Chronology of Important FOIA Documents: **Hanford's Semi-Secret Thorium to U-233 Production Campaign 1**

04.18.51	HW-20927 "Use of Thorium as Pile Flattening Material"	• "Considerable volume of thorium metal has been irradiated in the Hanford piles under the Special Request Program as SR-3-3 and ORNL-106." • "Note on U-233 Production"
03.11.54	HW-30989	• "AEC has requested **30 kg of U-233** in the form of irradiated thorium (Q) slugs" to be "completed by July 1, 1955." • "It is planned that some of the irradiated Q-slugs will be processed to extract the uranium (principally U-233) and the uranium will be analyzed to determine the isotopic makeup."
03.16.54	HW-31218 "Problems Relative to Thorium Processing"	• "A cursory literature survey of thorium chemistry and processing techniques has been carried out because of current indications that Hanford may become involved in large scale 23 production." Discusses the various processes for irradiating thorium to recover and decontaminate the thorium, uranium, and protactinium. Discusses the ORNL "Thorex" Process and Redox and Purex.
09.10.54	HW-33044 "The Irradiation of a novel Fuel Element Used for U-233 Production"	• "A new slug for U-233 production consisting of a solid thorium core externally jacketed by a thin Oralloy foil is described." (4) • "A current Hanford method of producing uranium-233 employs separate fuel and target slugs." (6) • "Unfortunately, such an element would not be satisfactory for U-233 production due to the mixing of U-233 and U-235 in the product. In the event that such a mixture of isotopes is acceptable for weapons purposes then the homogenous slug appears desirable."
	"Production of Thorium Oxide for Vibratory Compaction by a Modified Sol-Gel Process"	• "The product, called light thoria, may be further processed to make a dense thorium oxide that is suitable for canning and irradiation in a U-233 production cycle." • "To make oxide suitable for U-233 production, the thorium nitrate feed had to be low in U-238, Th-230, and neutron absorbers."
12.23.64	"U-233 Nitrate Shipment" Rough Draft by H.P. Shaw	• "Based on the information available, there does not appear to be enough time after the thorium run at Purex to permit two shipments of the product. Therefore, containers will be required for the entire load in one shipment." (3) • "The **U-233 nitrate** will be concentrated to 300 grams per liter, making a total of 900 grams for each container. . . . Procurement of the containers is probably a Purex function and should be started by May 1, 1965, to insure delivery by December." A shipping hazards evaluation will require about two months and should be in preparation during February." (3)
.03.24.65	DDTS Generated-230 "Request to Ship Thorium . . ."	" * * * However, the data obtained from these tests will be of little value in our present program as there [are] **only about 25 tons remaining to can** for reactor use."
04.14.65	DUN-1010 (Cited in P. Lavelle's Memo)	• Virgin thoria sent from National Lead Co. of Ohio. Initial test irradiation of 6 T. of thoria targets in D Reactor. • After favorable results, 4 more tons were tested in F Reactor in September 1964. • A core loading at F Reactor containing 2 more tons of thoria followed shortly thereafter.
