by a private company would only be possible if the AEC were willing to forego most or all depreciation of the plant. This would constitute a sizable subsidy on the part of the AEC and might still not be adequate to insure securing a reasonable part of the predicted

market. Furthermore, it would involve production only from the one section of the plant now operating. In view of the added \$25 - \$40 per pound/year investment necessary to put the second and third units back into operation, it does not seem likely that these could be privately operated under any conditions.

The cost of heavy water production in this country, particularly without government assistance, when compared with costs in Canada and other countries (also aided by indirect "assistance"), offer little encouragement to involvement in heavy water by a private company. Perhaps a more telling factor is the obvious tendency for nations to maintain as great an independence in the nuclear field as possible.

It seems reasonable to assume that a capability for producing 800 tons of heavy water per year will be installed in Canada and that the French Government will build sufficient capacity for its requirements. On this basis the only likelihood for foreign business for a U.S. producer over the next few years would seem to be supplying some shortfall Canadian needs and possibly some Indian requirements. Even in the case of the latter the Indian Government has stated that it will install its own heavy water plant. Alternatively, there is always the possibility that when Canada sells reactors to India it will also sell the heavy water requirements.

Even though commercial operation of the Savannah River plant may not be attractive today, the Committee feels that its continued operation through 1968 has much to recommend it provided that current stocks are not already in excess of what will be required from the AEC over the next four or five years. The Committee has been informed that present heavy water production of the Savannah River plant over and above that required for military purposes somewhat exceeds 100 tons per year. This, together with some 400 tons of heavy water currently under lease by the AEC, and which will be returned, may by 1968 result in the accumulation of 600 to 800 tons of heavy water. Such a stock could be useful in case the AEC should be asked to supply the requirements of other countries that

might develop. Furthermore, the successful development of the HWOGR in this country would add to domestic heavy water demands. Continued operation of one unit through 1968 could result in a modest accumulation of stocks but would maintain U.S. technical capability in the heavy water field. By 1969 the future national and international supply and demand situation should be much clearer.

HEAVY WATER REQUIREMENTS IN TONS D₂O

	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
AEC Project Requirements																
Miscellaneous Sales	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Foreign Sales	74	193 ^a	53	25	240 ^b	75	75	75	75	75	75	75	75	75	75	75
Foreign Leases	26	268 ^c	35	22												
Domestic Leases	44	87	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Research			5	10		35		40		10		10		10		10
HWOGR								180			370			725		725
Subtotal	147	552	113	77	260	130	95	315	95	105	465	105	95	830	95	830
Canada ^d					500	500	600	500	500	500	1000	1000	1000	1000	1000	1500
India ^e					200	200	200	200	200	200	200	200	200	200	200	200
Pakistan ^f						137			200			200		200		200
Other Asia								200		200		200	200	200	200	200
Europe ^g							200	100	200		500	500	500	500	500	500
South America								200		200		200		200	200	200
TOTAL	147	553	113	77	960	967	1095	1515	1195	1205	2165	2405	1995	3130	2195	3630

a. Includes requirement for EL-4

b. Includes requirement for Marviken and a German reactor

c. Includes requirement for Douglas Point

d. Includes requirement for Pickering and subsequent Canadian plants

e. Includes requirement for Rajasthan, Kalpakkam and subsequent plants

f. Includes requirement for Karachi and possible future plants

g. Includes requirement for EL-5, ORGEL and subsequent French, Swedish and other European stations

Savannah River *Atomic Energy of Canada*
John A. Hall *Myron B. Kratzer*

R. E. Hollingsworth, General Manager

THRU: John A. Hall, AGMIA

Original signed by
 Myron B. Kratzer

APR - 4 1966

Myron B. Kratzer, Director
 Division of International Affairs

Original signed by
 John A. Hall

APR 5 1966

CANADIAN REQUEST FOR THE PURCHASE OF 12,000 POUNDS OF HEAVY WATER

We are in receipt of a request from Atomic Energy of Canada, Limited, for the purchase of 12,000 pounds of heavy water valued at \$294,000 to be used for the replacement of losses in the NPD, NRX, and NRU reactors.

The Division of Production has assured us that the above quantity of heavy water is available at Savannah River. Its transfer to AECL pursuant to our Agreement for Cooperation is within Commission policy.

The quantity of heavy water involved exceeds the 1,000 pound limitation in my delegation of authority, AECM Chapter 0103-114 d. 1, therefore, recommend that you approve the sale of 12,000 pounds of heavy water to AECL.

With your approval, this Division will negotiate and execute the required sale contract.

APPROVED:

(Signed) John V. Maciguerra for

General Manager.

bcc: GM (2)
 AGMIA

- Secretariat
- W. Yeomans, DIA
- J. Downing, DIA
- R. Moore, Prod
- C. Lovejoy, OC
- G. Spiegel, DIA
- OGC

Is this of sufficient importance that JCAE should be informed? Yes No
 if "yes", indicate status and target date of JCAE notification.

APR 6 1966

ACTION 1289

File:
 SDT's
 desk

	DIA:OPNS Downing 15/	DIA:EUROP Yeomans 15/	PRODUCTION Moore type	OC Lovejoy 3/30	DIA:ADTI Holle 3/30	OGC: 3/30 3/31
OFFICE	DIA:M	DIA:PAR	DIA:DIR	AGMIA	AGM DGM	GM
SURNAME	Tataro Rebel	Spiegel	Kratzer	Hall		
DATE	3/30/66	3/31/66				

4-4-66

DATE:

ISOTOPES - HEAVY WATER

INDEX:

[REDACTED]

TO:

FROM:

SUMMARY: AEC 805/15. CANADIAN DECISION ON PROPOSED HEAVY WATER PLANT.
AEC was informed by letter on Dec. 3, 1965 that the Canadians were not prepared to accept the Commission's offer on heavy water (AEC 274/38)

FILED: IA-5-CANADA

INDEXER: 1-4-66

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOH S. BUCKNER DOE/NN-623

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

1-4-66

*Estevan - 1
Heavy Water*

R. E. Hollingsworth, General Manager
(TEBU) J. A. Hall, AGMIA Original signed by **DEC 22 1965**
John A. Hall
Original signed by
Myron B. Kratzer, Director Myron B. Kratzer
Division of International Affairs

DEC 21 1965

CANADIAN DECISION ON PROPOSED HEAVY WATER PLANT

The AECL has publicly announced the inability to enter into an agreement with the Dynamic Power Corporation for construction of the proposed Estevan Heavy Water Production Plant in Saskatchewan. The reason given was the the Dynamic Power Corporation was unable to obtain adequate assurance of financing. It has been rumored that Dynamic wanted Provincial underwriting of the entire capital costs and that Premier Thatcher of Saskatchewan rejected this degree of assurance.

You will recall that in August 1965, after Western Deuterium Company, Ltd., abandoned its plans for the proposed 300 tons a year plant at Estevan, the Dynamic Power Corporation was approached to take over the job since it was the second lowest bidder. It is now understood that Mr. Lorne Gray has indicated that AECL will approach Imperial Oil Company to ascertain whether they are interested in constructing the new plant and also consult Western Deuterium Company, Ltd., concerning the possible further expansion of their plant under construction in Nova Scotia, which is scheduled for completion in 1966.

In this connection, it will be recalled that Mr. Gray informed the AEC by letter of December 3, 1965, that the Canadians were not prepared to accept the Commission's offer on heavy water (AEC 274/38).

- bcc: AGMIA
- Secretariat (2) 
- OGC
- R. LeGassie, AGMPP
- M. Hudson, Canadian Office
- D. Hoyle, IA
- E. Rebol, IA
- European Br., IA

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OFFICE OF THE SECRETARY
12 VICTORIA PARK DRIVE

C O M P L E T E S Mat. Br. Action 6694 55 VI II SO

OFFICE >	IA:EUR	IA:EUR	IA:AD/PD&L	IA:AD/TE	IA:DIR	AGMIA
SURNAME >	WBurke/plg	WYeomans	(Acting) WYeomans	DHoyle	MKratzer	JHall
DATE >	12/15/65	12/ /65	12/ /65	12/ /65	12/ /65	12/ /65

12-21-65

*Photopos -
GT/RECORDS
Heavy Water*

UNITED STATES GOVERNMENT

Reference & Reproduction Branch

Memorandum

TO : File

FROM : W. B. McCool, *JJM* Secretary

SUBJECT: SUPPLY OF HEAVY WATER TO CANADA

SECY:JCH

DATE: December 21, 1965

1. At Information Meeting 544 on December 20, 1965, Commissioner Ramey requested a report regarding the supply of heavy water to Canada.

2. It is our understanding the Executive Assistant to the General Manager is taking the required action.

- cc:
- Chairman
 - Commissioner Ramey
 - General Manager
 - Deputy General Manager
 - Asst. General Manager
 - Exec. Asst. to Gen. Mgr.
 - General Counsel

13-21-65

December 9, 1965

AEC 274/38

COPY NO. 53

ATOMIC ENERGY COMMISSION

SAVANNAH RIVER HEAVY WATER PRODUCTION PLANT

Note by the Secretary

The Executive Assistant to the General Manager has requested that the attached letter of December 3, 1965 from Mr. J. L. Gray, Atomic Energy of Canada Limited, to the Controller be circulated for the information of the Commission.

W. B. McCool

Secretary

AEC
274
38

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12-9-65



CABLE ADDRESS "MOTA"

FILE NO.

ATOMIC ENERGY OF CANADA LIMITED
160 KENT STREET

OFFICE OF THE PRESIDENT

OTTAWA 4, ONTARIO

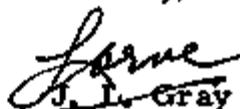
3rd December 1965

Dear Mr. Abbadessa,

Confirming my brief message to your office yesterday, this is to advise that we are not prepared to enter into an agreement involving an expenditure of \$15.8 million to re-activate the second third of the Savannah River heavy water production plant.

We are still very actively engaged in settling the Canadian heavy water production programme and I expect it will be another two months before the picture is really clear. At that time we will be in touch with you again regarding the material at present on loan and whether or not we have any additional requirements.

Yours sincerely,


J. L. Gray

Mr. John P. Abbadessa,
United States Atomic Energy Commission,
Washington 25, D.C.

Isotopic Heavy Water

UNITED STATES GOVERNMENT

Memorandum

TO : R. E. Hollingsworth
General Manager

FROM : *John P. Abbadessa*
John P. Abbadessa
Controller

SUBJECT: SALE OF HEAVY WATER TO AECL

DATE: NOV 16 1965

On November 11, 1965 George Quinn, Dixon Hoyle and I met with Mr. Loren Gray, President, AECL, in Ottawa regarding possible arrangements for a sale of heavy water to his company.

Generally we followed the format and the subject matter noted in my November 5 memorandum to you on this subject.

We left with Mr. Gray a copy of the proposed prices previously discussed with the Commission. Mr. Gray stated that he would not be interested in any of the arrangements that involved a price over \$17.50. The case involving a total shipment of 2,250 tons (225 tons for ten years) was at \$17.50. The only other cases involving prices below \$17.50 were those which assumed that Canada would invest the \$15.8 million. In answer to Mr. Gray's inquiry, we informed him that we used an interest rate of 4% in computing the prices. He stated that cost of money to him was of the order of 5.25% interest, and therefore, our investing the money would provide him the lower price.

We advised Mr. Gray that these prices were relatively firm but that since our discussions to date have only been exploratory in nature, we have not attempted to obtain any approvals from the Bureau of the Budget or the Congress. We also noted that the Commission has not formally approved the prices. We explained that these prices were computed on the basis that the particular quantities are in addition to the 230 tons he presently has on lease from us and contemplated that he would purchase this quantity at the regular \$24.50 price.

Mr. Gray asked several questions regarding the basis of the pricing which we answered forthrightly. We explained that the prices, where opening the second third of the plant was necessary, were based on incremental costs with some sharing between our two agencies with respect to operating costs. We also noted that interest costs were included at 4% and explained the need for providing for equipment replacement in these prices.



5010-107-1

R. E. Hollingsworth

- 2 -

NOV 16 1965

Mr. Gray discussed at some length the other options that he was considering, such information being already generally familiar to us. He asked us to express his appreciation to the General Manager for providing the information. We explained to him that in the event it was necessary for us to seek the \$15.8 million needed to renovate the second third of the plant, we faced a somewhat urgent budgetary time schedule. Mr. Gray indicated that his situation also was somewhat urgent and stated that he would provide the General Manager a definite answer as to his interest no later than the end of the month.

OFFICE OF THE GENERAL MANAGER
PLANT AND EQUIPMENT DEPARTMENT

NOV 16 1965

RECEIVED

Discussions - Heavy Water

OFFICIAL USE ONLY

UNITED STATES GOVERNMENT

Reference & Reproduction Branch D.C.

Memorandum

TO : File

DATE: November 10, 1965

FROM : W. B. McCool, Secretary *J.B.*

SUBJECT: PROPOSED PRICES FOR HEAVY WATER TO ATOMIC ENERGY OF CANADA LIMITED

SECY: JCH

1. At Information Meeting 530 on November 5, 1965, the General Manager and Mr. Abbadessa reviewed with the Commissioners the cases outlined in the Controller's November 5, 1965 hand-out regarding proposed prices to Atomic Energy of Canada Limited for heavy water at selected order levels. The Commissioners agreed staff should now explore the matter with Mr. Gray, AECL.

2. It is our understanding the Assistant General Manager for Plans and Production, Office of the Controller, and Division of International Affairs will take the required action.

- cc:
- Chairman
- General Manager
- Deputy General Manager
- Asst. General Manager
- Exec. Asst. to Gen. Mgr.
- Asst. Gen. Mgr. for Plans & Prod.
- Asst. Gen. Mgr. for IA
- General Counsel
- Director, Production
- Director, IA
- Controller

*copy filed.
IA-5-Canada*

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11-10-65

*Isotope Program
Heavy Water*

UNCLASSIFIED

AEC 274/37

October 1, 1965

COPY NO. 48

ATOMIC ENERGY COMMISSION

ATOMIC INDUSTRIAL FORUM STUDY
OF HEAVY WATER PRODUCTION AT SAVANNAH RIVER

Note by the Secretary

1. The attached correspondence with the Atomic Industrial Forum concerning a study of heavy water production in the U. S. is circulated for the information of the Commission at the request of the Assistant General Manager for Plans and Production.

a. Letter of September 28, 1965 from President, AIF, to the General Manager (Enclosure I).

b. Letter of June 18, 1965 from Executive Manager, AIF, to the General Manager (Enclosure II).

c. Letter of May 14, 1965 from the General Manager to the President, AIF (Enclosure III).

2. A report on the August 17, 1965 meeting of the Forum representatives with the AEC and Contractor staff was circulated as AEC 274/36.

W. B. McCool
Secretary

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Asst. GM for Reactors	15 - 16		

AEC
274
37

10-1-65

X O-m-7 Atomic Industrial Forum

ATOMIC INDUSTRIAL FORUM INC.

850 THIRD AVENUE • NEW YORK, N.Y. 10022 • PLAZA 4-1075

September 28, 1965

Mr. R. E. Hollingsworth
General Manager
U. S. Atomic Energy Commission
Washington, D. O. 20545

Dear Bob:

Following Charlie Robbins' letter to you of June 18th, the Forum held a seminar on August 17th attended by members of the AEO staff, du Pont and Forum representatives to consider whether the Forum should undertake a study of heavy water production at Savannah River. The recommendation of the member representatives was that such a study of heavy water production and its commercial possibilities should be undertaken, and at the last meeting of the Executive Committee these recommendations were approved. An ad hoc Committee on Heavy Water Production has been formed and will hold its first meeting shortly.

Because of the complex nature of the problem and the uncertainties regarding heavy water demand, it will be difficult to finish the study this year. We realize, however, that time is an important factor in any decision made with respect to the Savannah River plant and will send you the results of our study as soon as we can.

Sincerely,


W. Kenneth Davis
President

ATOMIC INDUSTRIAL FORUM INC.

850 THIRD AVENUE • NEW YORK, N.Y. 10022 • PLAZA 4-1075

June 18, 1965

Mr. R. E. Hollingsworth
General Manager
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Bob:

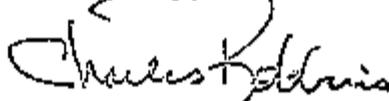
Ken Davis has asked me to reply to your letter of May 14 inquiring about the Forum's interest in undertaking a study of heavy water production in the U.S.

Your letter was brought to the attention of our Executive Committee when it met on June 10. The Executive Committee expressed considerable interest in the projected study. The Committee did not, however, believe that it should attempt to formulate a definitive reply to your inquiry until more consideration had been given to it by a more cognizant segment of the Forum membership.

Accordingly, the Executive Committee instructed the staff to explore further with you or such members of your staff as you might wish to designate the intended scope and purpose of such a study, as well as the mechanics for carrying it out. To do this we would like to organize a small ad hoc committee of perhaps 10 members to meet with appropriate AEC staff representatives to discuss in some depth what the AEC and the industry might expect to gain from such a study, what information might be available relative to Canadian production, what classification problems, if any, might be encountered in carrying out such a study, etc.

We have not as yet approached any of the Forum members whom we would plan to invite to serve on such an ad hoc committee and thought we should not do so until we had your reaction to this suggested approach. If you think well of this suggestion, we would like to proceed with the organization of such a committee and with plans for this committee to meet with appropriate representatives of the AEC staff at an early date.

Sincerely,



Charles Robbins
Executive Manager

MAY 14 1955

Mr. W. Kenneth Davis, President
Atomic Industrial Forum, Inc.
850 Third Avenue
New York, New York, 10022

Dear Mr. Davis:

The Commission is currently reviewing its long-range plans for heavy water production in the Savannah River Plant. An important consideration in this planning is the appropriate role that domestic private industry should play in this phase of the atomic energy program. The Commission has requested that, as the initial step, we seek the comments of the Atomic Industrial Forum regarding heavy water manufacture in the United States. If the Forum is willing to study this problem, the AEC would cooperate by supplying data available to it such as cost of AEC production, market projections, studies on the economics of a new plant, etc.

