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EXTRACTION OF TRITIUM FROM LITHIUM-ALUMINATE TARGETS

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EXTRACTION OF TRITIUM FROM LITHIUM-
ALUMINATE TARGETS

R. Cooperstein

November 13, 1968

DOUGLAS UNITED NUCLEAR, INC.
RICHLAND, WASHINGTON

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SUBJECT EXTRACTION OF TRITIUM FROM LITHIUM-
ALUMINATE TARGETS.

DISTRIBUTION:

1. *Letter - DNL*

References: (1) DUN-3045, "Analytical Data for 100-N Lithium-Aluminate Targets," WJ Ferguson, August 31, 1967. (Secret)

- (5) "Target Shipment and Storage Request," GC Fullmer, October 17, 1968. (Confidential)
- (6) Letter, OC Schroeder to W. Devine, Jr., "100-N Coproduct Program," October 15, 1968.

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This memorandum presents the most recent information on tritium extractions.

It goes on to summarize the results of the extraction program for completeness. A detailed evaluation of the results from the standpoint of extraction process efficiency will be issued under a separate cover.

References 1 and 2 list NRD's estimated product contents based on the physics computer code. References 3 and 4 report the extraction results as found. The results are reported on the basis of our estimates primarily. This can be misleading on the effectiveness of the extraction process. To ascertain the latter, one must rely on tritium content analyses of the extraction residues. To perform such analyses requires the use of awkward sampling techniques and cumbersome handling prior to carrying out the simple and precise tritium determination.

Performance And Cost Effectiveness

to establish the completeness of extraction. That is, to determine the material balance ratio - MBR - of the gases collected. This is a ratio of the volume of helium-3 collected. Theoretically, this should be 2.00. A higher value would infer an incomplete recovery of tritium while a lower value would indicate incomplete helium recovery. As seen in Table 1, the reported MBR values could leave one with the impression that the extractions were incomplete. By actual residue analyses this was found to be incorrect. The causes for the high MBR values have been established. The excess helium-4 recovered could be traced to the presence of excessive boron impurity contents in the early targets irradiated and to the malfunction of equipment during some of the extractions. The details of these findings will be included in the evaluation report.

The summary of extractions and their findings are listed in Table 1. The paucity of detailed data for the latter runs are due to the facts that (1) they were run on a production basis and (2) we must specifically request this information from our local AEC office before it will be supplied to us. This should apply particularly for any additional work as described in references 5 and 6 relating to analytical extractions for metal-alloy targets and those intended for inclusion in the next shipment in addition to the standard ceramic target cores.

R. Cooperstein

R. Cooperstein, Senior Engineer
Reactor Materials Technology

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TABLE 1

Run No., NPR	1	2*	3*	4*	5*(a)	6*(a)	7*
No. of Cores in Extraction	200	200	189	206	248	250	241
<u>Tritium</u>							
DUN Estimate, liters	---	105.56	105.56	---	40.41	43.23	---
Accounted for, liters	16.62	49.47	47.05	49.42	39.13	42.54	---
Accounted for, % of DUN Estimate	---	91.8	91.8	---	96.8	98.4	---
Residual tritium, % loss	0.05	0.43	0.21	0.42	0.31	0.31	1.5 ^(c)
<u>Helium-4</u>							
Estimate based on MBR=2.00, liters	33.24	98.94	94.10	98.84	80.82	86.46	---
Accounted for, liters	39.04	111.4 ± 7.2	110.5 ± 6.9	111.6 ± 7.4	87.00	95.19	---
Accounted for, % of estimate	---	105.5	105.5	---	107.6	110.1	---
MBR = $\frac{\text{volume helium-4 extracted}}{\text{volume (tritium + 1/2 helium-3 extracted)}}$	2.35	2.25	2.35	2.26	2.22 (2.22) ^b	2.24 (2.12) ^b	2.17
<u>Isotopic Concentration, %</u>							
Tritium	29.08	63.05	61.68	64.15	60.22	65.20	---
Deuterium	4.36	4.78	5.14	4.82	5.30	3.40	---
Protium	66.22	32.04	33.05	30.48	34.29	31.24	---

* Indicates productivity run.

(a) Spike subassemblies.

(b) Laboratory extraction valves.

(c) No excess aluminum added or ceramic not immersed in aluminum.

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TABLE (Continued)

Run No., NPR	8	9	10	11	12	13	14	15
Residual Tritium, % loss	1.4 ^(c)	---	---	---	0.62	0.55	0.36	1.62 ^(d)
MBR = $\frac{\text{volume helium-4 extracted}}{\text{volume(tritium+1/2 helium-3 extracted)}}$	---	2.10	2.12**		2.20***		2.03	2.03

(c) No excess aluminum added or ceramic not immersed in aluminum.

(d) Equipment failure during extraction.

** Combined with 11.

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