04.21.65	"Production of Clean Uranium-233" W.K. Woods, Research and Engineering	• "(Remarks intended for use during unclassified visit to stimulate the market for clean U-233.)" • "In sharp contrast, the United States and the free world have very limited quantities of U-233. The principal reason for past lack of interest in U-233 is because of the hard gamma radiation usually associated with fissionable materials." (1) • "Recent studies . . . have led to the development of economical methods for producing U-233 containing U-232 in concentrations of only a few ppm." (1) • "U-233 with lesser amounts of U-232 is currently unavailable, except for a few kilograms which were recently produced at the Hanford plant." (2) • "At the Hanford plant some six tons of thorium have been irradiated under a variety of experimental conditions, and upon subsequent chemical processing

		about 3 Kg of U-233 were obtained containing an average U-232 content of 2.5 ppm." (2) • "In addition, the Division of production is currently engaged in a program to produce **260 kg of U-233 containing about 5 ppm of U-232, for delivery during calendar year 1965.** Of this total, **200 kg are intended for the Division of Naval Reactors** for use in critical assembly studies in support of the seed-and-blanket reactor development program, an 60 Kg are intended for the Division of Reactor Development and Technology for various unclassified programs. The program is divided between the Hanford and Savannah River Production sites." (2) • "The irradiated thoria is dissolved in nitric acid and at Hanford is separated by solvent for extraction in the Purex plant. Since the Purex plant is normally used for the processing of many tons of irradiated uranium-238 (with accompanying uranium-235), it is necessary to flush this large chemical plant thoroughly before introducing U-233 along with tons of thorium into the plant. Hence, thorium is processed through the Purex plant in separate campaigns." (4)
04.27.65	Ltr: "Supplemental Info. And Instructions"	• The Purex Plant will **process approximately 150 tons of special thorium fuel eleme**nts during the months of October and November using a new process . . . ." • "All work shall be installed and complete to the maximum extent permitted by plant operations by September 1, 1965."
05.21.65	"150 Ton Thorium Process U-233 Shipment Container Equipment"	"If we are assured that the AEC will provide the U-233 shipping containers as specified for the **150-Ton Thorium Program**, then our major concern regarding shipping containers is alleviated."
05.27.65	RL-SEP-267 PT4 "Engineering Study Thorium Processing – Purex."	• "This document is a part of an engineering study which has been prepared to define the needs within the Chemical Processing Department for processing thoria in the Purex Plant in a single campaign during FY-1966." (3) • "1. **All of the thoria will be processed in one campaign in FY-1966**." (5) • "5. The U-233 product will be shipped offsite as a nitrate solution." (5) • "6. The containers for shipping the U-233 nitrate to the customer plant are to be provided by and are the responsibility of the AEC." (5) • "7. **The thorium product will be stored indefinitely at HAPO as a nitrate solution**." (5) • "The final concentration of the U-233 product is to be accomplished in the new **tantalum** E-N6 Concentrator and the new **titanium** TK-N7 Receiver Tank . . . presently being fabricated." (14)
06.17.65	"Dose Rates Associated with Possible Off-Plant Shipment of Th Recycle Material" D.A. Hoover, Consultant	• "A review was made also of dose rates which might be expected from massive amounts of thoria."
07.15.65	"U-233 – Thorium Program Letter – Chemistry Dept."	• "The objective of the overall program is to establish Hanford as the lead site for the production of clean U-233. . . . The clean U-233-thoium program has a high value in regard to the possible future operations at Hanford. It currently holds promise of providing a significant alternative product for the plant." • By July 1967, need to "Provide chemical processing data required for establishing a flowsheet for the operation of the Redox plant for a large-scale production program." • Required funds for the Chemistry Department for FYs 1966 – 1970 = $495,000.
07.26.65	HAN-92583/RL-SEP-650 "Process Bases & Specifications Thorium – U-233 Separations at the PUREX Plant"	• "The Purex Plant was originally designed for the chemical processing of irradiated natural uranium. It has been used nearly exclusively for this purpose during its approximately ten-year operating lifetime. However, during the winter of 1964-1965, a special processing campaign was planned and accomplished in which approximately **6 tons** of irradiated thoria targets were introduced to the

		plant, and the thorium-232 and uranium-233 were successfully separated and purified on a demonstration basis. More recently, the planning and facilities revisions necessary for the processing of **approximately 150 tons** of irradiated thoria have been underway." (1-4) • "Thus, for the relatively large operation subsequently planned, other process specifications are required."
