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Title: Acceptable Knowledge Summary Report for Combustible/Noncombustible, Metallic, and HEPA Filter Waste Resulting from

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Transuranic Waste Characterization/Certification Program
Cover Sheet

Acceptable Knowledge Summary Report for Combustible/Noncombustible, Metallic, and HEPA Filter Waste Resulting from ^{238}Pu Fabrication Activities

Waste Streams:
TA-55-43
TA-55-44
TA-55-45
Ta-55-46
TA-55-47
Facility: TA-55

Date: **February 19, 1998**

Print Name	Signature	Date
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ACCEPTABLE KNOWLEDGE SUMMARY REPORT

COMBUSTIBLE/NONCOMBUSTIBLE, METALLIC, AND HEPA FILTER WASTE RESULTING FROM ^{238}Pu FABRICATION ACTIVITIES

Introduction

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term of AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. The *Department of Energy, Carlsbad Area Office, Transuranic Waste Quality Assurance Program Plan* (QAPP) defines AK and provides guidelines on how acceptable knowledge should be obtained and documented. This AK package has been prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.2).

This report covers acceptable knowledge information for five waste streams generated at TA-55 during operations to fabricate various heat sources using feedstock ^{238}Pu supplied by the Savannah River Site (SRS). The ^{238}Pu feedstock itself does not contain quantities of RCRA-regulated constituents above regulatory threshold limits, as known from process knowledge at SRS and as confirmed by chemical analysis. No RCRA-regulated chemicals were used during ^{238}Pu fabrication activities at TA-55, and all ^{238}Pu activities were physically separated from other plutonium processing activities. Most of the waste generated from the ^{238}Pu fabrication activities is thus nonmixed waste, including waste streams TA-55-43, 45, and 47. The exceptions are waste streams TA-55-44, which contains discarded lead-lined rubber gloves used in the gloveboxes that contained the ^{238}Pu material, and TA-55-46, which may contain pieces of discarded lead. These waste streams have been denoted as mixed because of the presence of the lead-containing material.

1. Methodology of AK Information Search

The AK search for the information related to waste streams TA-55-43 through 47 covered:

- Review of documents related to the waste generation and waste management activities at TA-55 as listed on the *Acceptable Knowledge Roadmap* (Attachment 1) [analysis records, reports, databases, and memorandums]

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the *Acceptable Knowledge Roadmap*

- Analysis of processes generating waste and of the potential maximum concentrations of RCRA-regulated constituents produced in the waste by those processes, as documented in chemical analysis results and memoranda from waste management experts at TA-55.

The *TWCP Records Center* contains copies of the documents that are referenced in this summary report.

2. Description of the TA-55 ^{238}Pu Waste Streams

- **Facility and Mission**

The TA-55 facility, building PF4, 200 wing, rooms 204, 205, 206, and 207, were used exclusively to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. A map of the TA-55 facility is attached to this report (see Figure 1). The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55 because cross-contamination of the materials would adversely affect the quality and usability of the end products (*TWCP-1037*). The ^{238}Pu activities consisted of heat source fabrication both for defense missions (the Milliwatt Generator Program, *TWCP-1045)* and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled (*TWCP-887*). The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (*TWCP-1037*). All the fuels possess approximately the same weight percent ^{238}Pu, so there is no distinguishing isotopic signature among the fuels of the various projects.

- **Waste Physical Form**

The TA-55 ^{238}Pu waste streams are differentiated on the basis of bulk material content and the presence or absence of lead. The TA-55-45 metallic debris waste stream is defined as a retrievably stored (RS), nonmixed waste stream. The waste is metal waste generated from facility and equipment operations and maintenance. This includes metal scrap, small tools, small equipment items, motors, pumps, and process equipment. Only a small fraction of plastic (used as packaging and not in direct contact with the waste material) is present in this waste stream. Most of this waste was packaged in small, metal cans before being placed in 55-gallon drums. The TA-55-46 metallic debris waste stream is similar to its TA-55-45 counterpart, except that the waste containers may contain pieces of waste lead. The TA-55-43 combustible/noncombustible debris waste stream, also defined as RS nonmixed, includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during ^{238}Pu activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain noncombustible glass and metallic debris. Some of this waste was packaged in small, metal cans before being placed in 55-gallon drums. The TA-55-44 combustible/noncombustible debris waste stream is equivalent to the previous waste stream except that it contains leaded rubber gloves or lead scrap. The lead items are clearly visible on radiographic examination. The TA-55-47, RS, nonmixed waste stream contains used HEPA filters with only minor amounts of other materials.