To assist you in deciding upon the type of effort involved in such a study, the following general comments on production and future markets would be helpful. For some time, now, we have been operating the Savannah River heavy water plant at one-third capacity with the remainder of the plant in standby. The current level of operations (about 150 tons/yr) has been adequate to meet all requirements which include AEC uses, and sales and leases to both foreign and domestic customers. An adequate stockpile is maintained to meet requirement changes. Continued operation at the current level is critically dependent on the civilian market for U. S. production. The recent announcement that Canada will have one and possibly two heavy water production plants in the near future may be expected to have an impact on the future AEC sales to foreign markets.

As you know, the market for heavy water is largely dependent on the use of heavy water moderated atomic power reactors. In the United States, current industrial interest is preponderantly in light water moderated reactors. However, the AEC is supporting a program for the development of advanced converters, including heavy water moderated organic cooled reactors which may require sizeable quantities of heavy water in five to ten years. Until such requirements develop, the future prospects for large-scale production of heavy water appear to center around a continuing foreign market. The ability to sell U. S. heavy water to foreign customers would be dependent, of course, on the price quoted by the Canadians.

If the Form is agreeable to this study, we suggest inclusion of the following points:

1. The prospects for a private commercial heavy water production activity in the U. S.
2. The need for, and possible scope of, assistance by the Government in establishing such a commercial activity.
3. The role the AEC Savannah River heavy water plant might play in establishing a commercial activity.
4. If the market uncertainty precludes commercial interest at this time, the need for the Government to maintain a technical capability until the future direction is better defined.

Sincerely yours,

R. E. Hollingsworth
General Manager



~~Isotope - Heavy Water~~
 UNITED STATES
 ATOMIC ENERGY COMMISSION
 WASHINGTON, D.C. 20545

Secretariat
~~Isotope~~
 Isotope - Heavy Water

MEMORANDUM FOR CHAIRMAN SEABORG
 COMMISSIONER PALFREY
 COMMISSIONER RAMEY
 COMMISSIONER TAPE

SEP 17 1965

Signed E. J. Bloch
 THROUGH GENERAL MANAGER

SUBJECT: CANADIAN REQUEST FOR 1,000 TONS OF HEAVY WATER

Recently, the AEC's Scientific Representative in Canada informed me that Lorne Gray probably will wish to discuss with the Chairman during the IAEA Conference in Tokyo the possibility of AECL purchasing some 500 to 1,000 tons of heavy water at a price lower than our published price of \$24.50 (U.S.) per pound. This subject had been tentatively discussed during the Commissioners' and General Manager's visit to Canada last June.

Based on the indicated delivery schedule of 250 tons immediately and the balance distributed evenly over the next three years, our present inventory is adequate for the initial delivery but the remainder could be met only by essentially depleting our heavy water stockpile and proceeding as rapidly as possible to start up the second one-third of the Savannah River plant in order to rebuild our stockpile. The rehabilitation and start-up of the second one-third would cost about \$10,000,000 and would require about 18 months to complete. Thus, if funds were authorized in FY 1967 for the rehabilitation (and this item is not included in our current FY 1967 budget submission), production from the rehabilitated portion would not commence until early in Calendar Year 1968 and its contribution towards the Canadian 1,000 ton order would be minimal.

We are aware that the present production capacity of the Halifax plant (200 tons per year) is not sufficient to supply inventory and makeup requirements for the CANDU-type reactors already committed in Canada and overseas; consequently, AECL must develop a second source of supply, either the AEC or by construction of a second plant in Canada. Assuming that a second plant is built in Canada, the Capacity of the two plants would be adequate to supply all immediate future needs for CANDU-type

*cy filed Isotope 3-2-Appli. Requester
 Isotope - Heavy Water*

1965

reactors and continued AEC supply beyond the next three years would not be required. As a matter of fact, AEC heavy water potentially would be in direct competition for third country or U.S. markets with Canadian material.

We believe that the \$10,000,000 rehabilitation costs should be distributed over the quantity of material delivered to the Canadians, since our present one-third plant capacity is sufficient to meet current and projected AEC needs. If this were done, we would have to charge a price of about \$20 a pound to recover the \$10,000,000 plus our current out-of-pocket operating costs, without recovery of any amortization of the existing plant. However, the cost of production during the period when two-thirds of the plant are operated as a consequence of the Canadian order would be reduced. By supplying the heavy water to Canada, we would be placing them in a more favorable position to compete with American manufacturers in foreign markets. To the extent that we sell heavy water to Canada, at a price below our cost, we may be furthering this competition. Therefore, we recommend that no commitment be made at this time to the Canadians with respect to furnishing heavy water at a price less than the current \$24.50 per pound, but that we indicate our readiness to explore this problem in detail with them following the Tokyo Conference.

In considering AECL's requirements, we have assumed that the 230 tons of material already under lease contract for the Douglas Point reactor will ultimately be purchased. In entering into any long-term arrangements for AEC supply of heavy water, we would naturally expect AECL to execute a firm contract committing the Canadians to purchase a fixed quantity at a firm price over a time period consistent with the proposed plan for SR plant operation.

Myron B. Kratzer, Director
Division of International Affairs

Int. Ops. 3-2

Int. Ops. Heavy Water

R. E. Kollingsworth, General Manager

FOR: John A. Hall, AGMIA Original signed by Myron B. Kratzer

SEP 17 1965

Myron B. Kratzer, Director
Division of International Affairs Original signed by Myron B. Kratzer

SALE OF 2500 POUNDS OF HEAVY WATER TO SWITZERLAND

We are in receipt of a request from the Swiss Federal Institute for Reactor Research at Wurenlingen for the purchase of 2500 pounds of heavy water valued at \$61,250. This heavy water is to be used to further the heavy water research program at the Institute and falls within the scope of the Agreement for Cooperation between the United States and Switzerland

The Division of Production has assured us that this quantity of heavy water can be made available at Savannah River. Its transfer to the Swiss Federal Institute for Reactor Research is within Commission policy.

The quantity of heavy water involved exceeds the 1,000 pound limitation in my delegation of authority (ABCM Chapter 0103-114 d). I, therefore, recommend that you approve the transfer of 2500 pounds of heavy water to the Swiss Federal Institute for Reactor Research.

Upon approval, we will negotiate and execute a sale contract for this quantity of material.

APPROVED:

orig filed Int. Ops 3-2 - Appl. + Permit

Original Signed by
E. J. Bloch SEP 21 1965

EAGM	AGM	DGM	GM

SEP 17 1965

General Manager Acting

- cc: General Manager (2)
- AGMIA
- Secretariat (2)
- J. Downing, Opns Br., DIA
- W. Yeomans, Europ Br., DIA
- R. Moore, Production
- C. Lovejoy, OC
- OGC

Is this of sufficient importance that JCAE should be informed? Yes No
If "yes", indicate status and target date of JCAE notification.

SEP 10 1965

SEP - 7 1965

6 File: SDT's desk

ACTION 4995

OFFICE	OPNS	EUROR	PROD:	OC	DIA/ADTI	OGC	DIA:DIR	AGMIA
SOTDIA:M Tatalovich: jw								
SURNAME	Rebol	Downing	Yeomans	Moore	Lovejoy	Hoyle	Kratzer	Hall
DATE	9/17/65	9/12/65	9/18		9/9/65	9/9/65		

4-17-65

Isotopes - Heavy Water



UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

SEP 11 1965

Dear Chauncey:

This is a further response to your letter of July 14th, in which you expressed some concern about: 1) the validity of ground rules used for the economics of D₂O production as compared with the economics of enriched uranium production, and 2) the approach used by the AEC staff in presenting the relative merits of various advanced converters as regards fuel utilization.

My letter to you of August 5, 1965 indicated that we would give you our comments on fuel utilization. However, I understand that subsequent to the submittal of your July 14 letter, you had the opportunity to discuss, with mutual satisfaction, the pros and cons of the various issues with Dr. Swartout and Mr. Shaw.

I intend to further pursue the question of the ground rules on D₂O on which I have a long personal interest.

I share your confidence in the potential of this system, the resolution of the problems, and its successful economic development.

Sincerely,

(Signed) James T. Ramey

James T. Ramey
Commissioner

Dr. Chauncey Starr, President
Atomics International Division
North American Aviation, Inc.
P. O. Box 309
Canoga Park, California

bcc: Ramey (2)
GM (2)
AGMR
Secretariat (2)

9-11-65

OFFICE ▶	RDT:PM	RDT:D	RDT:D	AGMR	AGM	DGM	GM
SURNAME ▶	AGiambusso:rc						
DATE ▶	9/10/65	9/ /65	9/ /65	9/ /65	9/ /65		9/ /65

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AEC 274/36

September 8, 1965

COPY NO. 18

ATOMIC ENERGY COMMISSION

MEETING WITH ATOMIC INDUSTRIAL FORUM ON HEAVY WATER PRODUCTION

Note by the Secretary

The attached memorandum of September 2, 1965, from the Director of Production, with enclosures, is circulated for the information of the Commission at the request of the Assistant General Manager for Plans and Production.

W. B. McCool

Secretary

AEC
274
36

DISTRIBUTION

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Asst. GM for Operations	13
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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : G. F. Quinn, AGMFF

DATE: SEP 2 1965

FROM : *[Signature]*
F. P. Baranowski, Director
Division of Production

SUBJECT: MEETING WITH ATOMIC INDUSTRIAL FORUM ON HEAVY WATER PRODUCTION

PR:JLS

In April 1965, the Commission considered (AEC 274/35), the question of continued operation of the Savannah River heavy water production plants in the light of anticipated future requirements for heavy water and the prospect of future competition from Canadian plants. It was decided to continue operation of the Savannah River plant at one third capacity pending further review of the heavy water situation. The Commission suggested that, as a step in these considerations, the comments of the Atomic Industrial Forum regarding heavy water manufacture in the United States be solicited.

As a result of correspondence and meetings between Forum and AEC representatives, the Forum has expressed its interest in conducting such a study. An Ad Hoc Committee has now been established by the Forum to consider this question. The initial meeting of the Committee with AEC representatives was held on August 17, 1965 at Forum headquarters in New York. The meeting attendance was as follows:

Committee

Frank T. Barr, Chairman, Esso Research and Engineering Co.
John T. Sherman, Secretary, Atomic Industrial Forum, Inc.
W. B. Allred, Stone & Webster Engineering Corp.
P. M. Arnold, Phillips Petroleum Company
E. C. Fiss, ^{1/}Duke Power Company
Lee Ganner ^{1/}, Air Products & Chemicals, Inc.
Robert Loftness, Atomic International
Kenneth R. Osborn, Allied Chemical Corp.
Ray L. Witske, Westinghouse Electric Corp.

Atomic Energy Commission

Roland A. Anderson, Assistant General Counsel for Patents
H. L. Kilburn, Deputy Manager, Savannah River Operations Office
Clifford E. McColley, Division of Industrial Participation
Raymond J. Moore, Production Engineer, Division of Production
J. L. Schwennesen, Asst. Dir. for Reactor Products, Production
Ernest B. Tremmel, Director, Division of Industrial Participation

^{1/} Substituting for J. H. Arnold, Air Products & Chemicals, Inc.

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E. I. duPont de Nemours & Company

Victor R. Thayer, Dir. of Chemical Processing, Atomic Energy Div.

Mr. Barr requested that the AEC brief the Committee with respect to the background heavy water production situation, the reasons for soliciting Forum assistance, the status of market projections for heavy water and the status of the Canadian program. In response, Mr. Schwennesen provided a very brief summary of the history of AEC's production activity of heavy water, including original capital costs of facilities at Dana and Savannah River, plant capacities and production costs and the present status of the plants. A summary of projected requirements for heavy water was presented (attached as enclosure 1). The high qualitative nature of the projections was stressed, in particular it being pointed out that requirements after about FY-1966 are not firm but rather represent AEC's best estimates. Examination of the requirements data indicates that the heavy water market, during the near future at least, is preponderantly a foreign rather than a domestic market. The bulk of the potential foreign market requirements are associated with the likely construction of CANDU-type reactors in Canada and elsewhere in the world. The AEC heavy water organic cooled reactor program was discussed briefly in the context of the potential heavy water requirements for this reactor concept if it should be adopted in future large scale reactors in the United States. In the latter event there could be substantial U. S. heavy water requirements in the post 1975 period. In discussion of the potential market requirements picture, the Ad Hoc Committee indicated that it would likely attempt to assess the relative firmness of requirements as part of its study.

Mr. Schwennesen discussed the status of the Canadian heavy water production plans as these plans are now known by the AEC. He indicated that the Deuterium of Canada plant, now being constructed in Nova Scotia, is expected to be in operation in approximately one year. Atomic Energy of Canada, Limited, has contracted for the design output of the plant (200 tons per year) for a five-year period at a unit price of \$20.50 Canadian per pound of heavy water. The text of an August 9 announcement by AECL, regarding the withdrawal of the Western Deuterium Company, Limited, offer to construct a second Canadian plant in Western Canada was provided the Committee. This plant was to have been designed for a 300-ton per year capacity with AECL to guarantee a five-year market for the plant's output at a price of about \$14.00 Canadian per pound. The announcement notes, and information from the AEC Scientific Representative from Chalk River confirms, that AECL is likely to negotiate with Dynamic Power Corp. of Calgary, Alberta for the construction of the second plant on approximately the same capacity and base load guarantee basis as originally contemplated

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for the Western Deuterium Company plant. There is some expectation that costs for the Dynamic Power Company plant, if constructed, would be in the range of \$16.00 Canadian of heavy water to AECL. A copy of the Canadian announcement on this matter is attached as enclosure 2.

In the light of the information presented, Mr. Schwennesen discussed briefly the four principal issues which AEC suggested be included in the scope of a Forum study; These points are:

1. The prospects for a private commercial heavy water production activity in the U. S.
2. The need for, and possible scope of, assistance by the Government in establishing such a commercial activity.
3. The role the AEC Savannah River heavy water plant might play in establishing a commercial activity.
4. If the market uncertainty precludes commercial interest at this time, the need for the Government to maintain a technical capability until the future direction is better defined.

Mr. Tremmel subsequently elaborated on these points. He stressed the desire of AEC to obtain the industrial viewpoint and that every effort should be made to utilize the Government's assets at Savannah. If industry is not interested in constructing plants for production, he suggested that then efforts should be made to find a method for industry to take over the Savannah River heavy water plant to permit the U. S. to compete in the world market. He stressed the national policy desire to maintain the flow of dollars back into the U. S. wherever possible.

Dr. Thayer of duPont discussed alternate production processes for heavy water. He indicated that the Canadian Nova Scotia plant was essentially the same as that now employed at Savannah River. In response to a question he indicated that he knew of no specific new improvement being employed in this plant. The status of various alternate production processes, such as the ammonia-hydrogen exchange process, possible production of deuterium from the growing liquid hydrogen market, etc., were discussed. Dr. Thayer indicated his opinion that such alternative processes probably could not compete with the existing process because incremental capital investment required per unit of heavy water produced would result in excessive costs, assuming normal industrial accounting practices. In general, the Committee reserved judgment and indicated that it was unclear to what extent they might wish to investigate alternate processes for study.

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In response to a question, Mr. Schwemmen indicated that AEC production reactor and classified heavy water requirements would probably not exceed about 100 tons per year. This figure (exact numbers would be classified) is not included in the requirements table; on the other hand it was noted that the existing heavy water stockpile, whose size is also classified, could probably accommodate AEC's own needs for a reasonable period of time.

The Committee questioned AEC's desire as to the urgency of the study. It was suggested that, if at all possible, AEC would like to have it completed by late fall. To a great extent, however, the time incentives imposed by the market picture and the Canadian program suggest the time parameters for the development of appropriate Forum opinions.

Mr. Anderson was asked specifically the effect of the impending patent litigation upon the heavy water manufacturing situation. Mr. Anderson declined to comment as to AEC's position with respect to its own operations. He indicated that to the extent that any problem might exist with regard to the Spevack patents, it was probable that Mr. Spevack would pursue the matter whether the Government or industry operated the plant. Mr. Anderson provided information as to the particular patents that were at issue and, in response to a question, indicated that, based upon past experience, it might take several years for the case to be heard in the Court of Claims.

The Forum Committee met in closed executive session following the AEC presentation for discussions and indicated that there would be further contact as required with the AEC.

Enclosures:

1. Projected Requirements for D₂O
2. Canadian Announcement

- ENCLOSURE 1
HEAVY WATER REQUIREMENTS
IN TONS D₂O

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<u>AEC Projected Requirements</u>	<u>FY 65</u>	<u>FY 66</u>	<u>FY 67</u>	<u>FY 68</u>	<u>FY 69</u>	<u>FY 70</u>	<u>FY 71</u>	<u>FY 72</u>	<u>FY 73</u>	<u>FY 74</u>	<u>FY 75</u>	<u>FY 76</u>	<u>FY 77</u>	<u>FY 78</u>	<u>FY 79</u>	<u>FY 80</u>
Miscellaneous Sales	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Foreign Sales	74	193	53	25	240	75	75	75	75	75	75					4/
Foreign Leases	26	268	35	22	-	-	-	-	-	-	-					
Domestic Leases ^{1/}	44	87	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Research (Low T/D ratio D ₂ O for Bubble Chambers) ^{2/}	-	-	5	10	-	35		40		10						
HWOCR ^{2/}	-	-	-	-	-	-			180		370			725		725
SUBTOTAL	147	553	113	77	260	130	95	135	275	105	465					
<u>CANDU - Firm Reactors</u> ^{3/}																
Canada						400		500								
India			200		200	400										4/
Pakistan				137												
<u>CANDU-Planned Reactors</u> ^{3/}																
Canada						500		500	500		500					
Europe					200		400			500						
Asia (India, Japan, Pakistan)							800	800	800	800	800					
S. America							200		200		200					
TOTAL	147	553	313	214	660	1430	1495	1935	1775	1405	1965					

^{1/} AEC programs; U.S. Government or AEC-supported programs.
^{2/} Based on RD&T estimate of 2,000 tons needed by 1980; quantities by years assumed.
^{3/} Based on generalized DIA estimates of one ton per MWe; quantities by years assumed.
^{4/} Based on generalized DIA forecasts only to FY 1975.