07.28.65	"Irradiated Thorium Recycle" Attn: Mr. H. E. Parker, Director – Chemical Processing Division at AEC – from G.E.'s General Manager of the Processing Dept.	• "Gentlemen: . . . The thorium processing campaign now planned for the latter months of this year is expected to produce approximately 80,000 gallons of thorium **nitrate product solution**. When combined with that produced in the January 1965 run, the estimated total will be about **85,000 gallons**. . . . We currently plan that the solution will be trucked from the Purex Plant to the U-Plant and will be stored in Tanks 006, 007, and 008 in the WR Vault." • "Thorium nitrate solution shipped to Off-Site Processing Plant: It is assumed that shipping is by RR tank car of approx. 8000 gallon capacity. . . . In this case a normal tank car loaded with thorium nitrate solution fresh from processing would have a dose rate of 125-150 mr/hour at one meter from the surface of the car. . . . Tank cars are very vulnerable to unusual transportation conditions, and could not be relied upon to contain the biologically toxic material in the event of an accident. We do not know any feasible means whereby the tank car could be modified to meet industry's generally accepted criteria for impact, fire, and containment**. Shipping irradiated thorium nitrate by tank car is not recommended**." (3) • "In connection with the shipment of thorium solutions and oxides, there is another very important aspect that must be considered in addition to capital and schedule. Biologically, thorium is similar to plutonium in that it is a bone seeker. The principal liability from any accidental release of thorium nitrate to the environs will result from the **contamination of the groundwater** in the vicinity of a spill an exposure of persons in the vicinity using the water." • "Taking cost, inventories, and safety into consideration, we recommend that the irradiated thorium cycle be closed at Hanford."
09.24.65	"U-233 Processing in 234-5 Bldg." To: File	• "Hanford is still faced with the possibility of having to process U-233 beyond the nitrate [so to oxide] by June 1, 1996 in a quantity of (1) 200 kg. or (2) 10 kg or (3) none." • "Financing for this job, of course, does not exist because the job has not been scheduled. It would fall within the capital equipment budget. The nature of the work would make it a "project". Appropriation request for this capability will not be scheduled (as previously planned) until the program is further along."
09.28.65	HAN-92655 – Letter re: "Thorium and U-233 Program" from H.E. Parker, Director of G.E.'s Chemical Processing Divison	"Gentlemen: Please be advised that the fuel fabricator for the Naval Reactor Program on the Large S--- - B------ Reactor (LSBR) will not receive U-233 product prior to April 1, 1966, and that the U-233, when delivered, is to be {freshly separated?} from daughter products. The **100 kg of U-233 being {purchased?} from the Savannah River Plant** is now being processed and will be {repurified?} prior to being delivered in April. Accordingly, the Hanford product delivery should begin the middle of May 1966. To meet the above requirements, please defer the thoria campaign scheduled for Fall 1965 and {reschedule?} appropriate to a May product delivery. Additional irradiations under consideration indicate you should **plan the campaign for approximately 300 Tons of thoria**. Furthermore, please arrange that the **100 kg of U-233 for the LSBR program** will be a "---- ---" --- that the U-238 content will be as low as possible, and will {demonstrate?} the very minimum of U-238 contamination from Hanford ------ facilities. Hanford is to deliberately select for this delivery the U-233 material with the lowest U-238 content. We have been informed that for the **future 450 kg of U-233 required for the LSBR {core?},** the Division of Naval Reactors will probably specify less than .5% U-238 contamination. Since the **size of this thoria campaign will be increased** and it is desirable to minimize the number of shipping containers required to deliver the U-233 nitrate, please

		advise us on the following: * * * * * * * Previous correspondence on specifications has been reviewed with Naval Reactor representatives, and a revised set of tentative specifications for U-233 was hand carried to R.E. Tomlinson of your organization. It is requested that these specifications be examined carefully and that we have your comments on all problem areas. If comments previously made are still applicable, please include these in your reply so that full information may be available in one letter. Please advise us of the effect that this rescheduling of a thoria campaign will have upon deliveries of plutonium, and the effect upon reactor storage basin fuel inventories as the end of FY-1966."