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C O P Y

ENCLOSURE 2

AUG 10 1965

CHALK RIVER SPECIAL REPORT NO 41. FOLLOWING IS VERBATIM TEXT
PUBLIC ANNOUNCEMENT RELEASED BY AECL AFTERNOON AUGUST 9:

AUGUST 1965

ATOMIC ENERGY OF CANADA LIMITED ANNOUNCED TODAY THAT WESTERN
DEUTERIUM COMPANY LTD HAS WITHDRAWN ITS PROPOSAL TO BUILD A
300 TON PER YEAR HEAVY WATER PRODUCTION PLANT AT ESTEVAN SASKATCHEWAN.
THIS PLANT WAS TO EMPLOY A NEW PROCESS BASED ON THE USE OF ORDINARY
WATER AS A SOURCE OF DEUTERIUM, COUPLED WITH AN AMMONIA-HYDROGEN
EXCHANGE PROCESS. AECL HAS EXAMINED THE PROCESS AND HAS CONCLUDED
THAT IT IS TECHNICALLY SOUND.

ONE OF THE REQUIREMENTS IN THE INVITATION TO SUBMIT PROPOSALS
WAS THAT THE PLANT SHOULD BE IN FULL PRODUCTIVE CAPACITY 31 MONTHS
AFTER ACCEPTANCE OF A PROPOSAL. WESTERN DEUTERIUM COMPANY LTD HAD
BEEN INFORMED THAT ITS PROPOSAL WAS ACCEPTABLE BUT HAS SUBSEQUENTLY
DECIDED THAT IS COULD NOT GUARANTEE IN A CONTRACT THAT FULL
PRODUCTION WILL BEGIN BY NOVEMBER 1967. CONSEQUENTLY, NO CONTRACT
HAS BEEN SIGNED BETWEEN AECL AND WESTERN DEUTERIUM COMPANY LTD.

A CONTRIBUTORY FACTOR INFLUENCING THE DECISION OF WESTERN DEUTERIUM
IS THAT WITH THE GROWING MAJOR INCREASE IN THE DEMAND FOR FERTILIZER,
BOTH IN CANADA AND ABROAD, FERTILIZER PRODUCTION PLANTS ARE BEING
PLANNED THAT WILL PRODUCE VERY LARGE QUANTITIES OF AMMONIA. IT APPEARS
THAT HEAVY WATER COULD BE PRODUCED IN A COMBINED FERTILIZER/HEAVY
WATER PRODUCTION PLANT AT A COST EVN LESS THAN FROM A SINGLE
PURPOSE HEAVY WATER PRODUCTION PLANT.

UNCLASSIFIED

MR. HAROLD HUSBAND, PRESIDENT OF WESTERN DEUTERIUM COMPANY LTD., HAS SAID THAT THE COURSE OF PRUDENCE DICTATED THAT HE SHOULD FORFEIT THE SIGNIFICANT SUM OF MONEY ALREADY SPENT ON THE PRELIMINARY DESIGN OF THE HEAVY WATER PLANT RATHER THAN RISK THE PENALTIES FOR LATE COMPLETION OF THE PLANT AND THE UNCERTAINTY OF ITS FUTURE COMPETITIVE POSITION.

THE AMMONIA/HYDROGEN ISOTOPE EXCHANGE PROCESS FOR HEAVY WATER PRODUCTION APPEARS TO HAVE CONSIDERABLE POTENTIAL FOR DEVELOPMENT AND APPLICATION. AN ASSOCIATION OF INTERESTS IN FRANCE, INCLUDING THE COMMISSARIAT A L'ENERGIE ATOMIQUE, HAS BEEN ACTIVELY WORKING ON THE PROCESS FOR SOME TIME. WESTERN DEUTERIUM HAD PROPOSED TO USE, UNDER APPROPRIATE AGREEMENTS, SOME OF THE TECHNOLOGY DEVELOPED BY THIS ASSOCIATION.

SINCE CANADA WILL HAVE INCREASING REQUIREMENTS FOR HEAVY WATER TO MEET THE NEEDS OF NUCLEAR POWER STATIONS OF CANADIAN DESIGN BUILT AT HOME AND ABROAD, AECL HAS CONTINUED THE DISCUSSIONS WITH THE FRENCH INTERESTS BEGUN BY WESTERN DEUTERIUM. AN AECL TECHNICAL AND ECONOMIC STUDY TEAM IS EXPECTED TO VISIT FRANCE IN MID-AUGUST. THE OBJECT IS TO ENSURE THAT THE TECHNOLOGY IS AVAILABLE FOR FUTURE APPLICATION IN CANADA. CANADA STILL HAS A REQUIREMENT FOR ADDITIONAL HEAVY WATER IN THE IMMEDIATE FUTURE TO MEET KNOWN REQUIREMENTS SUCH AS THAT OF ONTARIO HYDROS MAJOR NUCLEAR POWER STATION AT PICKERING. AN APPROACH IS THEREFORE BEING MADE TO DYNAMIC POWER CORPORATION LTD OF CALGARY, ALBERTA WHICH SUBMITTED THE SECOND LOWEST BID PRICE

UNCLASSIFIED

IN ITS PROPOSAL WITH A VIEW TO ENTERING CONTRACT DISCUSSIONS FOR
THE UNDERWRITING OF 300 TONS OF HEAVY WATER PER YEAR. DYNAMIC
POWER PROPOSED TO USE THE HYDROGEN SULPHIDE PROCESS AND TO BUILD
A PLANT AT ESTEVAN, SASKATCHEWAN.

SIGNED MILLER N HUDSON

BT

D. O. Topper Heavy Water

Secretariat

MAY 14 1965

Mr. M. Kenneth Davis, President
Atomic Industrial Forum, Inc.
650 Third Avenue
New York, New York, 10022

Dear Mr. Davis:

The Commission is currently reviewing its long-range plans for heavy water production in the Savannah River Plant. An important consideration in this planning is the appropriate role that domestic private industry should play in this phase of the atomic energy program. The Commission has requested that, as the initial step, we seek the comments of the Atomic Industrial Forum regarding heavy water requirements in the United States. If the Forum is willing to study this problem, the AEC would cooperate by supplying data available to it such as cost of AEC production, market projections, studies on the economics of a new plant, etc.

To assist you in deciding upon the type of effort involved in such a study, the following general comments on production and future markets would be helpful. For some time now, we have been operating the Savannah River heavy water plant at one-third capacity with the remainder of the plant in standby. The current level of operations (about 150 tons/yr) has been adequate to meet all requirements which include AEC uses, and sales and leases to both foreign and domestic customers. An adequate stockpile is maintained to meet requirement changes. Continued operation at the current level is critically dependent on the civilian market for U. S. production. The recent announcement that Canada will have one and possibly two heavy water production plants in the near future may be expected to have an impact on the future AEC sales to foreign markets.

5-14-65

MAY 14 1965

W. Kenneth Davis

- 2 -

As you know, the market for heavy water is largely dependent on the use of heavy water moderated atomic power reactors. In the United States, current industrial interest is predominantly in light water moderated reactors. However, the AEC is supporting a program for the development of advanced converters, including heavy water moderated organic cooled reactors which may require sizeable quantities of heavy water in five to ten years. Until such requirements develop, the future prospects for large-scale production of heavy water appear to center around a continuing foreign market. The ability to sell U. S. heavy water to foreign customers would be dependent, of course, on the price quoted by the Canadians.

If the Forum is agreeable to this study, we suggest inclusion of the following points:

1. The prospects for a private commercial heavy water production activity in the U. S.
2. The need for, and possible scope of, assistance by the Government in establishing such a commercial activity.
3. The role the AEC Savannah River heavy water plant might play in establishing a commercial activity.
4. If the market uncertainty precludes commercial interest at this time, the need for the Government to maintain a technical capability until the future direction is better defined.

Sincerely yours,

R. E. Hollingsworth

General Manager

D. C. OFFICE
OFFICE OF THE SECRETARY
U. S. ATOMIC ENERGY COMMISSION

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5	-----	G. F. Quinn			
6-8	-----	FD Files			
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MAY 14 1965

RECEIVED

RR
R Moore:mg
Lindsey

SEE ATTACHED YELLOW FILE COPY

274/35

Isotopes - Heavy Water
OFFICIAL USE ONLY

Res. & Status Br. - GTN

UNITED STATES GOVERNMENT

Memorandum

TO : Frank P. Baranowski, Director
Division of Production *Original signed by*
F. T. Hobbs for DATE: May 4, 1965

FROM : W. B. McCool, Secretary

SUBJECT: AEC 274/35 - OPERATION OF HEAVY WATER FACILITIES AT SAVANNAH RIVER PLANT

SECY: ICB

1. As you will recall, during discussion of AEC 274/35, at Meeting 2103 on April 29, 1965, the Commission agreed the heavy water plant at Savannah River should continue to be operated by E.I. du Pont de Nemours & Company at one-third capacity through this calendar year pending further review of the heavy water situation.

2. The General Manager has directed you to take the action required by the above decision. Copies of pertinent correspondence should be provided the Office of the Secretary.

cc:
Chairman
General Manager
Deputy General Manager
Asst. General Manager
Exec. Asst. to Gen. Mgr.
Asst. Gen. Mgr. for P&F
Director, Industrial Participation
Controller
General Counsel

copy filed:
PLB.L.7 - Savannah

OFFICIAL USE ONLY

5-4-65

UNITED STATES GOVERNMENT

Memorandum

TO : **Ernest B. Tammol, Director**
Division of Industrial Participation

Original signed by **Frank P. Baranowski, Director**
Division of Production

FROM : *F. T. Hobbs* *for* **W. B. McCool, Secretary**

DATE: May 4, 1965

SUBJECT: **COMMERCIAL OPERATION OF THE HEAVY WATER PLANT AT SAVANNAH RIVER**

SECY: ICB

1. As you will recall, during discussion of ABC 274/35 - Operation of Heavy Water Facilities at Savannah River Plant, at Meeting 2103, on April 29, 1965, the Commission requested that staff discuss with AIF the possible formation of an appropriate committee to consider the question of commercial operation of the plant.

2. The General Manager has directed you to take the action required by the above request. Copies of pertinent correspondence should be provided the Office of the Secretary

- cc:
- Chairman
 - Commissioner Ramey
 - General Manager
 - Deputy General Manager
 - Asst. General Manager
 - Exec. Asst. to Gen. Mgr.
 - Asst. Gen. Mgr. for P&P
 - General Counsel
 - Controller

Copy filed:
Om-7-AIF

5-4-65

UNITED STATES GOVERNMENT

Memorandum

TO : File DATE: March 15, 1965

FROM : W. B. McCool, Secretary *Original signed
W. B. McCool*

SUBJECT: AEC 1177 - REQUESTS TO LEASE AEC MATERIALS BY VULCAIN
SECY:JCH

1. At Information Meeting 460 on March 12, 1965, the Commissioners accepted the Division of International Affairs' recommendation that AEC should offer to lease 3,000 kg of uranium and 10 metric tons of heavy water to Belgium for use in the Vulcain variable moderation reactor development project under the conditions outlined in Mr. Kratzer's February 12, memorandum.
2. It is our understanding the Division of International Affairs is taking the required action.

- cc:
- Chairman
 - General Manager
 - Deputy General Manager
 - Asst. General Manager
 - Exec. Asst. to Gen. Mgr.
 - Asst. Gen. Mgr. for IA
 - Director, International Affairs
 - Director, RD&T
 - General Counsel
 - Director, Production
 - Controller
 - Director, Congressional Relations

*Copy filed:
Materials - 3. Belgium*

3-15-65

DATE:

IN 3-11-65
To G. MERRITT & CO.

INDEX: Isotopes -HEAVY WATER

TO:

FROM:

SUMMARY: AEC 1177. REQUESTS TO LEASE AEC MATERIALS BY VULCAIN.

Request from Belgium to lease enriched uranium and heavy water for use in the VULCAIN variable moderation reactor development project. In view of the anticipated expiration of the U.S. Belgium bilateral agreement in July, the heavy water and enriched uranium would be made available under the US Euratom Additional Agree. as amended.

FILED: MATERIALS 2- BELGIUM

INDEXER: date 3-11-65

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOIS. BUCKNER DOE/NW-623

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

3-11-65

CROSS-REFERENCE <i>(Name, number, or subject under which this form is filed)</i>		
	➔	Isotopes Heavy Water
IDENTIFICATION OF RECORD	DATE	
	TO	
	FROM	
	BRIEF SUMMARY OF CONTENTS	Memo to the Gen. Mgr. requesting his approval for the purchase by the Canadian Gov. of 10,000 pounds of heavy water.
FILED <i>(Name, number, or subject under which the document itself is filed)</i>	Isotopes 3-2 Appli. and Requests date of memo: 9-3-64	

9-3-64

CROSS-REFERENCE <i>(Name, number, or subject under which this form is filed)</i>		
		
	Isotopes & Heavy Water	
IDENTIFICATION OF RECORD	DATE	
	TO	
	FROM	
	BRIEF SUMMARY OF CONTENTS	Memo to the Gen. Mgr. requesting his approval for the sale of 6 tons of heavy water to the Federal Republic of Germany,
FILED <i>(Name, number, or subject under which the document itself is filed)</i>	Isotopes 3-2 Appl. and Requests date of memo: 8-27-64	
<div style="text-align: right; font-size: 2em; font-weight: bold;">847-64</div>		
<p>Optional Form 21 Feb 1962 GSA Circular 280</p> <p style="text-align: center;">CROSS-REFERENCE</p>		

UNCLASSIFIED

AEC 983/4

May 22, 1964

COPY NO. 54

AEC
983
4

ATOMIC ENERGY COMMISSION

MISCELLANEOUS SMALL HEAVY WATER SALES

Note by the Secretary

The General Manager has requested that the attached memorandum from the Director of Production be circulated for the information of the Commission.

W. B. McCool
Secretary

<u>DISTRIBUTION</u>	<u>COPY NO.</u>
Secretary	1, 51-58
Commissioners	2 - 6, 59
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5-22-64

UNCLASSIFIED

OPTIONAL FORM NO. 10
5010-104

UNITED STATES GOVERNMENT

Memorandum

TO : A. R. Luedecke, General Manager
THRU: G. F. Quinn, AGMPE *[Signature]*
FROM : *[Signature]* P. P. Baranowski, Director
Division of Production

DATE: MAY 11 1964

SUBJECT: MISCELLANEOUS SMALL HEAVY WATER SALES

FRR:RJM

For the past several years, until 1963, the total of all miscellaneous small sales of heavy water to U.S. customers have averaged about 2,000 pounds per year. Some of this D₂O has been sold to universities and laboratories for research use and the remainder to U.S. companies.

Recently, small sales have increased, with a major part of the increase involving a single customer, Merck and Company. Sales to Merck totaled 2,250 pounds in 1963 and are estimated at 5,000 to 6,000 pounds in 1964. Merck indicates that they are making deuterized compounds for resale and have been pleasantly surprised at the current demand for these compounds.

We are aware that a significant part of our D₂O sales has been to firms that act as retail distributors. The distributors buy the AEC minimum quantity (125 pounds), or more, repackage and process the bulk D₂O into D₂ gas, deuterized compounds or smaller lots of D₂O. Except for an export license, there are no controls on the usage or sale of D₂O. However, the AEC has in force an arbitrary limitation on bulk sales to an individual purchaser that was established at the time when D₂O was in short supply; it was initially set at 500 pounds and later was relaxed to 2,000 pounds per year.

In the present instance, Merck indicated that the heavy water is being sent to one of their plants in Canada. In the case of shipments to Canada, a specific U.S. export license is not required if the material is to be reexported to the United States or consumed in Canada. However, for all exports to Canada there is a requirement that a "Destination Control Statement" be included with each shipment. This statement is to the effect that permission must be obtained from the United States prior to any export to a third nation. Therefore, if Merck exports deuterium from Canada, our Department of Commerce regulations would prevail and the AEC would be notified by the Department of Commerce. (There is no record in the Department of Commerce of exports from Canada.)

Our records show that Merck has already received 2,000 pounds this year and Savannah River expects another 2,000 pound order soon. Since there is no evidence of diversion to undesirable uses, we propose to authorize SR to fill the Merck order when it is received.

UNCLASSIFIED

For the longer term, we are considering removing the limit of one ton/year to a customer now imposed on SR. In its place we would substitute a requirement that the Production Division be notified prior to filling any single request for one ton or more and that all sales be reported semi-annually. The current supply of D₂O is ample and we expect to be able to fill all reasonable orders; however, the proposed reporting system would allow investigation of unusual sales.

CROSS-REFERENCE <i>(Name, number, or subject under which this form is filed)</i>	➔	Isotopes Heavy Water 
IDENTIFICATION OF RECORD	DATE	
	TO	
	FROM	
	BRIEF SUMMARY OF CONTENTS	AEC 208/3 - INQUIRY FROM BELGIUM CONCERNING SUPPLY OF HEAVY WATER Memo frm. Wells re the above.
FILED <i>(Name, number, or subject under which the document itself is filed)</i>	Isotopes 3-2 Applications and Requests date of paper: 4-22-64	

19-88-7

Isotope Heavy Water

WARREN G. MAGNISON, WASH., CHAIRMAN
 JOHN C. PASTORE, R.I.
 A. S. MIKE NOMINONY, OKLA.
 STROM THURMOND, S.C.
 FRANK J. LAUSCHE, OHIO
 RALPH YARBOROUGH, TENN.
 CLAIR ENGLE, CALIF.
 E. L. BARTLETT, ALASKA
 VANCE HARTKE, IND.
 GALE W. MCCOY, WYO.
 PHILIP A. HART, MICH.
 HOWARD W. CANNON, NEV.

MORRIS COTTON, N.C.
 THURSTON S. MOORE, N.Y.
 HUGH SCOTT, PA.
 WINSTON L. PRUDY, VT.
 J. GLENN BEALL, MD.

United States Senate

COMMITTEE ON COMMERCE

March 5, 1964

EDWARD JARRETT, CHIEF CLERK

DD-379.5
e/l
SM/R-com

Hon. Glenn Seaborg, Chairman
 Atomic Energy Commission
 Washington 25, D.C.

Dear Chairman Seaborg:

Attached you will find an article which appeared this week in The Augusta Chronicle concerning the production and sale of heavy water.

As you recall I raised similar points during the February meeting in Senator Russell's office and it is my hope the Commission will give this matter careful study and take whatever action would be in the best interests of this nation's program in this field.

With best wishes,

Sincerely,

Strom Thurmond

Strom Thurmond

ST:k

RECEIVED
 U.S. SENATE
 MARCH 10 1964

3-5-64

SRP threat seen in Canadian plan

Special to The Chronicle

WASHINGTON — Planned construction of a "heavy water" production plant in Canada poses a threat to output of the Savannah River Plant at Aiken and could take the U.S. out of the world market in that field, a nuclear expert warned here Tuesday.

The prediction came from Robert Gifford, executive director of the Southern Interstate Nuclear Board, in a briefing for Senate employees on activities of that body.

This country is now selling "heavy water" at \$24.50 per pound, Gifford said, whereas the Canadians plan to produce at about \$20.50 — partially through national subsidy of the coal used in production.

The U. S. currently supplies not only its own "heavy water" requirements, he reported, but since 1959 has sold more than 1.6 millions pounds to foreign nations — about 551,000 pounds of that to Canada.

This government, he added, has even aided Canada to the extent of a \$5 million subsidy of heavy water moderated reactor development there, with another \$5 million proposed.

Gifford also noted that enriched uranium, provided to operate reactors throughout the free world, has reached a depletion cycle which requires refuel-

ing and recovery of spent fuel elements.

The United Kingdom, he said, is making a strong bid for the research fuels that will put it in favorable positions also to get power fuels for reprocessing.

He speculated, however, that the U. S. might be able to meet that competition by handling its own reprocessing at the Savannah River Plant instead of in a facility in Idaho — a move he said would result in considerably lower cost.

In that connection he cited a 46-ton shipment of spent fuel off-loaded at the port of Savannah and shipped to Idaho for reprocessing. Had the shipment been sent to the Aiken plant instead there would have been a freight saving of some \$8,000 on the single consignment, he said.

A Savannah River Plant spokesman said there is nothing new about the announcement. He said Canada stated some time ago it had plans for a heavy water plant.

Canada has been a big user of heavy water, he said.

The spokesman said Canada has done much work in the development of heavy water cooled power reactors using natural uranium. The U. S. Atomic Energy Commission has cooperated closely in this work he said.

Isotopes - Heavy Water
~~OFFICIAL USE ONLY~~

Reference Section

UNITED STATES GOVERNMENT

Memorandum

TO : File

FROM : W. B. McCool, Secretary

SUBJECT: GERMAN PURCHASE OF HEAVY WATER

SECY:McQ

DATE: February 7, 1964

*Original signed by
F. T. Hobbs*

1. At Information Meeting 347, on February 5, 1964, the Commissioners had no objection to the General Manager's proposal to approve the sale of 32 metric tons of heavy water to the Nuclear Research Center at Karlsruhe, Germany.

2. Attached is a copy of the January 31, 1964 memorandum by the Director of International Affairs which was the basis of the General Manager's discussion.

Attachment:
As noted above

- cc:
- Chairman w/o attachment
 - General Manager w/o attachment
 - Deputy General Manager w/o attachment
 - Asst. General Manager w/o attachment
 - Director, International Affairs w/o attachment
 - Controller w/o attachment
 - General Counsel w/o attachment

*copy filed:
Isotopes 3-2*

~~OFFICIAL USE ONLY~~

2-7-64

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE: October 14, 1963

INDEX: ISOTOPES 3 - Heavy Water ✓

~~IA-5 BRITIAN~~
~~IA-5 ISRAELI~~

TO: Commissioners

FROM: A. W. Betts, DMA

SUMMARY: TRIPARTITE UK-FRANCE-ISRAELI AGREEMENT ON THE USES OF HEAVY WATER - Memo from A. W. Betts

FILED: IA-5 BRITIAN

~~INDEX:~~ Date of memo: 10/14/63

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JCL/...

10-14-63

DATE:

INDEX: Isotopes Heavy Water

TO:

FROM:

SUMMARY: Ltr. to Mr. Bundy stating that the Gov. of Israel has requested the USAEC to furnish, under lease 4 tons of heavy water.

FILED: Isotopes Program 3-2 Applications and Requested

INDEXER: date of ltr: 7-1-63

REMARKS:

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DOE NSI DECLASSIFICATION REVIEW D.O. 12328
BY JOIS. BUCKNER DOE/NN-628

U. S. ATOMIC ENERGY COMMISSION

CORRESPONDENCE REFERENCE FORM

7-1-63

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE:

~~ISOTOPES-3-HeavyWater~~

~~ISOTOPES-3-HeavyWater~~

INDEX: ISOTOPES-3-HeavyWater

TO: Commissioner Wilson

FROM: George Quinn, Assistant GM for Plans and Production

SUMMARY: This memo is in response to Commissioner Wilson's memo of 4-8-63 forwarding a copy of a letter from Mr. J. Lorne Gray, President, AECL regarding possible future AEC sales of heavy water to AECL.

FILED:

INDEXER: IA-2-Canada, Bil. Agree.

REMARKS: date of memo: 4-15-63

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOI S. BUCKNER DOE/NN-823

47563

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE:

INDEX: Isotopes Heavy Water

TO:

FROM:

SUMMARY: AEC 863/1 - HEAVY WATER AND URANIUM ON LOAN TO CANADA
To determine the position to be taken by AEC
with respect to heavy water and natural uranium
loaned to Canada by MED during World War II
but now claimed by Canada.

FILED: Materials 3 Canada

INDEXER: date of paper: 3-4-63

REMARKS:

5-4-63

Isotypes - Heavy Water

UNITED STATES GOVERNMENT

OFFICIAL USE ONLY

Reference Section

Memorandum

TO : **Algie A. Wells, Director**
Division of International Affairs

DATE: **January 3, 1963**

FROM : **W. B. McCool, Secretary** *Original signed
W. B. McCool*

SUBJECT: **LEASING OF HEAVY WATER ABROAD**

SECY:McQ

1. At Information Meeting 227 on December 31, 1962, the Commissioners discussed policy established in August 1958 (AEC 983/1) which permits lease of heavy water for use in domestic or foreign research, medical and testing reactors in quantities of one short ton or more for the initial inventory requirement of the reactor.

2. The Commissioners agreed that the lease of heavy water for the "initial inventory" included the leasing of sufficient heavy water for use while the "initial inventory" was being purified.

3. The General Manager has directed that you take the action necessary to carry out the above decision.

cc:

Chairman
General Manager
Deputy General Manager
Assistant General Manager
Asst. Gen. Mgr. for I.A.
Asst. Gen. Mgr. for R&D
Asst. Gen. Mgr. for P&P
Director, Industrial Participation
Director, Production
Director, Reactor Development
Controller
General Counsel

~~OFFICIAL USE ONLY~~

1-3-63

Isotope Heavy Water

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. E-457
Tel. HAZELWOOD 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Thursday, December 13, 1962)

AEC REDUCES SALE PRICE OF HEAVY WATER

The Atomic Energy Commission has reduced the sale price of heavy water from \$28 to \$24.50 per pound, f.o.b. Savannah River Plant, Aiken, South Carolina, effective immediately.

The \$28 price which included an allowance for depreciation was established in 1955. The new price has resulted principally from a reduction in the depreciation charges based on a recent study of the service life of the AEC's heavy water facilities in South Carolina. The study, based on inspection and maintenance records during the ten-year operating period of the heavy water facilities, indicated the facilities could be operated over a longer period of time than originally estimated.

The base charge for heavy water leased by the Commission has also been reduced to \$24.50 per pound. This price reduction is effective January 1, 1963, for those leases which do not have a fixed base charge. The price is based on a continuation of the current level of production from the Savannah River Plant. The AEC will consider a further reduction in its price for heavy water if commitments from customers require operation of the heavy water plant at increased capacity.

Heavy water is water that contains a greater amount of the heavy hydrogen isotope (deuterium) than is found in ordinary water. It is used in reactors to moderate or slow down neutrons so that they will more readily split fissionable materials, such as uranium 235, to create a chain reaction. It is used also as a coolant, to remove heat from reactor cores. Heavy water is separated from ordinary water in a special facility at the AEC's Savannah River Plant.

(more)

Copies filed:
1 - Mr. A. S. Aronson, Atomic Policy
1 - Mr. E. S. Cramer, AEC, Office
1 - Mr. J. R. Doolittle, AEC, Office

12-13-62

The cost of heavy water for use in a central station electrical generating plant, powered by a heavy water-moderated and -cooled reactor, represents a substantial portion of the initial cost of such a facility. The reduction in cost of heavy water will reduce the capital cost of heavy water power reactor plants and will enhance their potential for producing economic nuclear power. It is expected that the cost of electricity produced by such plants may be reduced by about 0.2 mills per kilowatt hour. The new heavy water price is expected to encourage more favorable consideration of the construction of heavy water reactor plants both in the U. S. and abroad.

The Commission has a development program to determine the potential of various types of heavy water moderated, natural uranium fueled reactors. This program, administered by the Commission's Savannah River Operations Office, includes operation of the Heavy Water Components Test Reactor near Aiken, South Carolina; research and engineering effort necessary to develop economical power from reactors of the heavy water type; a cooperative development program with Canada; exchange of information on heavy water reactors with several foreign countries; and administration of the research and development program for the 17,000 electrical kilowatt heavy water power reactor at Parr, South Carolina, by the Carolinas-Virginia Nuclear Power Associates, Inc. In addition, the AEC's Plutonium Recycle Test Reactor at Richland, Washington, is a heavy water moderated type reactor.

(NOTE TO EDITORS AND CORRESPONDENTS: This information is being issued simultaneously by the Commission's Savannah River Operations Office in Aiken, South Carolina.)

12/13/62

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE:

INDEX: Isotopes Heavy Water

TO:

FROM:

SUMMARY: Ltr. to AEC frm. Mr. Urey stating that he recently became associated with Deuterium Corp. which is interested in establishing a small scale heavy water plant & engage in private commercial production of deuterium and its related products.

FILED: IR&A 3 Industrial Participation

INDEXER: date of ltr: 12-3-62

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12065
BY JOI S. BUCKNER DOE/NW-523

17-3-62

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE:

INDEX: ISOTOPES-HEAVY WATER

TO:

FROM:

SUMMARY: AEC 1043/8: LEASE OF HEAVY WATER FOR USE IN CANADIAN CANDU POWER REACTOR. To consider whether the heavy water to be supplied to Canada by the AEC for the CANDU reactor, under our cooperative program for the development of heavy water moderated power reactors, should be leased.

FILED:

INDEXER: IA-2-Canada, Bil. Agree. with

REMARKS: date of paper: 9-7-62

Isotope Heavy Water

SEP 4 1962

Dr. R. D. Macdonald
Deputy Director
National Bureau of Standards
U. S. Department of Commerce
Washington 25, D.C.

Dear Dr. Macdonald:

The Commission has considered your request for obtaining heavy water for the Bureau's Research Reactor, WRR, and has determined that the heavy water you require will be furnished on a sale or lease basis, at your option.

On a lease basis, the heavy water will be made available with no charges by the Commission except for those costs actually incurred in connection with the lease: this means that essentially the Bureau would pay for losses, contamination, shipping, and so on. The term of the lease could be for a period up to five years.

On a sale basis, the heavy water would be furnished at our cost, excluding depreciation and all administrative expenses, at the time the water is shipped. Each unit of the product sold is approximately 25.00 pounds.

Since all heavy water transfers are handled by our Savannah River Operations Office, please notify Mr. R. G. Blair, Manager, of the arrangement you prefer and he will prepare the necessary instrument.

Any additional information required by your office may be obtained from Mr. W. A. Stahlberg, Technical and Distribution Director, Savannah River Operations Office, P. O. Box 16, Aiken, South Carolina.

Sincerely yours,

cc: R. G. Blair, Manager, SR
CJ
AGIRD
CC
CSE

SIGNED, A. R. HUEBCKE

Control Manager

Typed 8/24/62
JERLanschme

RD:O CSE CC
Kratz 8/17/62 8/1/62 8/1/62

RD:SR RD:SA RD:O AGIRD LEM/PCM CC
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8/17/62 8/1/62 8/1/62 8/1/62 8/1/62 8/1/62

atc983/3

94-62

SEP 4 1962

Honorable Chas. McNiff
Chairman, Public Committee
on Atomic Energy
Congress of the United States

Dear Mr. McNiff:

The Commission has established a permanent policy of providing heavy water to other Government agencies on a lease basis. Such determinations will be made on a case-by-case basis.

Natural heavy water Government agencies will be at no charge, except for special costs incurred in connection with the lease--these would normally consist of charges for losses and transportation, but would not include use charges. The term of a lease would be for a period up to five years; this will not preclude renewals for subsequent periods.

Since to other Government agencies are priced at 1/10 cost, excluding depreciation and the price spread, as the case of the one is suggested. Such cost at the present time is approximately \$11.00 a pound.

No charges are made for a loan in connection with an agreement for the conduct of research by the recipient agency in which the AEC has a programmatic interest, providing such research is included in and is a part of work currently budgeted for under an AEC program.

Classification of the Commission's policy was investigated by a request from the National Bureau of Standards for heavy water for their research reactor to be located at Oak Ridge, Maryland. The arrangement for providing heavy water to the National Bureau of Standards will be on a lease or sale basis, at the option of NBS.

In view of the limited interest in this matter, no public announcement is contemplated.

Sincerely yours,

SIGNED, A. R. YUEDECKE

RD:CA	RD:D	RD:EE	OGC	OC	DPI	Production
Arrotta	Kratz	McGarry				

8/ /62	8/ /62	8/ /62	8/ /62	8/ /62	8/ /62	8/ /62
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RD:OR	RD:D	OGC. LIA.	AGIRD	AGI/DGI	GH
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8/20/62	8/ /62	8/ /62	8/ /62	8/ /62	8/ /62
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cc: AGIRD
 ✓GH
 (2) Cong.
 Lia.
 OGC
 OC
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 P

AEC 983/3

~~OFFICIAL USE ONLY~~

Isotopes - Heavy Water Reference Section

UNITED STATES GOVERNMENT

Memorandum

TO : Frank K. Pittman, Director
Division of Reactor Development

DATE: August 13, 1962

FROM : Harold D. Anamosa, Acting Secretary Original signed
H. D. Anamosa

SUBJECT: AEC 983/3 - SALE OR LEASE OF HEAVY WATER TO OTHER GOVERNMENT AGENCIES

SYMBOL: SECX:JCH

1. At Meeting 1864 on August 8, 1962, the Commission revised the language of its decision on AEC 983/3 - Sale or Lease of Heavy Water to Other Government Agencies at Meeting 1858 on June 29, 1962, as follows:

a. Established a permissive policy of providing heavy water to other Government agencies on a lease basis;

b. Noted that the permissive policy of providing heavy water to other Government agencies on a lease basis will be determined on a case-by-case basis. Pricing arrangements, consistent with present pricing policies, for sale, lease and loan are as follows. Sales to other Government agencies will be priced at AEC cost, less depreciation and the added factor, (currently about \$14 per pound). Material leased to other Government agencies will be at no charge, except for actual costs incurred in connection with the lease -- these would normally consist of charges for losses and contamination but would not include use charges. The term of a lease would be for a period up to five years; this will not preclude renewals for subsequent periods. No charge will be made for a loan in connection with an agreement for the conduct of research by the recipient agency in which the AEC has a programmatic interest, providing such research is included in and is a part of work currently budgeted for under an AEC program.

c. Noted that the NCAE will be advised of this action by a letter such as that contained in Appendix "B" as revised, to AEC 983/3;

d. Noted that a public announcement will not be issued; and

e. Noted that AEC 983/3 is unclassified.

~~OFFICIAL USE ONLY~~

8-13-62

~~OFFICIAL USE ONLY~~
~~CONFIDENTIAL USE ONLY~~

Frank K. Pittman
(AEC 983/3)

-2-

August 13, 1962

2. On June 29 we also informed your office of the appropriate revisions to be made in the letter to the JCAE in accordance with the Commission's action in paragraph 1 above.

3. The General Manager has directed you to take the action required by the above decision. It is our understanding that your office will prepare the correspondence to the JCAE. A copy of this letter together with other pertinent correspondence should be provided the Office of the Secretary.

cc:
Chairman
General Manager
Deputy General Manager
Asst. General Manager
Asst. Gen. Mgr. for Research and Development
General Counsel
Controller
Congressional Liaison

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~~CONFIDENTIAL USE ONLY~~

Isotope Heavy Water

UNITED STATES GOVERNMENT

Memorandum

TO : Frank K. Pittman, Director
Division of Reactor Development

DATE: June 29, 1962

FROM : W. B. McCool, Secretary ^{Original signed}
W. B. McCool

SUBJECT: AEC 983/3 - SALE OR LEASE OF HEAVY WATER TO OTHER GOVERNMENT AGENCIES

SYMBOL: SECY:WLV

1. We informed your office on June 29, 1962, that at Meeting 1858 on June 26 the Commission:

a. Established a permissive policy of providing heavy water to other Government agencies on a lease basis; ~~with the following exception:~~

~~A loan in connection with an agreement for the conduct of research by the recipient agency in which the AEC has a programmatic interest, provided such research is included in and is a part of work currently budgeted for under an AEC program.~~

b. Noted that the JCAE will be advised of this action by a letter such as that contained in Appendix "B" as revised, to AEC 983/3;

c. Noted that a public announcement will not be issued; and

d. Noted that AEC 983/3 is unclassified.

2. On June 29 we also informed your office of the appropriate revisions to be made in the letter to the JCAE in accordance with the Commission's action in paragraph 1 above.