04.15.66	DUN-1010 "Thoria Target Element Failures"	• "The thorium program at Hanford was initiated in response to an order placed by the Atomic Energy Commission for the production of U-233 from the irradiation of thorium or thorium oxide (thoria). The **initial orders called for approximately 130 kg U-233 and subsequent orders have since increased this figure.**" (3) • "In the event of further requests for high purity U-233, the equipment and knowledge exist with which these orders may be filled with a minimum of effort." (3) • "By using high purity thorium or thorium oxide (thoria) and limiting the reactor exposure, the U-233 produced will contain very low levels of radioactive contaminants, primarily U-232. The incentive of the thoria program is to fill, as economically as possible, the AEC's requests for high purity U-233." (4) • "In view of the favorable performance of these tests and based upon the existence of orders for substantial amounts of U-233, **irradiation of thoria as a source of U-233 on a production basis began at KW Reactor in late September, 1964**." (5) • 25 target element failures had occurred by this date. Of these failures, 14 resulted in unscheduled reactor shutdown in C, KE, or KW Reactors.
07.21.66	DUN-1349/Han-9520 "Thoria Delivery Schedule"	• "The July forecast includes **thoria target element** requirements for **shield protection** on an annual basis totaling slightly in excess of **27 tons**."
09.21.66	ISO-539 "Trip Report – Thoria Specifications Appraisal Mtg."	• Mtg held "to develop specifications to be used for the procurement of thoria, on the basis of competitive bidding by private industry, for U-233 production by AEC contractors." • "Although future thoria requirements are uncertain, the AEC plans that a "modest" thoria stockpile be available to permit rapid implementation of production in the event that proposed "clean"U-233 programs are actually carried out." • STATUS of U-233 PROGRAM: the AEC reviewed the program and said the **known requirements [for all facilities] are as follows:** **<u>FY</u> <u>Kg U-233</u>** **68 100** **69 --** **70 200** "Present Naval Reactor plans, which may not materialize, would require the following additional amounts: <u>FY</u> <u>Kg U-233</u> 68 100 69 350 70 150 • "The Hanford program for **reactor fringe loadings** would produce about **50 kg/yr of U-233.** However, according to Lindsey, this program has not gained complete acceptance by the AEC. The major Hanford problem is separations, and until that is resolved, "chances for a U-233 program at Hanford don't look too good.""

		• "Workinger commended Hanford for the performance of the separations campaign recently completed. He also introduced the problem of the possible future need by the Navy to produce U-233 containing a maximum of .25 percent U-238. In the Hanford campaign, U-238 content was limited at a minimum of about .6% in the thoria input to the reactors. Workinger concluded that we may need to obtain thoria with 1 ppm maximum of U-238 (compared to current specifications of 10 ppm)."
04.07.67	DUN-2409 "Thoria target element fabrication and irradiation experience."	• "Thoria (thorium oxide) target elements have been produced at Hanford since mid-1964 for irradiation in the production reactors to form U-233..." • "A unique advantage of the Hanford production reactors is a soft neutron flux which minimizes the formation of the contaminant U-232 and permits the production of a relatively pure U-233 which can be handled with little or no shielding."(2) • "Since the beginning of the program about **180,000 elements have been irradiated** and a total of 26 failures have occurred during radiation." (10) • "Consideration is being given to the recycling of thoria irradiated at Hanford, because only a small portion (1%) of the thorium is consumed in each reactor cycle for producing U-233."