3. The General Manager has directed you to take the action required by the above decision. It is our understanding that your office will prepare the correspondence to the JCAE. A copy of this letter together with other pertinent correspondence should be provided the Office of the Secretary.

- cc:
- Chairman
- General Manager
- Deputy General Manager
- Asst. General Manager
- Asst. Gen. Mgr. for Research and Development
- General Counsel
- Controller
- Congressional Liaison

Copy filed: PTB & 50-Res. Center for Gov. Agencies

6-29-62

Intercept - Heavy Water

135

June 28, 1962

MEMORANDUM FOR THE CHAIRMAN

RE: Comments on Commission Action on AEC 983/3 "Sale or Lease of Heavy Water to Other Government Agencies"

The Secretary has advised me that after discussion of AEC 983/3 at the meeting on Tuesday, June 26th, and subsequent to my departure from the meeting, the Commissioners rejected the recommendations of the staff and approved a policy of leasing heavy water on a long term basis to other government agencies. I understand that, because I had previously consented to the paper, the Commission action was taken subject to my comments.

I further understand that the decision to reject the staff recommendations, was based on Dr. Pittman's oral statement that he had reluctantly concurred in the staff paper, but that he preferred leasing rather than sale. Apparently his rationale was his belief of consistency with our policy of leasing special nuclear materials to other agencies, and also with the policy of leasing heavy water to private reactor operators, domestic and foreign.

I believe that argument for consistency would not persuade me to approve a policy of leasing heavy water in "perpetuity" to other government agencies. First the leasing of special nuclear materials is of limited duration in that they must be returned for reprocessing and also the agencies must pay for the burn up.

Secondly the relationships between government and industry and between government agencies are different in many areas. The so-called "integrity of appropriations" mentioned in the staff paper is a principle of long standing and has been a source of many "battles" between the Congress and executive agencies and departments. The Congress maintains, and rightfully so, that the only control and accounting for programs is through the appropriation process. Agencies have been "called" many times for alleged circumvention of the will of Congress by indirectly supplementing the funding of programs by various methods.

6-28-62

Third, even if the Commission were to adopt Dr. Pittman's philosophy as policy it would not, in my opinion, eliminate this Congressional problem. Likewise, the Bureau of the Budget has the primary responsibility in this area of "integrity of appropriations", and any proposal which affects the funding of programs would need SOB approval.

For these reasons I concurred in the staff paper as presented to the Commission, and I would be unable to join in a change from the original staff proposal.

John S. Graham

cc: Dr. Wilson
Mr. Olson
Dr. Harvorth
General Manager
Secretary ✓

June 25, 1962

COPY NO. 55

ATOMIC ENERGY COMMISSION

CORRECTION TO AEC 983/3

SALE OR LEASE OF HEAVY WATER TO OTHER GOVERNMENT AGENCIES

Note by the Secretary

The Director, Division of Reactor Development, has requested that the following changes be made in the paper:

a. At the top of page 3, delete "found it would be illegal to offer" and insert "indicating that GAO frowns on" in lieu thereof.

Done

b. On page 6, delete last sentence of paragraph 3.

W. B. McCool

Secretary

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June 19, 1962

AEC 983/3

COPY NO. 55

AEC
983
3

ATOMIC ENERGY COMMISSION

SALE OR LEASE OF HEAVY WATER TO OTHER GOVERNMENT AGENCIES

Note by the Secretary

The General Manager has requested that the attached report by the Director of Reactor Development be circulated for consideration by the Commission at an early date.

W. B. McCool

Secretary

<u>DISTRIBUTION</u>	<u>COPY NO.</u>
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ATOMIC ENERGY COMMISSION

SALE OR LEASE OF HEAVY WATER TO OTHER
GOVERNMENT AGENCIES

Report to the General Manager by the Director,
Division of Reactor Development

THE PROBLEM

1. To consider establishing a policy for supplying heavy water to other Government agencies.

BACKGROUND & SUMMARY

2. At Meeting 1395 on August 8, 1958, after consideration of AEC 983/1, the Commission approved a policy to permit lease or sale of heavy water for use in domestic or foreign research, medical or testing reactors. For domestic research or medical reactors, the lease would be for the period for which the reactor is licensed. The paper did not mention Government operated reactors, but reactors licensed under Section 104 of the Atomic Energy Act or similar types of reactors being built abroad in friendly nations would be covered. This paper proposes a policy under which heavy water would be sold to Government agencies.

3. In December, 1958, the National Bureau of Standards informed the AEC of its plans to construct a ten megawatt research reactor at its Gaithersburg site and requested information regarding the loan of heavy water for the reactor in order that a more realistic budget estimate could be made. The DRD staff informally advised the Bureau that although there was no clear policy on the furnishing of heavy water to other Government agencies, a loan appeared to be reasonable. Subsequently, after exchanges of correspondence, contacts with the Bureau, and further review of AEC policies, the Deputy General Manager, on June 12, 1961 informed NBS that it would waive the use charge for

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the SNM, but the heavy water would be provided on a "sale only" basis. Based on AEC's established policy for pricing sales to other Government agencies the price is about \$14.00 a lb. The purchase cost to NBS would be about \$1.8 million (130,000 lbs.). The heavy water is needed in FY 1963.

4. NBS informed AEC, by letter of November 2, 1961, that it did not budget for the heavy water and that appropriations for the reactor project are insufficient to cover the purchase of this material. NBS has indicated that, based on contacts with AEC representatives, it had not expected to be confronted with the need to finance the purchase of heavy water, and consequently that an AEC decision now to furnish the material only on a sale basis will constitute a serious hardship. (See Appendix "A") The Bureau requested that the problem be presented to the Commission in the interest of alleviating the difficulty. The NBS has not requested funds for the heavy water in its FY 1963 budget.

5. In a similar case, the Defense Atomic Support Agency (DASA) was advised that heavy water for the DASA-TRIGA reactor would be furnished by the AEC on a sale basis. Subsequently, DASA requested that the heavy water be provided on a temporary loan basis until it could budget for the material and the funds became available. The request for a temporary loan was approved, but the term of the agreement covering the loan was limited to one year. DASA has budgeted for the heavy water in FY 1963.

6. The arguments in favor of sale of heavy water to Government agencies are (a) the action would be in line generally with the Commission's general policy of furnishing materials and services to other Government agencies and would be consistent with action taken on DASA's request for heavy water (b) a GAO

OFFICIAL USE ONLY

decision on Section 601 of the Economy Act of 1932, ^{indicating that} ~~found it would~~
^{GAO found on} ~~be illegal to offer~~ a long term lease to other Government agencies
(this would not preclude a temporary lease of five years or less)
and (c) heavy water is a capital cost of the reactor, is accounted
for as such and its lease would be tantamount to a capital loan.

7. The principal argument in favor of lease is that reactors owned by Government agencies should be treated the same as domestic and foreign reactors (See AEC 983/1).

STAFF JUDGMENTS

8. The Office of the General Counsel and the Controller concur in the recommendation of this paper. The Division of Public Information concurs in the statement regarding a public announcement. The Division of Production has no objection to the recommendation of this paper.

CONCLUSION

9. The sale rather than lease of heavy water to other Government agencies appears to be consistent with general AEC established practices for providing materials or services to other Government agencies. However, it appears advisable to loan the material to NBS for a year provided NBS is unable to obtain sufficient appropriations in time to purchase it.

RECOMMENDATION

10. The General Manager recommends that the Atomic Energy Commission:

a. Establish a policy of providing heavy water to other Government agencies on a sale basis with the following exceptions:

(1) A temporary loan, if needed, for a period not to exceed one year to enable the Government agency involved to obtain appropriations for the purchase of the material.

(2) A loan in connection with an agreement for the conduct of research by the recipient agency in which the AEC has a programmatic interest, provided such research is included in and is a part of work currently budgeted for under an AEC program.

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b. Note that NBS will be offered heavy water on a temporary loan basis.

c. Note that the JCAE will be advised of this action by a letter such as that contained in Appendix "B";

d. Note that a public announcement will not be issued;

e. Note that this paper is unclassified.

LIST OF ENCLOSURES

	<u>PAGE NO.</u>
APPENDIX "A" - NBS Budget Officer's Memo.....	5
APPENDIX "B" - Proposed JCAE letter.....	6

UNITED STATES GOVERNMENT
MEMORANDUM

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

TO : Dr. I. C. Schoonover
Associate Director

FROM : Budget Officer

SUBJECT: Acquisition of Heavy Water for the Research Reactor

As you requested I have had my staff confirm your statements with regard to the manner in which we have treated the requirement for heavy water in our budgetary considerations of the Research Reactor.

During the stages of planning for the NBSR efforts were made to determine through both formal and informal contacts with representatives of the AEC by what method NBS would be able to obtain the required amount of heavy water. It was hoped that the AEC would exercise a precedent it set for non-government academic institutions, namely to grant a waiver of use charge on this material. We were, in fact, encouraged in this belief from preliminary negotiations with the AEC.

It appeared that the worst budgetary problem which NBS might be required to face would be the one resulting from an AEC decision that the Bureau rent this material. Therefore, in the light of the encouragement given and because we had no sound basis for defending such costs in our budget, we have not included at any time in our plans or budget presentations funds to finance the purchase of heavy water. A specific determination was not received from the AEC until the letter of June 12, 1961, from the Deputy General Manager indicated it would be necessary for us to purchase this material outright.

Original signed by, J. E. Skillington, Jr.
J. E. Skillington, Jr.

APPENDIX "B"

DRAFT LETTER TO THE JCAE

1. The Commission has established a policy clarifying its position on the furnishing of heavy water to other Government agencies.

2. The Commission will furnish heavy water to other Government agencies on a sale basis, the price reflecting AEC cost, less depreciation and the added factor, with the following exceptions:

a. A temporary loan, if needed, for a period not to exceed one year to enable the Government agency involved to obtain appropriations for the purchase of the material.

b. A loan in connection with an agreement for the conduct of research by the recipient agency in which the AEC has a programmatic interest, provided such research is included in and is a part of work currently budgeted for under an AEC program.

3. Clarification of the Commission's policy was instigated by a request from the National Bureau of Standards for heavy water for their research reactor to be located at Gaithersburg, Maryland. This action is in line generally with the Federal policy of furnishing materials and services to other Government agencies on a sales basis so as not to supplement the other agencies appropriation. ~~This is a requirement of the Economy Act of 1932.~~

4. In view of the limited interest in this action, no public announcement is contemplated.

HW

Val for file

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. D-192
Tel. Hazelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Friday, August 4, 1961)

**AEC TO REPROCESS HEAVY WATER FROM FOREIGN
REACTORS AT SAVANNAH RIVER PLANT**

A. R. Luedecke, General Manager of the U. S. Atomic Energy Commission has authorized its Savannah River Plant to perform heavy water reprocessing services for foreign reactor operators on condition that the heavy water was originally purchased from the Commission. No commercial facilities are available to perform this service.

Heavy water of 99.75 percent purity is produced in a heavy water extraction facility at the Savannah River Plant in South Carolina. It is used as a moderator to slow down neutrons in reactors during the fission process. Under agreements with foreign reactor operators, authorized under the Atomic Energy Act of 1954, heavy water which has become degraded during reactor operations will be shipped to the Savannah River Plant for reprocessing and refinement to restore the purity of the material. This service will assist reactor operators to improve reactor efficiency and reduce the amount of heavy water that must be purchased for replacement purposes.

Charges for this service will be set on the Savannah River Plant's cost for upgrading which is based on the percentage of deuterium oxide still remaining in the returned material. Heavy water can become diluted or degraded through absorption of atmospheric moisture and by dilution with light water.

Approximately 500 tons of heavy water produced at the Savannah River Plant have been sold to foreign nations since 1955.

- 30 -

copies *Initial:*
PL 1961-7- Chemical Processing
PL 1961-7- Savannah River

8-4-61

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. D-146
Tel. Hazelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Monday, June 5, 1961)

TWO RECORDS ESTABLISHED AS U. S. SELLS
169,500 POUNDS OF HEAVY WATER TO CANADA

The sale of 169,500 pounds of heavy water to the Government of Canada, the largest shipment made by the United States since it inaugurated its program for the sale of heavy water to foreign countries in 1955, resulted in a record quarter year total of 170,625 pounds for the period ending March 31, 1961. The combined sales, including 1,000 pounds to Norway and 125 pounds to Australia, at the established price of \$28 per pound, amounted to \$4,777,500.

Canada purchased the heavy water at a cost of \$4,746,000 for use in its natural uranium fueled, heavy water moderated, power reactor program. Most of the shipment, 159,500 pounds, will be employed in the 20,000 KWE prototype NPD-2 power demonstration reactor which is nearing completion at Rolphton, Ontario. This reactor is a prototype for the 200,000 KWE CANDU plant scheduled for completion at Douglas Point on Lake Huron in 1964. The other 10,000 pounds were sent to the Atomic Energy of Canada, Ltd., at Chalk River, Ontario, for use as supplemental heavy water in the NRX and NRU reactors.

Canada and the United States signed an agreement last year for a cooperative effort in developing heavy water moderated reactors.

During calendar 1960, the United States sold 27,335 pounds of heavy water for a total of \$765,380. Sales in pounds were: Australia, 1,000; Canada, 6,000; Japan, 6,835; and

(more)

6-5-61

Norway, 13,500. Heavy water was leased during 1960 to three foreign countries: France, 36,500 pounds; India, 500 pounds; and the Republic of West Germany, 2,000 pounds.

Pursuant to AEC policy, heavy water may be leased for use only in research, medical or testing reactors in quantities of one short ton or more for the initial inventory requirements of the reactor.

Since the first sale of heavy water in 1955, to March 31, 1961, the U. S. Government has sold 988,494 pounds of heavy water to foreign countries for a total of \$27,677,552. Sales in pounds are: Australia, 25,125; Belgium, 505; Canada, 453,500; Denmark, 12,787; France, 66,002; India, 42,020; Italy, 20,000; Japan, 26,835; Norway, 49,700; Republic of West Germany, 89,000; Sweden, 57,000; Switzerland, 36,000; and the United Kingdom, 110,020. Leases for the period were to Denmark, 22,046; France, 36,500; India, 30,000; and the Republic of West Germany, 2,000, for a total of 90,546 pounds.

Heavy water (deuterium oxide) is separated from ordinary water in a special facility at the Savannah River plant. Heavy water contains a heavy isotope of hydrogen known as deuterium which has an atomic weight of 2, compared with ordinary hydrogen's atomic weight of 1. Water has an average of one part of heavy water to 6,500 parts of ordinary water.

The advantage of using heavy water rather than light water as a reactor moderator is that fewer neutrons are lost. The neutron conservation makes possible the use of natural uranium fuels or fuels of low enrichment.

(NOTE TO EDITORS AND CORRESPONDENTS: This announcement is being distributed simultaneously in Aiken, South Carolina, by the Commission's Savannah River Operations Office.)

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

DATE:

INDEX: ISOTOPES-HEAVY WATER

TO:

FROM:

SUMMARY: AEC 293/49: HEAVY WATER TECHNOLOGY, IN EUROPE, 1960. This report summarizes information on heavy water technology in Europe obtained by an AEC team which visited the principal centers of heavy-water activity in France, Germany and Switzerland during the period June 21-29, 1960.

FILED:

INDEXER: Security-4-5-Visits to Foreign Countries

REMARKS: date of paper: 8-25-60

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOI S. BUCKNER DOE/NN-823

DATE:

INDEX:

IA 12 IAEA

~~IA-2 Agres. with Yugoslavia~~

~~CGN-7 JCAE~~

~~Isotopes Heavy Water~~

TO:

FROM:

SUMMARY: Ltr. to the JCAE informing them that the AEC has informed Yugoslavia that the requested heavy water is available under suitable arrangements established under IAEA procedures.

FILED: Isotopes 3-2 Applications & Requests

INDEXER: date of ltr: 8-9-60

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOIS. BUCKNER DOE/NN-623

U. S. ATOMIC ENERGY COMMISSION

CORRESPONDENCE REFERENCE FORM

8-9-60

AEC

Antoine S. Henry Water

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

PRESS RUN
FOR IMMEDIATE RELEASE
(Thursday, April 28, 1960)

No. C-79
Tel. HAZELWOOD 7-7831
Ext. 3446

**AEC SELLS 222,787 POUNDS OF HEAVY
WATER TO SIX COUNTRIES**

Chairman John A. McCone of the Atomic Energy Commission announced today that the Commission sold 222,787 pounds of heavy water to six countries in 1959. The Commission also leased 51,546 pounds of heavy water to two other countries.

The sales were to Canada, 98,000 pounds; West Germany, 71,000; Japan, 20,000; Denmark, 12,787; France, 11,000; and Switzerland, 10,000. Leases were to India, 29,500, and Denmark, 22,046.

Heavy water, or deuterium oxide, contains a heavy isotope of hydrogen known as deuterium which has an atomic weight of 2, compared to ordinary hydrogen's atomic weight of 1. Ordinary water has an average of one part of heavy water to 6,500 parts of natural water.

Heavy water plays an important part in the process of nuclear fission, or splitting of the Uranium-235 atom, in certain types of reactors. The heavy water slows neutrons to speeds at which they can be utilized to sustain fission reactions in reactors fueled with natural uranium.

The 1959 sales brought to 790,534 pounds the total quantity of heavy water sold to countries since 1955.

The purchasers and the amounts purchased in the 1955 through 1959 period are: Canada, 278,000 pounds; Britain, 110,020;

(more)

07-55/-

Italy, 20,000; Australia, 24,000; France, 66,002; Switzerland, 36,000; India, 42,020; Belgium, 505; Denmark, 12,787; Japan, 20,000; Norway, 35,200; Sweden, 57,000 and West Germany, 89,000.

The purchases through 1959 represent a gross return to the Government of \$22,134,952. The charge of \$28 per pound covers production costs and heavy water plant depreciation, plus Commission administrative costs. The purchaser also pays costs of packaging, handling and cost of a stainless steel container in which the water is shipped. Countries leasing the water pay the Commission 4 percent interest on the monetary value of the material.

Heavy water is separated from the raw water of the Savannah River in a special facility at the Commission's Savannah River Plant near Aiken, South Carolina.

(NOTE TO EDITORS & CORRESPONDENTS: This information is being released simultaneously by the Commission's Savannah River Operations Office at Aiken, South Carolina.)

42860

April 24, 1960

DISTRIBUTION

✓ Commissioner
✓ General Manager
✓ Secretary

MEMORANDUM FOR: THE GENERAL MANAGER

General:

At the Foreign Affairs Council dinner last evening the Chairman had a conversation with Governor Herbert Lehman. In the course of the conversation, Governor Lehman inquired about heavy water. He asked the nature of it, how it was used, and what the future of heavy water is. He then went on to say that Inasal was one of the leading producers of heavy water.

Would you please look into the validity of assertion that Inasal is a major producer of heavy water? I am not sure that this is the case.

The Chairman would like to write Governor Lehman and would, therefore, appreciate hearing from you in the next few days.

Edward C. Brown, Jr.
Special Assistant
to the Chairman

ECBrown/ha

4-26-60

Isotopes: Heavy Water

At: R. Luedecke, General Manager
(THRU) E. J. Bloch, Asst. Gen. Mgr. for Mfg.
G. F. Quinn
Director of Production

cc: E. Bloch
SROO
Secretariat
Gen. Counsel
React. Devel.
Finance

MODEL FORM OF HEAVY WATER LEASE

SYMBOL: FC:LWM

APR 1 1959

Aug

In a meeting on October 8, 1958, the Commission established a policy which would permit the leasing of heavy water for use in domestic or foreign research, medical and testing reactors in lieu of sale, at the requestor's option. Also, on October 21, 1958, the Commission approved a policy which would permit the lease of heavy water for the preoperational research and development phase of power and process heat reactor projects under authorized cooperative programs.

This is to advise you that for the implementation of these Commission actions, a form of lease has been prepared which will serve as a model for all domestic leases of heavy water. In addition, this model may be adapted for future leases of heavy water to foreign countries.

By memorandum dated March 19, 1959, the Director, Division of Reactor Development, delegated to the Manager, SROO, the responsibility to execute and administer all domestic lease agreements for heavy water. However, before entering into agreements providing for the delivery of heavy water of 10 tons and over, the Manager must first obtain the approval of the Director of Production.

The model lease form (Attachment A) was reviewed by and has the concurrence of the Divisions of Reactor Development, Finance and Production and the Office of General Counsel. As concurred in the model lease provides:

1. A term of years in accordance with AEC 983/1 and 983/2; i.e., (a) for domestic power and process heat reactors under authorized cooperative programs - the period of preoperational research and development and the period of the operating license, (b) for domestic research and medical reactors - the period of the operating license

(continued)

54-60

or such shorter period as the parties may agree upon, and (c) for domestic testing reactors, 5 years or such shorter period as the parties may agree, but subject to renewal during the period that special nuclear material is also leased for the reactor project.

2. Rate of use charge, base charge for the determination of the value of heavy water leased, and other charges such as for loss of material and charges for rental of shipping containers, are flexible and dependent upon the Commission's pricing policy.
3. For termination of the lease by the lessee at any time upon 30 days' written notice and without payment of cancellation charges.
4. For the return by lessee of heavy water at any time subject to meeting acceptability tests for contamination and dilution.
5. For the return by the lessee of unacceptable material for reprocessing at AEC's option.
6. For the right by the lessee to purchase any or all material under lease.
7. For the right to co-mingle material under Lease with the material owned by the lessee.

Provision is not made for AEC termination of the lease in the event heavy water is obtainable commercially.

Attachment

Heavy Water Lease Agreement, 2/11/60

DRAPP
2/11/60
KYLARS
OGD:LAN

UNITED STATES
ATOMIC ENERGY COMMISSION

HEAVY WATER LEASE AGREEMENT

THIS LEASE AGREEMENT (sometimes hereinafter referred to as the "Lease"), entered into this _____ day of _____, 19____, by and between the UNITED STATES OF AMERICA (hereinafter called the "Government"), acting through the UNITED STATES ATOMIC ENERGY COMMISSION (hereinafter called the "Commission") and (name, state, address) (hereinafter called the "Lessee");

WHEREAS, the Lessee desires to lease from the Commission a quantity of heavy water, as hereinafter defined, for use in its (research, etc.) reactor; and

WHEREAS, the Commission in furtherance of its responsibility to foster and encourage research and development activities in the field of atomic energy is willing to lease such heavy water upon the terms and conditions as provided herein; and

WHEREAS, this Lease is authorized by and executed under the Atomic Energy Act of 1954, as amended;

NOW, THEREFORE, the parties hereto do mutually agree as follows:

ARTICLE I - DEFINITIONS

As used in this Lease:

- a. The term "Act" means the Atomic Energy Act of 1954, as amended and as the same may be amended from time to time.
- b. The term "base charge" means the dollar amount per pound of heavy water meeting specifications, in effect as of the time any particular transaction under this Lease takes place, determined in accordance with established Commission pricing policy then in effect.
- c. The term "Commission" means the United States Atomic Energy Commission or any duly authorized representative thereof, including the Contracting Officer except for the purpose of deciding an appeal under the article entitled "Disputes".

- h. The term "Designating Officer" means the person selecting this Lease on behalf of the Commission and includes his successors or any duly authorized representative of such person.
- i. The term "established Commission pricing policy" means any applicable price or charge in effect at the time any particular transaction under this Lease takes place (i) published by the Commission in the Federal Register, or (ii) in the absence of such a published figure, determined in accordance with the Commission's pricing policies set forth in Part 1700 of the AEC Manual, a copy of which will be furnished Lessee upon request. The Commission's published prices and charges and Part 1700 of the AEC Manual may be amended from time to time.
- j. The term "heavy water" means deuterium oxide (D₂O).
- k. The term "persons acting on behalf of the Commission" includes employees and contractors of the Commission, and employees of such contractors, who implement or participate in the implementing of this Lease pursuant to their employment or their contracts with the Commission.
- l. The term "value of the material under Lease" means the dollar amount determined by multiplying the base charge by the total number of pounds, or fractions thereof, of heavy water issued and delivered to Lessee hereunder, minus the total number of pounds, or fractions thereof, of heavy water (i) returned in a form meeting specifications pursuant to Article X and (ii) for which payment has been made pursuant to Article VIII e. or IX and (iii) which the Commission has accepted for return pursuant to Article X e.
- m. The term "specifications" means the specifications for heavy water set forth in Article III.
- n. The term "rate of use-charge" means the Commission's daily rate of annual (365 days) use-charge in effect for the period covered by the Commission's invoice, determined in accordance with established Commission pricing policy then in effect, which rate of use-charge will be identical with the Commission's rate of use-charge for special nuclear material.

ARTICLE II - SCOPE

The Commission hereby leases to the Lessee under the terms and conditions set forth herein _____ pounds of heavy water for use as the initial inventory in the _____ reactor known as _____ located at _____ and having AEC Facility License Number _____. The heavy water leased hereunder will be delivered in accordance with Appendix A, attached hereto and made a part hereof, subject to the provisions of Article VII b.

ARTICLE III - SPECIFICATIONS

The specifications for the heavy water leased hereunder are as follows:

- a. D₂O content: equal to or greater than 99.75 mol per cent.
- b. D₂O₂ content: equal to or less than 1×10^{-5} grams per gram of heavy water.
- c. Specific conductivity: equal to or less than 15.0 microhm per centimeter.
- d. Color: none.
- e. Turbidity: clear.

ARTICLE IV - TITLE

Except as provided in Article VIII c., title to all heavy water furnished to Lessee under this lease shall at all times be and remain in the Government.

ARTICLE V - TERM AND TERMINATION

- a. Except as otherwise provided herein, Lessee shall have the right to possess and use the heavy water covered by this lease until _____ provided that this lease may be extended by the mutual agreement of the parties.
- b. The Commission may terminate this lease without liability as its part if Lessee's AEC Facility License is revoked or terminated pursuant to the provisions of the Act, or for Lessee's breach of the terms of this lease, or in time of war or national emergency as declared by Congress. In the event of termination of this lease for any of the reasons specified in this Article V b., the Commission shall have the right to require Lessee to return any or all heavy water leased hereunder which is in the Lessee's possession or control, notwithstanding any other provision of this lease which gives Lessee any right to pay for such material in lieu of return.
- c. Lessee may terminate this lease ^{at} any time upon thirty days' written notice to the Commission. Such termination shall not affect Lessee's obligations under the terms of this lease, which obligations have been incurred prior to the effective date of the termination.

- 4 -
4. Whenever this Lease has expired, or been terminated or cancelled, and Lessee shall have failed to return or pay for at least charges, material leased hereunder, the Commission shall have the right to enter upon Lessee's premises to recover or take possession of the material subject to this lease and to charge to the Lessee its full costs therefor, as determined in accordance with established Commission pricing policy then in effect.

ARTICLE VI - INSPECTION AND TESTING

Weight, deuterium content and other analytical measurements of the heavy water leased hereunder shall be ascertained and certified by the Commission or persons acting on behalf of the Commission, in accordance with its, or their, normal practice. The Lessee may in accordance with mutually accepted procedures test the heavy water to determine if it meets specifications prior to the delivery thereof by the Commission, but any claim of the Lessee that heavy water to be leased hereunder does not meet specifications, which is not submitted to the Commission prior to delivery thereof, is hereby waived.

ARTICLE VII - DELIVERY

- a. Heavy water leased hereunder will be shipped f.o.b. commercial conveyance at the Commission's Savannah River Plant, Daraburton, South Carolina, or such other Commission facility as the Commission may designate. Delivery of heavy water to a carrier for the account of Lessee shall be deemed delivery of heavy water to Lessee for the purposes of this lease.
- b. The Commission will make reasonable efforts to deliver heavy water at the time or time provided in Appendix A attached hereto but neither the Government, the Commission nor persons acting on behalf of the Commission shall be subject to any liability for any failure to do so.

ARTICLE VIII - CHARGES

Lessee shall pay to the Commission the total amount of the following charges:

- a. A use-charge determined by multiplying the Commission's rate of use-charge by the daily balance of the value of the material water leased.
- b. The Commission's service charges, if any, for withdrawal and packaging and other services enumerated in Article VI hereof determined in accordance with established Commission pricing policy then in effect.

- c. Except as otherwise provided in Article X c. or XIV a charge determined by multiplying the base charge by the total number of pounds, or fractions thereof, of heavy water which for any cause whatsoever including causes beyond the control and without the fault or negligence of Lessee, (i) is not returned to the Commission and (ii) although it is returned, does not meet specifications. Upon such payment title to any material so paid for shall vest in Lessee.
- d. The cost of handling and analyzing any heavy water returned to the Commission, whether accepted or not, determined in accordance with established Commission pricing policy then in effect.
- e. The cost of any analysis requested by Lessee determined in accordance with established Commission pricing policy then in effect.
- f. The Commission's charge, if any, for processing determined in accordance with Article X c. hereof.
- g. A charge for the use of each Commission-owned shipping container, determined in accordance with established Commission pricing policy then ⁱⁿ effect. For all containers not returned within the allowed or agreed upon time, or returned in a condition unacceptable to the Commission, Lessee shall pay the Commission's charge for the container determined in accordance with the established Commission pricing policy then in effect.

ARTICLE IX - UNEXPECTED LOSS

Lessee shall notify the Commission within 3 days after the occurrence of any extraordinary loss or contamination of heavy water leased hereunder. Subject to the provisions of Article XIV^a, and upon submission of a bill by the Commission in accordance with Article XIII b. (5), Lessee shall pay to the Commission an amount equal to the base charge multiplied by the number of pounds, or fractions thereof, of heavy water lost or contaminated through such occurrence.

ARTICLE X - RETURN OF HEAVY WATER TO THE COMMISSION

- a. Lessee shall return or pay for at base charges all heavy water leased hereby upon the expiration or earlier termination or cancellation of this lease, provided; however, that Lessee shall have the right to return or pay for at base charges such material at any time prior to such date, subject to the provisions of Article X ^c d.

* This reference applies to power Administration reactors. (AEC 951/2)

- b. Except as provided in (a) below, all heavy water subject to this lease returned to the Commission shall meet specifications. Heavy water returned will be weighed and analyzed by the Commission within a reasonable time after receipt thereof and will not be accepted as satisfying the provisions of this lease until such measurements indicate that specifications have been met. Heavy water not accepted will be held subject to Lessee's instructions for disposal at Lessee's expense. In the absence of such instructions, the Commission shall dispose of the material as it sees fit, at Lessee's expense.
- c. The Commission may at its sole discretion, elect to accept the return of heavy water not meeting specifications. If the Commission accepts such heavy water, Lessee shall pay a service charge for processing such returned heavy water so as to enable it to meet specifications. Such charge shall be determined in accordance with the established Commission pricing policy then in effect. Whenever heavy water returned by Lessee is subject to processing charges under this paragraph, Lessee shall continue to pay the use charge on such heavy water until expiration of the processing period as determined by the Commission, determined in accordance with the principles of Article VIII a.
- d. The Parties recognize and agree that the heavy water leased hereunder may be co-mingled with other quantities of heavy water owned by the Lessee. The Lessee's obligations hereunder shall be satisfied if either heavy water leased hereunder or an equivalent amount of heavy water meeting specifications is returned under the conditions of this Article X. It is hereby agreed that Lessee shall hold the Government, the Commission or persons acting on behalf of the Commission, harmless from any claims of third parties alleging rights in, or in connection with, the heavy water then co-mingled. Title to the Lessee-owned heavy water used in co-mingling shall rest in the Government upon acceptance of such material for return under this Article X.
- e. All heavy water returned to the Commission shall be delivered by Lessee to the Commission's Savannah River Plant, P.O. commercial conveyance at Darlington, South Carolina. Unless waived by the Commission, Lessee shall give the Commission at least fifteen days (15 days) written notice of intent to return heavy water. Lessee, at the time of shipment, shall notify the Commission of the date and method of shipment and expected date of arrival.

ARTICLE XI - CHANGES IN RATE OF USE CHARGE AND BASE CHARGE

- a. The rate of use charge and base charge are subject to change by the Commission in accordance with the Act.
- b. Any change in rate of use charge or base charge shall be effective on *prospectively* either July 1 or January 1, as stated in a notice of change published by the Commission. *in advance*
- c. Whenever the Commission changes the base charge, the value of the material under lease will be recomputed using the new base charge. The recomputed value of the material under lease will be used thereafter for all purposes under this lease.
- d. Lessee will be notified of any change in the value of the material under lease as a result of changes in the base charge. Lessee will promptly notify the Commission of any disagreement with, discrepancies, or errors in such notices.

ARTICLE XII - SHIPPING CONTAINERS

The heavy water leased hereunder shall be delivered and returned in containers owned by the Commission, unless otherwise agreed by the Parties. The Commission shall, if requested, furnish Lessee, F.O.B. commercial wharves at the Savannah River Plant, Darlington, South Carolina, suitable containers for the return of heavy water. Lessee agrees not to use Commission containers for any other purpose other than as a receptacle for heavy water, and to return said containers to the Commission, F.O.B. commercial wharves at the Savannah River Plant, Darlington, South Carolina, in a clean and undamaged condition within 90 days (or such longer period as may be agreed to by the Commission), after delivery to Lessee.

ARTICLE XIII - PERFORMANCE OF COMMISSION OBLIGATIONS; BILLING

- a. The Commission may fulfill its obligations under this Lease through the operator of any of its facilities.
- b. Billing for amounts due the Commission under this Lease will ordinarily be made
- (1) following the performance of any service,
 - (2) semi-annually for use charge,
 - (3) for the charges specified in Article VIII(c) hereof, upon the termination or earlier expiration or cancellation of this Lease.

(3) For charges relating to the use or non-use of containers following the termination of such charges.

(5) For charges due under Article IX, following notification provided in such Article.

d. All bills rendered by or on behalf of the Commission are due thirty days (30 days) from the date of invoice. Payment received after thirty days (30 days) from date of invoice shall entitle the Commission to an additional charge of 6% per annum on such amount.

ARTICLE XIV - THESE CONTRACTS; AMENDMENT

It is recognized that Lessee and the Commission have heretofore entered into Contract No. _____ dated _____ concerning _____. The Lessee's responsibilities and liabilities under this Lease including liability under Article VIII d., and VIII e., and IX, are subject to the provisions of said contract.* Nothing in this Lease shall be deemed to obligate Lessee to pay the Commission's charges with respect to heavy water and/or services subject to this Lease, or to observe other specific provisions of this Lease if the Commission, in accordance with statutory or other authority available to it, determines that such charges, or other provisions, are not applicable to this Lease.

ARTICLE XV - INJURY OR DAMAGE

Neither the Government, the Commission, nor persons acting on behalf of the Commission make any warranty or other representation expressed or implied that heavy water furnished subject to this Lease (a) will not result in injury or damage when used for the purpose for which it is intended, (b) will accomplish the results for which it is requested from the Commission, or (c) is safe for any other use. The Lessee shall hold the Government, the Commission and persons acting on behalf of the Commission harmless from any damages resulting from the use or possession of heavy water by the Lessee pursuant to this Lease.

ARTICLE XVI - ASSIGNMENT

Lessee may not assign this Lease nor transfer the heavy water furnished hereunder beyond its control, without the express written approval of the Commission.

ARTICLE XVII - INSURE INDemnIFICATION

Unless expressly waived in writing by the Commission, the Lessee agrees to indemnify the Government, the Commission, and persons acting on behalf of the Commission against liability, including costs and expenses incurred, for

* This reference applies to power demonstration reactors (AWC 583/2)

infringement of any letters Patent occurring in the course of the performance of any service, analysis or test performed for Lessee as a result of following specific instructions of Lessee in connection therewith, or occurring in the utilization by Lessee of any material provided hereunder; provided, that insofar as such materials are prepared or used or services utilized in the performance of a Government contract, this indemnity agreement shall not apply and the terms of such contract shall govern the rights of the parties.