08.28.67	DUN-3034 "Irradiation of On-Site Recycled Thoria"	• "Thorium 232, in the form of thorium oxide (thoria), is irradiated in the DUN operated reactors to produce U-233 and to provide protective fringe poison." (3) • "The quantity of unirradiated virgin thoria is approaching a level where recycle will become necessary." • Atlantic Richfield Hanford Company reports that it had approx. 200 T of thorium on site, in the form of thoria nitrate solutions resulting form the chemical processing of previously irradiated thoria elements in production operations. (P. Lavelle's summary)
08.15.68	DUN-4462 "Production Test Authorization 149 Large Scale Thoria Wafer Irradiation."	• "The **K reactors** are **currently involved in** producing approximately **460 kg of U-233 for the AEC**. The product as delivered is to contain not more than 8 ppm U-232 as a lot-to-lot average and less than 0.5 percent U-238." (3) • "With the potential of reducing the U-238 contaminant levels in the U-233 in line with making a concerted effort to produce the highest quality end product possible, this test merits conductance on a priority basis." (4)
09.18.68	DUN-4737 "Thoria Delivery Schedule"	• **FY** — **Tons of Thoria** **69-70** — **170** **71** — **24** **72** — **24** **73** — **20** **Total: 239 T Th.**
04.02.69	DUN-5660	• "The program to irradiate thoria to produce U-233 for the DNR commitment was reviewed and reevaluated . . . and indicated that **at least one extra core** beyond irradiations shown in the Study Forecast . . . **would be necessary**. To allow ARHCO . . . to meet the DNR specifications, consideration should be given to irradiating two cores of thoria beyond the 12 cores shown in the reference document . . . ." • **Core No. 13 would add 23 kg. U-233 and Core No. 14 would add 20 kg. U-233.**
05.21.69	DUN-5841	• "Approximately **60 T of thoria** are being diverted to the **wafering process** and represent essentially **all of the material remaining to be irradiated in the current campaing including the additional cores**." (3) • ". . . care must be taken to assure that the **200 Area** shipment summaries clearly define the wafer thoria model and corresponding contaminant category." (4) • "The 300 Area will ship its entire remaining inventory of K3T thoria target elements to the K Reactors during the week of May 12, 1969.
02.06.70	SOP # 132.01 "Thorium Process –	• "The organic overflow from the Co-Decontamination Cycle (HAP) contains thorium, U-233 and fission products. . . ." (Rest of memo goes on to explain

	General Description"	difference between thoium-U-233 processing and uranium-plutonium processing."
02.13.70, etc.	SOP # 136.11 PUREX Plant documents.	• G Cell Solvent System Thorium Operation • E Cell • D Cell • SOP # 136.12 09.24.70 10% Nitric Flush of Tk-G1 and TK G-8 "in order to remove any uranium that has been held up" • R Cell Solvent System • R Cell Solvent System "Thorium Operation Emergency Shutdown" • R Cell Solvent System "Thorium Operation – Startup" • R Cell Solvent System "Thorium Operation TK-R8 Disposal" (SOP No. 137.08)
03.03.70	DUN-6790 "Irradiated Thoria" <u>But See</u> DUN-5866 "Irradiated Thoria", which has same dates and key codes, but slightly different (and higher) production numbers. <u>See Also</u> ARH-1642 below which summarizes KE & KW Thorium data	• Summarizes thoria irradiated in B, C, D, KE and KW reactors. Also lists the U-232 ppm count and the U-238 ppm count. <u>#</u> <u>Date</u> <u>Tons Thoria</u> <u>Kg. U-233</u> B 09.66 – 02.68 20.10 25.221 C 11.66 – 06.68 25.60 43.765 D 01.67 – 07.67 14.35 19.968 KE 07.66 – 01.70 171.82 236.485 07.66 – 09.67 35.45 47.135 KW 02.66 - 09.67 46.43 46.833 05.68 – 10.69 143.82 200.445 02.70 – 03.70 N/A 6.3 **TOTALS: ~457.57 Tons 626.152 Kg**
04.07.70	SOP # 134.03 "Second Uranium Cycle Th Operation Pre-Startup"	"The purpose of the pre-startup procedure is to ascertain that the Second Uranium Cycle equipment, aqueous makeups and associated piping routes are ready for operation."
06.23.70	SOP 135.01 "Third Uranium Cycle Thorium Operation General Description"	Many separate documents that follow all re: third uranium cycle.
07.29.70	SOP # 134.01 "Second Uranium Cycle Thorium Operation General Description"	"The processing of U-233 through the J21 tank and J22 and J23 columns presents critical mass control problems not encountered during normal uranium-plutonium processing."