ARTICLE VIII - RIGHT TO USE AND PUBLISH INFORMATION

The Commission shall have the right to publish and use any information or data acquired by the Commission or persons acting on behalf of the Commission as a result of any service, analysis or test performed hereunder for the Lessee.

ARTICLE IX - DISPUTES

a. Except as otherwise provided in this lease, any dispute concerning a question of fact arising under this lease which is not disposed of by agreement shall be decided by the Contracting Officer, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to Lessee. The decision of the Contracting Officer shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the Lessee mails or otherwise furnishes to the Contracting Officer a written appeal addressed to the Commission. The decision of the Commission or its duly authorized representative for the determination of such appeals shall be final and conclusive unless determined by a court of competent jurisdiction to have been fraudulent, or capricious, or so grossly erroneous as necessarily to imply bad faith, or not supported by substantial evidence. In connection with any appeal proceeding under this Article, the Lessee shall be afforded an opportunity to be heard and to offer evidence in support of its appeal. Pending final decision of a dispute hereunder, Lessee shall proceed diligently with the performance of the Lease and in accordance with the Contracting Officer's decision.

b. This "Disputes" article does not preclude consideration of law questions in connection with decisions provided for in paragraph (a) above; provided, that nothing in this lease shall be construed as making final the decision of any administrative official, representative, or board on a question of law.

ARTICLE X - LAW, REGULATIONS AND ORDINANCES

Except as otherwise authorized by the Commission, the Lessee shall abide by all applicable laws, regulations and ordinances of the United States or of any State, territory or political subdivision.

ARTICLE XII - OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this Lease or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this Lease if made with a corporation for its general benefits.

ARTICLE XIII - WARRANTY AGAINST CONTINGENT FEE

The Lessee warrants that no person or selling agency has been employed or retained to solicit or secure this Lease upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Lessee for the purpose of securing business. For breach or violation of this warranty the Government shall have the right to cancel this Lease without liability or in its discretion to deduct from the Lease price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

ARTICLE XIII - NOTICES

a. Any notices required by this Lease of the Lessee shall be submitted in writing to the Commission addressed to:

United States Atomic Energy Commission
Savannah River Operations Office
Post Office Box A
Aiken, South Carolina

b. Any notices required by this Lease of the Commission shall be submitted in writing to the Lessee addressed to:

IN WITNESS WHEREOF, the parties have executed this Lease Agreement the day and year first above written.

THE UNITED STATES ATOMIC ENERGY COMMISSION

BY _____
(Contracting Officer)

WITNESSES: _____
(Lessee)

BY _____

TITLE _____

~~OFFICIAL USE ONLY~~*Antelope Prog. Heavywater*

Office Memorandum • UNITED STATES GOVERNMENT

TO : The Files

DATE: November 12, 1958

FROM : Robert D. *CPD* Coppedge

SUBJECT: COMMISSION DECISION ON AEC 983/2 - LEASE OF HEAVY WATER FOR USE IN POWER REACTORS UNDER AUTHORIZED PROGRAMS

During consideration of AEC 983/2 - "Lease of Heavy Water for Use in Power Reactors Under Authorized Programs", at Meeting 1415 on October 21, 1958, the Commission approved a policy which would make available at no charge heavy water for the first five years of reactor operation, and suggested the opinion of the Ad Hoc Advisory Committee on Reactor Policies and Programs be obtained as to leasing heavy water beyond this period.

On November 7, 1958, Mr. Paul Fine, Director, Office of Operations Analysis and Forecasting, advised that the matter was discussed with the Ad Hoc Advisory Committee and, by agreement between the Committee, the General Manager and the Assistant General Manager for Research & Industrial Development, the Committee could not furnish this opinion.

Therefore, no further action by the Office of the Secretary on this matter is contemplated.

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11-12-58

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Office Memorandum • UNITED STATES GOVERNMENT

TO : Frank K. Pittman, Acting Director
Division of Reactor Development

DATE: October 23, 1958

FROM : W. B. McCool, Secretary

SUBJECT: COMMISSION DECISION ON AEC 777/75 - MODIFICATIONS TO THIRD INVITATION
UNDER POWER DEMONSTRATION REACTOR PROGRAM

SYMBOL: SECY:RVW

1. This will confirm that at Meeting 1415 on October 21, 1958, the Commission:

a. Approved modifications to the third invitation under the Power Demonstration Reactor Program as described in the draft public announcement attached as Appendix "A" to AEC 777/75;

b. Noted that the announcement will include provision for special arrangements with respect to heavy water in accordance with the Commission's decision on AEC 983/2;

c. Noted that notification will be made as follows:

(1) A public announcement similar to Appendix "A" to AEC 777/75 will be issued.

(2) Letters similar to Appendix "B" to AEC 777/75 will be sent to the JCAE and GAC.

d. Noted that AEC 777/75 is unclassified.

2. The General Manager has directed that you take the action necessary to implement this decision. This will also confirm our understanding that your office is preparing the letters to the JCAE and the GAC. Copies of these and any other pertinent correspondence should be provided the Office of the Secretary.

cc: General Manager
Asst. Gen. Mgr. for Adm.
Asst. Gen. Mgr. for R&ID
General Counsel
Controller
Director, Industrial Development
Director, Information Services
Congressional Liaison
D. C. Office

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Copy filed: SH 6-P DRD

16-23-58

~~OFFICIAL USE ONLY~~*Isotope 3 - Heavy Water**Yellow***Office Memorandum • UNITED STATES GOVERNMENT**TO : Frank K. Pittman, Acting Director
Division of Reactor Development

DATE October 23, 1958

FROM : W. B. McCool, Secretary

SUBJECT: COMMISSION DECISION ON AEC 983/2 - LEASE OF HEAVY WATER FOR USE IN POWER
REACTORS UNDER AUTHORIZED PROGRAMS

SYMBOL: SECY:RVW

1. This will confirm that at Meeting 1415 on October 21, 1958, the Commission:

a. Approved a policy which would permit the lease, under the conditions set forth in paragraph 3 ~~above~~, of heavy water for the pre-operational research and development phase of power and process heat reactor projects under authorized cooperative programs;

b. Approved a policy which would make available at no charge heavy water for the first five years of reactor operation;

c. Noted that the JCAE will be notified of this decision by letter similar to Appendix "B" to AEC 983/2, as revised;

d. Noted that a public announcement of this decision will be contained in the proposed modification to the Third Invitation, PDRP (see AEC 777/75); and

e. Noted that AEC 983/2 is unclassified.

2. The General Manager has directed that you take the action necessary to implement this decision. This will also confirm our understanding that your office will prepare the revised letter to the JCAE. Please provide a copy of this letter and any other pertinent correspondence to the Office of the Secretary.

cc: General Manager
Asst. Gen. Mgr. for Adm.
Asst. Gen. Mgr. for R&ID
General Counsel
Controller
Director, Industrial Development
Director, Information Services
Congressional Liaison
D. C. Office

~~OFFICIAL USE ONLY~~*10-23-58*

DATE:

INDEX: Isotopes Heavy Water

TO:

FROM:

SUMMARY: AEC 771/75 - NO DIFFICULTIES TO THIRD INVITATION UNDER POWER
DEMONSTRATION REACTOR PROGRAM
Paper has to do with funds which will be available to the
Commission which may provide for the waiver by the Commission
of its charges for the use of heavy water not to exceed
5 years under the PDRP and public announcement of each
reactor project the Commission considers desirable for
construction.

FILED: IR&A 6 PDRP

INDEXER: date of paper: 10-16-58

REMARKS:

CONFIRMED TO BE UNCLASSIFIED
DOE NSI DECLASSIFICATION REVIEW E.O. 12958
BY JOIS. BUCKNER DOE/NSI-423
U. S. ATOMIC ENERGY COMMISSION

CORRESPONDENCE REFERENCE FORM

10-16-58

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October 16, 1958

AEC 983/2

COPY NO. 36

ATOMIC ENERGY COMMISSION

LEASE OF HEAVY WATER FOR USE IN POWER REACTORS
UNDER AUTHORIZED PROGRAMS

Note by the Secretary

The General Manager has requested that the attached report by the Acting Director of Reactor Development be circulated for consideration by the Commission during the week of October 20, 1958.

W. B. McCool
Secretary

DISTRIBUTION

COPY NO.

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X.JR+M.C. PDRP

16-6-58

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ATOMIC ENERGY COMMISSION

LEASE OF HEAVY WATER FOR USE IN POWER REACTORS
UNDER AUTHORIZED COOPERATIVE PROGRAMS

Report to the General Manager by the
Acting Director of Reactor Development

THE PROBLEM

1. To consider making available on a lease basis, the heavy water needed for the research and development and operating periods of power and process heat reactors under authorized cooperative programs:

SUMMARY

2. At Meeting 1395 on August 8, 1958, after consideration of AEC 983/1, the Commission established a policy to permit lease of heavy water for use in domestic or foreign research, medical, and testing reactors. The Commission did not approve the proposal in AEC 983/1 that heavy water also be leased for power demonstration reactors. This paper proposes a policy under which heavy water required for projects accepted by the Commission under authorized cooperative programs would be leased to the contractor for the same period and under terms similar to those followed in the case of special nuclear material. Power and process heat reactors outside cooperative programs would not be affected.

3. Lease For pre-operational Research and Development. During the pre-operational research and development periods, the costs of which are to be borne in whole or in part by the Government, substantial quantities of heavy water will be required under the proposed contracts with Carolinas Virginia Nuclear Power Associates, Incorporated (CVNPA), the East Central Nuclear Group and Florida West Coast Nuclear Group (ECNG-FWCNG). If the companies had to buy the heavy water the funds available for the research and development

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work would be seriously reduced. No policies now exist under which the heavy water can be leased to power demonstration program contractors for this research and development work. This paper proposes that heavy water be leased to such contractors for power and process heat reactors under authorized cooperative programs on the following basis:

- a. Normal use charges (4% per year of the value of the heavy water) would be made against the cost of the research and development work under the contract;
- b. The contractor would be responsible for all losses not normally covered by insurance (e.g., process losses), and any such losses except those due to wilful misconduct or bad faith of the contractor's managerial personnel would be charged to the R&D costs under the contract;
- c. AEC will resume responsibility for all losses of heavy water due to casualties normally covered by insurance (including purification and other related costs of restoring contaminated heavy water), unless the loss results from wilful misconduct or bad faith on the part of the contractor's managerial personnel; the loss so assumed by AEC would not be charged to the R&D costs under the contract.

The assumption by AEC of responsibility for losses normally covered by insurance is in lieu of requiring the contractor to obtain property insurance and then reimbursing him therefore.

4. Approval of the leasing in the CVNPA and ECNG cases would assist in the development of heavy water-moderated reactors of two different types, each of which shows economic promise. AEC has a strong moral commitment to CVNPA to lease the heavy water by virtue of the assumption stated in the Letter of Understanding with CVNPA dated May 6, 1958, that AEC would lease the heavy water. Negotiations on the CVNPA contract are virtually completed except for terms relating to heavy water. It is felt that the heavy water required by ECNG during the research and development period should also be leased for the sake of uniform and equitable treatment. Negotiation of this contract is underway.

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5. Lease For Reactor Operation. The FY 1959 AEC Authorization Act (PL 85-590) empowered AEC to waive for five years of operations the use charge on heavy water for use in any third round reactor. AEC based this legislative request on the need to provide additional assistance of this type to CVNPA and PP&L (Pennsylvania Power and Light--Westinghouse). To implement this legislation, it is recommended that AEC lease the heavy water required for the operation of power and process heat reactors under authorized cooperative programs for the period of the operating license and waive the first five years' use charge thereon. This will assure the operators of such reactors that heavy water will be available to them on a lease basis for the same period as fuel. AEC is now committed, by the Program Justification Data referred to the JCAE, to waive heavy water use charges for CVNPA (\$420,000) and ECNG-FWCNG (\$450,000). The question of leasing and waiving five years' use charges on the heavy water for PP&L (\$950,000) will be presented to the Commission when a proposal is received from PP&L early in FY 1960 for Phase II of that arrangement, covering the further assistance to be furnished by AEC. Leases under this paragraph would provide for the contractors having full responsibility for the heavy water while under lease to them.

STAFF JUDGMENTS

6. The Offices of General Counsel and Industrial Development concur in the recommendation of this paper. The comments of the Division of Finance are attached as Appendix "A".

CONCLUSION

7. Permitting the lease of heavy water for use during the pre-operational research and development and for the full term of the operating period for power and process heat reactors under

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authorized cooperative programs, and waiving use charges thereon for the first five years of the operating phases will (a) strengthen the power demonstration program; (b) contribute to the attainment of economic nuclear power; (c) implement the objectives of the Commission in requesting the legislative authorization to waive heavy water use charges now provided by PL 85-590, Section 109c; (d) fulfill conditional commitments made to CVNPA and ECNG-FWCNG; and (e) not conflict with the conditions of the Invitation for the Third Round of the PDRP, or the program justification data submitted to JCAE covering the projects in question.

RECOMMENDATION

8. The General Manager recommends that the Atomic Energy Commission:

- ✓ a. Approve a policy which would permit the lease under the conditions set forth in paragraph 3 above, of heavy water for the pre-operational research and development phase of power and process heat reactor projects under authorized cooperative programs;
- ✓ b. Approve a policy which would permit the lease under the conditions set forth in paragraph 5 above, of the heavy water required for the operating period of such reactors;
- ✓ c. Approve a policy which would permit the waiver of use charges on heavy water during the first five year's operation of such reactors;
- d. Note that the JCAE will be notified of this decision by letter similar to Appendix "B";
- e. Note that public announcement of this decision will be contained in the proposed modification to the Third Invitation, PDRP (see AEC 777/25);
- f. Note that this paper is unclassified.

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APPENDIX "A"

COMMENTS OF THE DIVISION OF FINANCE

1. We do not object to the Commission being asked to establish a policy that would permit the issuance of invitations in which AEC would offer to consider leasing heavy water during the pre-operational research and development period and for a further period not to exceed five years of reactor operation. However, we would not want to establish a policy that the Commission would, either as a general practice or as a form of assistance that the Commission might offer or consider granting under particular invitations, lease heavy water for the entire period of the operating license.

2. Heavy water is a capital cost of the reactor and is accounted for as such. Lease of heavy water is tantamount to a capital loan.

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APPENDIX "B"

DRAFT LETTER TO THE JCAE

1. The Commission has established a policy clarifying its position on the lease of heavy water for power and process heat reactor projects under authorized cooperative arrangements.

2. The Commission will consider making heavy water available on a lease basis for research and development purposes during the period prior to operation of such reactors and for the entire period of the operating license.

3. In addition, the Commission will consider waiving the use charge on such heavy water for the initial five-year operating period, in accordance with the legislative authorization contained in PL 85-590.

4. The extent to which such assistance would be considered would be covered by the specifics of each invitation. Power reactors outside authorized cooperative arrangements will not be affected by this policy.

5. Public announcement of this decision will be contained in the forthcoming modification to the Third Invitation under the Power Demonstration Reactor Program.

AEC

*Isotope Program. ?
Heavy Water*

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. A-209
Tel. HAZELWOOD 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
FRIDAY, AUGUST 15, 1958

AEC TO LEASE HEAVY WATER FOR USE IN NUCLEAR REACTORS

The United States Atomic Energy Commission has established a policy to lease or sell heavy water for use in domestic or foreign research, medical or testing reactors. Heretofore, Atomic Energy Commission transactions in heavy water were primarily on a sale basis.

The domestic or foreign requestor will now have a choice of leasing the material at four per cent per annum of the sales price or purchasing heavy water at the established price of \$28 per pound. The heavy water will be leased in quantities of one short ton or more for the initial inventory requirement of the reactor.

For domestic research or medical reactors, the term of the lease will be for the period for which the reactor is licensed; for foreign research medical or testing reactors, the estimated useful life of the reactor. Heavy water for domestic testing reactors will be leased for five years, subject to renewal for the duration of the period for which special nuclear material is also leased.

The possibility of leasing heavy water will serve to reduce substantially the cost of a reactor project, encouraging use and development of heavy water reactors. The policy to lease heavy water will also make more funds available for research and development to advance the peaceful applications of nuclear energy here and abroad.

All transfers of heavy water abroad, either by lease or sale, will be subject to appropriate safeguards.

(more)

85-51-8

Information regarding domestic lease of heavy water can be obtained from:

United States Atomic Energy Commission
Savannah River Operations Office
P. O. Box A
Aiken, South Carolina
R. C. Blair, Manager

Persons interested in foreign lease of heavy water should contact:

United States Atomic Energy Commission
Division of International Affairs
Washington 25, D. C.

~~OFFICIAL USE ONLY~~*Richard S. Topik - Heavy Water File (1941)*

Office Memorandum • UNITED STATES GOVERNMENT

TO : Frank K. Pittman, Director
Office of Industrial Development
John A. Hall, Director, International Affairs

FROM : W. B. McCool, Secretary

DATE: August 14, 1958

SUBJECT: COMMISSION DECISION ON AEC 983/1 - LEASE OF HEAVY WATER FOR USE IN REACTORS

SYMBOL: SECY:RVW

1. This will confirm that at Meeting 1395 on August 8, 1958, the Commission:

a. Established a policy which would permit lease of heavy water for use in domestic or foreign research, medical and testing reactors, in lieu of sale, at the requestor's option;

b. Noted that such leasing will be carried out under the general conditions set forth in paragraphs 7 and 8 of AEC 983/1, as revised;

c. Noted that the JCAE will be advised of this action by letter such as Appendix "B" to AEC 983/1, as revised; *It was not sent - release issued before JCAE could be informed by the*

d. Noted that a public announcement will be made similar to Appendix "C" to AEC 983/1, as revised; and

e. Noted that AEC 983/1 is unclassified.

2. You will recall that the Commissioners specifically requested that heavy water not be provided for either foreign or domestic power demonstration reactors under this policy.