09.03.70	SOP # 140.16 "Unloading Thorium Nitrate Solution from Truck Trailer"	"Thorium nitrate solution is received form Purex Plant by Truck Trailer to be unloaded and stored in 50,000-gallon capacity tanks in 241-WR Vault Area. It can be pumped to any one of four storage tanks (006-007-008 or 009). It can also be unloaded and stored in any one of three storage tanks at Redox (204-1, 204-2 or 204-3). These tanks are approximately 50,000-gallon capacity."
09.21.70	SOP # 141.01 "Thorium Campaign: Special Operating Procedure"	"The last of the high U-238 thoria should be charged on or about September 21. The plant will go into a special shutdown for turnaround to specification U-233 (low U-238)."
09.23.70	SOP # 142.02 "Thorium Campaign, Special Operating Procedure, DNR Headend Startup" PUREX Plant	"The dissolvers will be ready to receive the first DNR thoria on or about September 24, 1970. The downstream tanks TK-D5 and E6 may still contain high U-238 metal solution. The dissolvers will start dissolving DNR thoria and the metal solution will be stored in the downstream tanks until tankage is full before starting the solvent extraction process."
09.30.70	SOP 133.04 "Final Thorium Cycle Thorium Operation Startup"	"The purpose of this procedure is to start, and bring up to rates, the Final Thorium Cycle, while minimizing thorium losses."
10.08.70	SOP # 138.10 "Fresh	"During the thorium run it has been necessary to make up nitric acid as a greater amount

	Acid Makeup Thorium Operations"	of acid is removed form the inventory as combined nitric in the thorium product."
10.29.70	SOP # 140.01 "General Description of U-233 Product Handling"	Great description of the program. Stored at the U-221 Pipe Gallery (see also SOP.#140.06)
11.09.70	Ltr from G. L. Ritter of Atlantic Richfield Hanford to O.F. Beaulieu	"Headend operations and feed accumulation have continued since the Nov. 6, 1970 shutdown. As soon as sufficient feed has been collected to fill tanks F12, D5, E6, and H1, solvent extraction processing will commence. Startup is tentatively scheduled on or about Nov. 11, 1970. The Plant will continue to process specification U-233 (low U-238)."
12.01.70, etc.	e.g. "Post Thorium Flush Chemical Flush J Cell Package" All at PUREX Plant	Series of documents describing the processes of thorium runs and flushing to remove trace quantities of U-233 and thorium. • J Cell • L Cell – including the 3AF (J5) tank, 3A (T-L1) and 3 (T-L2) columns • Documents re: decontamination of U-233 with respect to thorium • Vent headers in N Cell • 203-A piping post thorium flush
No Date	ARH-1642 "CY 1970 DNR Thoria-U-233 Data"	• "The attached data describe the thoria irradiated and U-233 produced for the ------ campaign: [KE & KW Powder and Wafer Elements:] 311.2 Tons Thoria 434.8 Kg U-233 7.8 ppm U-232"
06.09.70	DUN-7033 "Thoria Data Analysis"	• "Thoria is irradiated in the Hanford reactors for the production of U-233. The product quality is acutely sensitive to the control of the unseparable contaminant isotopes U-232 and U-238. . . . The problem statement . . . is as follows. The U-233 content and U-232 and U-238 contaminant levels forwarded to ARHCO are strictly key averages. . . . "
04.11.77	"U-Th FUEL FABRICATION / REPROCESSING" Comments of Ripfel, Advisory Engineer.	"Based upon this review, the U-Th fuel fabrication/reprocessing is judged to be technically feasible. The next step is to select the fuel cycle scheme and evaluate it in terms of economics, resource utilization, and, eventually, commercialization. Simultaneously, the fabricabilility of MOX U/Th pellets, with typical FBR wt% U-233, should be established and scoping for characterization initiated."
09.28.79	UNI-1400 "Evaluating the Feasibility of Thorium Irradiations in N Reactor to Produce U-233 – A Status Report."	• "Interest in alternate fuel cycles using U-233 as the prime fissile isotope stimulated inquiries into U-233 production capabilities at the Hanford N Reactor." (1) • "Considerable experience was accumulated at the Hanford Single Pass Reactors (SPR) for producing U-233 from thorium metal and thoria. Different loading arrangements were explored to maximize U-233 production with a minimum of U-232 contamination." (1) • "**Preliminary studies relating to thorium irradiations in N Reactor for the production of U-233 were initiated in FY-1978**." (1) • "The purpose of this report is to document the work completed to **define an approach to irradiating thorium in N Reactor to produce U-233**. . . . The effort represents a start in establishing a thorium irradiation program in N Reactor. The preliminary calculations indicated that significant quantities of U-233 could be produced in N Reactor. The __product fuel design is not suitable for clean U-233 (less than 10 ppm U-232) production" (2) • "U-232 and U-233 production figures from thorium irradiation tests in D, F, and K Reactors were compared with predictions calculated DCODE and HAMMER_ISOGEN." (2) • "Thorium is a naturally occurring element composed mainly of the Th-232 isotope with some Th-230 contaminant. By capture of neutrons Th-232 can be converted to U-233, a useful fissile isotope." (3) • "The U-232 chain presents special radiological hazards due to the presence of 2 Mev decay gammas from Th-228, a member of the decay chain." (4)

		• **"Large scale irradiations of thorium performed in the K reactors were preceded by special test irradiations in F, D, and K reactors. The special tests provided information on optimizing of U-233 production and minimizing contamination by U232. Special efforts were pursued to achieve U-232 contamination level below 10 ppm." (4)** • " . . . the amount of U-233 produced per ton of thorium metal is 2050 g/ton at 1500 MWD/ton of U exposure. There are 54 tons of thorium in the reactor at any one time. For 233 full power operating days at a power level of 3860 MWt . . . , an estimated 250 kg of U-233 could be produced per year. The calculated U-232 concentration would be approximately 45 ppm U-232 in U-233. . . . A super cell type fuel to target arrangement should result in a softer neutron spectrum near the targets resulting in lower quantities of U-232 contamination in the product." (9)
	Handwritten notes – 1st page reads "Myrnalloy = thorium Early 1950's"	• 2 campaigns b/w 1967 – 72 • Recovered from the Purex waste stream • Hanford had a lot of thorium cans stored up. • "Thorex" process – a solvent extraction process for treating irradiated thorium to recover purified U-233 • 1965 Campaign: used "powder – called "Thoria process Flow" (thorium oxide). Bldg 3732. • 1967 – then went to Thoria wafer process, in bldg 3722. Made wafers, but then brought to bldg. 3732 to can. • Thorium metal won't dissolve in nitric acid. "Moore discovered you must add fluoride to the nitric acid to act as a catalyst and then the thorium dissolves just fine. But, fluoride is a bad waste product – you don't want this in your waste."
03.22.94	"Request to Dispose of Material as Waste"	Request that thoria be transferred to an EM project account and approved for disposal as [LLW] waste at WHC.

* DUN-4475 "Uranium Content in Incoming Thoria"

Dates Thoria Rec'd	Pounds Received	Converted to Tons
05.23.68 – 06.25.68	82,000	41
06.04.68 – 07.02.68	72,000	36
06.24.68 – 08.26.68	70,000	35
07.08.68 – 09.24.68	76,000	38
09.10.68 – 09.24.68	42,000	21
09.24.68 – 10.25.68	40,000	20
10.25.68 – 11.08.68	32,000	16
11.08.68 – 11.25.68	32,000	16
12.03.68 – 01.21.69	24,000	12
12.27.68 – 01.27.69	38,000	19
02.26.69	4,000	2
02.06.69 – 03.19.69	44,000	22
02.26.69 – 06.16.69	52,000	26
06.30.69	8,000	4
May 1968 to June 1969	616,000 lbs.	308 Tons