3. The General Manager has directed that you take the action necessary to carry out the above decision. This will also confirm our understanding that your office will prepare the revised letter to the JCAE. Please provide a copy of this and other pertinent correspondence to the Office of the Secretary.

cc: General Manager
Asst. Gen. Mgr. for Administration
Asst. Gen. Mgr. for R&ID
General Counsel
Controller
Director, Information Services
D. C. Office

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85-41-8

DATE:

12/16/58

12/16/58

INDEX: Materials Heavy Water

TO:

FROM:

SUMMARY: AEC 205/51 - RELATIONSHIP OF THE PRICE OF HEAVY WATER AND THE PRICE OF BERYLLIUM METAL

Ltr. to AEC fr. Pres. of Brush Beryllium Co. recommending to the Commission they include in its power reactor devel. program a policy of encouraging the use of beryllium metal as a moderator & reflector. Such a policy would result in a higher production rate and lower production costs of the metal.

FILED: Materials Beryl

INDEXER: date of paper: 8-7-58
date of ltr: 7-29-58

REMARKS:

U. S. ATOMIC ENERGY COMMISSION
CORRESPONDENCE REFERENCE FORM

87-58

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AEC 983/1

August 4, 1958

COPY NO. 55

ATOMIC ENERGY COMMISSION

LEASE OF HEAVY WATER FOR USE IN REACTORS

Note by the Secretary

The General Manager has requested that the attached report by the Directors of International Affairs and Industrial Development be circulated for consideration by the Commission during the week of August 4, 1958.

W. B. McCool

Secretary

DISTRIBUTION

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ATOMIC ENERGY COMMISSION

LEASE OF HEAVY WATER FOR USE IN REACTORS

Report to the General Manager by the
Directors of Industrial Development and International Affairs

THE PROBLEM

1. To determine if the AEC should lease heavy water for domestic and foreign use in nuclear reactors, and if so, the conditions under which leases will be made.

SUMMARY

2. The present situation with respect to heavy water is as follows:

a. As a general rule D_2O is sold both domestically and abroad by AEC in minimum quantities of 125 pounds or more at \$28.00/lb. for commercial use.

b. Export abroad of large quantities is limited by internal AEC policy to sale to friendly countries agreeing to appropriate safeguards.

c. Domestic non-profit educational and medical institutions are loaned heavy water for educational purposes and research reactors. The quantities are limited to 10,000 pounds per institution and 100,000 pounds total per fiscal year for educational purposes and to 35,000 pounds per institution and 70,000 pounds total per fiscal year for the research reactor assistance program. (See AEC 267/42 and 267/46.) No charge is made to the aforementioned projects for normal consumption of heavy water. Similar loans are not extended to foreign research reactors under the grant program.

d. AEC intends to loan heavy water to the Carolina-Virginia Nuclear Power Associates without charge for use in its critical experiment and is seeking authority from Congress to loan D_2O to them at no charge for the first five year period of reactor operation.

3. Although in many statements in the press and before the Joint Committee on Atomic Energy the AEC has indicated that heavy water may be either sold or leased for use in reactors, no lease has been made and criteria under which leasing would

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be appropriate have not been developed. Until recently, it seemed satisfactory for AEC not to lease heavy water. Currently, however, there is some dissatisfaction by private industry and foreign countries with this policy and AEC has been asked to lease or loan heavy water domestically and abroad for use in reactors.

4. Two primary reasons are advanced by those requesting that heavy water be leased: 1/

a. The amount of money required to purchase heavy water is roughly 40% or more of the total cost of a research reactor. Assistance, in the form of grants, for foreign research reactors is limited to a maximum of \$350,000. Since a heavy water moderated research reactor requires at least four-tons of heavy water at a cost of about \$225,000, a major part of the U. S. assistance to such a reactor would be expended in the purchase of the necessary heavy water. The penalty of using heavy water is high. Purchasing heavy water cuts down the amount of funds left for operating the programs centered on the reactor. The net effect is that these groups prefer to acquire reactors using ordinary water because of the much lower capital expenditures.

b. There is no ready resale market for heavy water in large quantities. A purchaser is committed to long term use or, conversely, to a substantial loss in the event the reactor is shut down.

5. The AEC has additional reasons for permitting, as a general policy, the leasing of heavy water for use in reactors:

a. Reactors using D₂O require considerably less U-235 to produce results equivalent to reactors using ordinary water. The national interest in efficient use of special nuclear material warrants development of reactors using heavy water.

b. The lease of enriched uranium and the waiver of the use charge in the case of the Power Demonstration Reactor Program reactors and research reactors is a substantial form of assistance and encourages development and use of these reactors. However, at present if U-235 is conserved by using D₂O in the reactor, the operator is forced to give up a major portion of this assistance and required to purchase the D₂O. This adds

1/ Copies of correspondence on file in Office of Industrial Development and Division of International Affairs.

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substantial to his capital investment. Present administrative policy places D₂O reactors at a distinct economic disadvantage; serves to discriminate against and discourage development of heavy water reactor technology; and, conversely, it encourages reactors using more U-235.

c. Present policy fails to exploit the fact that heavy water at its present cost of production represents a great American technological triumph. Instead, the user is penalized by having to purchase it whereas those using ordinary water can lease the additional U-235 needed to operate such reactors.

d. AEC has heavy water in stockpile. Encouragement to use D₂O by a means such as leasing if it results in greater demand for D₂O, will recover some of the government's expenditure on this material.

e. Loans with or without a lease charge to the Carolina-Virginia project would discriminate against independent efforts to develop heavy water power reactors unless AEC leased as a general policy.

6. To remedy the situation, it is proposed that AEC lease heavy water

a. for use in reactors licensed under section 104 of the Act, and

b. for use in similar types of reactors built abroad in those friendly foreign nations who have agreed to appropriate safeguards. 1/

7. General conditions of leasing would include the following:

a. AEC would offer to sell or lease heavy water, at the customer's option, in minimum quantities of one short ton for use as the initial inventory requirement of a reactor.

b. In the case of domestic research or medical reactors, the lease would be for the period of the license or such shorter period as the parties may agree upon. For foreign research, medical, test, or power demonstration reactors, the lease would be for a period determined to be a reasonable estimate of the useful life of the reactor or such shorter period as the parties may agree in accordance with the terms of the Agreement for Cooperation. out see #2
9-14-61

c. In the case of domestic test and power reactors, the lease period would be limited to five years or such shorter period as parties may agree, but subject to

1/ Note that the State Department feels we should examine the possibility of leasing under certain conditions. Letter on file in the Division of International Affairs.

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renewal during the period that special nuclear material is also leased.

d. The lease charge proposed is 4% per annum of the published AEC sales price for heavy water.

e. The lessee, upon return of the heavy water, would pay for costs of repurifying the returned material and for material not returned (e.g. because of loss or consumption).

f. In view of the charges payable upon termination of the lease or return of the heavy water, the lessee would be expected to give reasonable assurance, perhaps a deposit, that he will be in a position to pay the charges.

8. It is not proposed to lease ordinary make-up requirement regardless of quantity. These would be available only on a sale basis. This treatment is the equivalent of charging for burn-up of U-235.

9. It is not intended that adoption of a general policy to lease heavy water would replace or affect special assistance programs such as that for domestic research reactors and educational programs. (AEC 558/12, 909/1, 267/28, and 262/46).

10. Repurification of heavy water will be a likely area for industrial participation once there is a sufficient demand for the service.

STAFF JUDGMENTS

11. The Office of the General Counsel and the Division of Reactor Development concur in the recommendation of this paper. The Division of Information Services concurs in the proposed public announcement. The comments of the Divisions of Finance are attached as Appendix "A".

CONCLUSIONS

12. Permitting the lease or purchase of heavy water for use in domestic or foreign reactors of the type licensable under

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Section 104 of the Act (research, medical, testing, and demonstration reactors) is in the national interest for reasons outlined in paragraphs 4 and 5 and further strengthens our assistance in support of the President's "Atoms for Peace" program.

RECOMMENDATION

13. The General Manager recommends that the Atomic Energy Commission:

- a. Establish a policy which would permit lease of heavy water for use in domestic or foreign research, medical, testing, and demonstration reactors, in lieu of sale, at the requestor's option;
- b. Note that such leasing will be carried out under the general conditions set forth in paragraphs 7 and 8 above;
- c. Note that the JCAE will be advised of this action by letter such as Appendix "B";
- d. Note that a public announcement will be made similar to Appendix "C";
- e. Note that this paper is unclassified.

LIST OF ENCLOSURES

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APPENDIX "A" - Comments of the Division of Finance . . .	6
APPENDIX "B" - Draft Letter to the JCAE	7
APPENDIX "C" - Proposed Public Announcement	8

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APPENDIX "A"

COMMENTS OF THE DIVISION OF FINANCE

1. Heavy water is a capital cost of the reactor and is accounted for as such. The arguments in the paper for the lease of heavy water are based on the higher cost of heavy water as a moderator compared with light water, graphite or organic compounds -- yet, in principle, no one has proposed aid for other type moderators. This higher cost ratio would seem to remain true whether or not the license was issued under Section 104 or Section 103. Lease of heavy water is tantamount to a capital loan.

2. It is requested that the above be appended to the staff paper as representing the views of the Controller.

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APPENDIX "B"

DRAFT LETTER TO THE JCAE

1. The Commission has established a policy clarifying its position on the lease of heavy water to foreign and domestic users. Heavy water will be leased for use in research, medical, testing and power-demonstration reactors if the customer prefers such a transaction to direct purchase.

2. For domestic research or medical reactors, the term of the lease will be limited to the period for which the reactor is licensed. For domestic testing and power-demonstration reactors, the term will be limited to five years, subject to renewal during the period for which special-nuclear material is also leased. For foreign research, medical testing or power-demonstration reactors, the term will be limited to the period covered by the Agreement for Cooperation.

3. We have attached a public announcement which will be released shortly giving further information on the lease arrangement.

4. We shall be glad to answer any questions you might wish to ask concerning this policy.

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APPENDIX "C"

PROPOSED PUBLIC ANNOUNCEMENT

AEC TO LEASE HEAVY WATER FOR USE IN NUCLEAR REACTORS

1. The U.S. Atomic Energy Commission has established a policy to lease or sell heavy water for use in domestic or foreign research, medical, testing and power demonstration reactors. Heretofore, AEC transactions in heavy water were primarily on a sale basis.

2. The domestic or foreign requestor will now have a choice of leasing the material at four per cent per annum of the sales price or purchasing heavy water at the established price of \$28 per pound. The heavy water will be made available in quantities of one short ton or more for the initial inventory requirement of the reactor.

3. For domestic research or medical reactors, the term of the lease will be for the period for which the reactor is licensed; for foreign research medical reactors, the estimated useful life of the reactor. Heavy water for testing and power reactors will be leased for five years, subject to renewal for the duration of the period for which special nuclear material is also leased.

4. The possibility of leasing heavy water will serve to reduce substantially the cost of a reactor project, encouraging use and development of heavy water reactors. The policy to lease heavy water will also make more funds available for research and development to advance the peaceful applications of nuclear energy here and abroad.

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5. All transfers of heavy water abroad, either by lease or sale, will be subject to appropriate safeguards in agreements for cooperation or in contracts containing such safeguards.

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Interagency Heavy Water

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. TI-5
Tel. Hazelwood 7-7800
Ext. 4463

July 3, 1958

AEC HEAVY WATER PRODUCTION AND SALES

Deuterium Oxide (D₂O), commonly known as heavy water, has assumed an important role in atomic industry because it has proved to be an excellent material for moderating the neutrons which maintain the chain reaction in nuclear reactors. The neutrons released in the fission of uranium-235 move at too high a velocity to maintain the chain reaction in most present day reactors. They are moderated or slowed down most efficiently by allowing them to collide with atoms of about the same mass until they reach a velocity at which they can effectively carry on the chain reaction.

The mass of most materials is too high for efficient moderation. Others capture too many neutrons or have poor physical properties. Of the good moderators (hydrogen, deuterium, beryllium and graphite), deuterium (as heavy water) is second best to hydrogen with regard to mass and best of all with regard to minimum neutron capture.

How Heavy Water is Produced

The amount of heavy water contained in natural water varies slightly, depending on the source of the water, but averages one part in 6,500 or approximately 0.015 percent of deuterium oxide. Heavy water (D₂O) is obtained by concentrating this very small proportion to any desired degree of purity. Several methods of doing this have been used commercially--namely, dual-temperature chemical exchange, water distillation, electrolysis of water, and combined electrolysis of water and steam-hydrogen chemical exchange. (Further information on these processes can be found in Atomic Energy Facts, available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price \$2.00, paperbound).

(more)

7-3-58

Of the processes for concentrating heavy water from 0.015 percent to its maximum concentration of about 99.75 percent, none is clearly superior throughout the range of concentration. Most of the processing cost is incurred at low concentration percentages, mainly because large plants with large heat requirements are necessary to handle the volume of water that must be treated. As the proportion of heavy water increases and the volume decreases in the last stages of enrichment, the electrolysis process, comparatively expensive for the early stages, becomes more attractive economically.

The process used by the Commission, in its heavy water plant operated by the E.I. du Pont de Nemours Company, Savannah River, Aiken, S.C., is a combination of initial enrichment by hydrogen sulfide dual-temperature exchange, intermediate concentration by water distillation, and final concentration by electrolysis. On a mass production basis the process is relatively inexpensive. The selling price of \$28 per pound covers operating expenses, plant overhead and depreciation, and a general AEC overhead charge.

Current Supply of Heavy Water

The Commission maintains a stockpile of heavy water sufficient to meet foreseeable needs, foreign and domestic, and available heavy water plant capacity is in excess of these expected requirements. As a result, the Commission recently shut down a large plant at Dana, Indiana, and the Savannah River Plant facilities are being operated at a lower rate of production to meet current needs. The Dana facilities are being kept on stand-by.

Domestic Sale of Heavy Water

Any individual, firm, institution, or Government agency in the United States may purchase heavy water from the Atomic Energy Commission. No access permit or special license is required. The minimum quantity that the Commission will sell is 125 pounds. Smaller quantities may be obtained from commercial suppliers.

Special approval by the AEC is required before quantities of heavy water in excess of 500 pounds may be sold to any one person or concern in any one year. A "Heavy Water Order Form" should be used for all non-Government purchases.

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Copies of the forms are available from:

Savannah River Operations Office
U. S. Atomic Energy Commission
Post Office Box A
Aiken, South Carolina

Federal agencies wishing to place orders for heavy water should use Form AEC-375, "Isotope Order Blank," which may be obtained from:

Office of Industrial Development
U.S. Atomic Energy Commission
Washington 25, D. C.

Purchase orders should be made out in quadruplicate and sent to the Savannah River address.

Packaging

Heavy water is packaged in stainless-steel, non-returnable, non-refillable drums. The drums are of two sizes, containing net weights of 125 or 500 pounds of D₂O and costing about \$43 and \$100 respectively.* The cost of the containers is added to the D₂O charge of \$28 per pound for shipment.

Transportation Charges

Unless otherwise specified, shipments will be made by express with transportation charges collect. The purchaser should specify whether or not the shipment is to be insured. Precautions are necessary to protect this material--shipped in liquid form--from freezing in cold weather. Heavy water, although having chemical and physical properties very similar to those of ordinary water, will freeze at slightly higher temperatures than its counterpart--about 3.8°C as compared with 0°C for ordinary water.

* Prices subject to change.

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Export of Heavy Water by Private U.S. Concerns

Export of heavy water by private U.S. concerns is subject to licensing by the United States Department of Commerce and to Part 110 of the Regulations of the United States Atomic Energy Commission, Title 10 of the Code of Federal Regulations. Copies of these regulations may be obtained from the Department of Commerce and the Atomic Energy Commission (Division of Licensing and Regulation) respectively.

Foreign Sales of Heavy Water by the AEC

During the past three years the Commission has sold approximately 250 tons of heavy water to foreign countries, mostly West European and British Commonwealth nations. It is expected that an additional 100 tons will be sold to foreign countries during 1958. There is no general limitation on quantities that may be sold, and an agreement for cooperation is not a prerequisite, but sales are arranged in accordance with individual sales agreements, subject to appropriate safeguards to insure against diversion to nonpeaceful uses.

Sale of heavy water abroad has been on the increase. During 1955, only two shipments were made, 20 tons to Canada and 11 to the United Kingdom. The following year France bought 16.5 tons; Canada, 10.2 tons; India, 21 tons; Belgium, 5 pounds; and the United Kingdom, 33 tons, for a total of 80.7 tons exported.

In 1957, France bought 11 tons, mostly for its E1 ("Eau Lourde"-Heavy Water) series of reactors at Saclay. Canada bought 63.5 tons, for its NRU (National Research Universal) reactor and for a subcritical assembly at the University of Toronto. A private Swiss concern, Reactor, Ltd., purchased 9 tons for a research reactor at Wuerenlingen, Switzerland. Belgium bought 500 pounds for research purposes, Australia 11 tons for its first research reactor, near Sidney, and the United Kingdom 11 tons for its civilian power program. A firm in Sweden, Aktiebolaget Atomenergi (Swedish Atomic Energy Co.) bought 28.5 tons for use in a prototype reactor for district heating in a Stockholm suburb. Norway's Atomic Energy Institute purchased 17.6 tons for an experimental reactor under construction at Halden. Total sales for 1957 were somewhat more than 145 tons.

(more)

Specifications and Properties of AEC-Produced Heavy Water

Chemical Specifications:

D₂O content 99.75 mol percent, minimum

KMnO₄ demand 1.0 x 10⁻⁵ grams per gram heavy water

Tritium content No specification has been set on tritium content. AEC may, upon consideration of the ultimate use of any shipment, furnish heavy water with tritium content of the order of 40 microcuries per milliliter. For uses where this level is not allowable, heavy water may be made available with a lower tritium content than given herein. If heavy water of high tritium content is to be furnished, the purchaser will be notified prior to shipment.

Physical Specifications:

Electrical Conductivity - 15.0 micromhos per centimeter, maximum

Odor - None

Turbidity - Clear

Physical Properties:

Density - 1.105 gram per milliliter at 25°C, (9.25 lb/gal.)

Freezing Point - 3.82°C

Boiling Point - 101.4°C