- **Waste Content Description**

The waste in these waste streams was generated from 1979 until the present, and spans the time before and after implementation of the *Los Alamos Transuranic Waste Certification Plan (Certification Plan)* in 1984 (*TWCP-697*), its approved *Generator Attachment for TA-55* in 1987 *(TWCP-701)*, and associated generator procedures and QA programs. All waste containers have waste origination and disposition forms (WODFs), originated by the generator, that describe the contents of the container. The *LANL Certification Plan* required use of an assigned content code system or, after mid-1991, of the LANL Waste Profile Request form (WPRF) (*see Attachment 2 for an example of a WPRF*). Both systems required the waste generator to sign a statement noting the RCRA hazardous constituents of the waste (*see Attachment 3 for an example of a WODF*). All containers generated after 1987 also have signed generator statements indicating that the waste contains no constituents restricted by the current WIPP Waste Acceptance Criteria (WIPP WAC) (*see Attachment 3 just above the block for Section II*).

Waste generated prior to 1987 was generated through the same processes and therefore contains similar materials. In particular, explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process (*TWCP-1037*). No statements signed by the generator attesting to the absence of free liquids are available prior to 1987. However, process descriptions indicate that free liquids were not produced as part of the waste stream (*TWCP-1037*), and an easy source of disposal for liquids was available through radioactive waste drain lines leading to the Radioactive Liquid Waste Treatment Plant (TA-50, Bldg. 1). In addition, the material content of each drum will be carefully examined by real time radiography to ensure that the drum conforms to its expected material content and contains no free liquids above the WIPP WAC limits.

The WPRF was, and still is, the LANL-wide system for reporting RCRA information on waste (*LANL WAC*). Waste may not be generated until the prospective generator attends "Waste Generator Training" and completes a WPRF, describing the chemicals and process that will be used in generating the waste. The WPRF is submitted to waste management reviewers, who assign the appropriate EPA hazardous waste codes and return the approved WPRF to the generator, who may then begin to generate the waste. An approved WPRF is assigned a reference number for identification and tracking purposes. Any change in materials or process requires submittal of a new WPRF, which is given a new reference number when it is approved.

- **Waste Stream Volume and Time Period of Generation**

The period of generation of the ^{238}Pu wastes is from 1979 until the present. From 1979 through 1997, $^{238}PuO_2$ was processed at TA-55 for development tasks and for heat source fabrication for the defense-related Milliwatt Generator Project (*TWCP-XXX1*) and for NASA. The latter included the General Purpose Heat Source (GPHS) developed in the late 70s and early 80s and produced for the Cassini mission from 1992 to 1997. The Lightweight Radioisotope Heater Unit (LWRHU) developed in 1979 and 1980 was produced in 1984 and 1985 for the Galileo mission and the Cassini mission from December 1993 through 1995. Milliwatt generators were fabricated from the beginning of ^{238}Pu operations at TA-55 in 1979 through September of 1990. Since then, personnel have disassembled these generators in the same gloveboxes to the present time (*TWCP-1029* shows that the Milliwatt Generator Program is still funded by defense programs).

The volumes of the waste streams containing ^{238}Pu materials, particularly as they will be packaged to ship to the WIPP, cannot be determined at this time due to two factors. First, the majority of the ^{238}Pu wastes were packaged at high ^{238}Pu loadings, with some combustible material drums containing as much as 10-20 grams of ^{238}Pu and several metallic material drums containing up to 70 grams ^{238}Pu. These drums must be divided and repackaged to meet the thermal wattage limits for shipping. The ^{238}Pu waste that contains combustible materials may be shipped in drums, standard waste boxes (SWBs), or as loose material in ten-drum overpacks (TDOPs), depending on the configuration of items in each drum and the location and type of repackaging campaign used to prepare the waste for shipment to WIPP. Therefore the as-shipped volume is difficult to estimate at this time.

Second, some of the existing waste drums contain small cans filled with filter cake (also called hydroxide cake, *TWCP-1037*) generated from treatment of analytical solution residues and decontamination solutions. In this treatment process, up to four liters of these solutions are mixed with ferric nitrate solution. The insoluble metal hydroxides are precipitated by caustic treatment with sodium hydroxide solution, and the precipitate is collected by filtration. If the filtrate is above the acceptable radioactivity discard limit for the caustic waste line to TA-50, this ferro-floculation is repeated and the precipitate added to the previous filter cake. The filter cakes are heated at 600 - 800 C for about 5 hours to form a dried filter cake that is discarded with the other solid TRU wastes. At this time, analysis information is not sufficient to prove that the precipitate is below regulatory threshold limits for RCRA metals. Drums containing these cans, and any combustible, noncombustible, or metallic wastes generated in the filter cake process, are clearly denoted on waste packaging records as containing items from the filter cake process, identified under process status code (P/S) R8 on the WODF. The process status code is also listed on the TA-55 TRU Waste Databases (*TWCP-1043*). Drums containing items from process R8 will be handled in one of two ways. Either the item will be removed during the repackaging already required to bring the waste container into compliance with the shipping wattage limits, or the entire container will be assigned to a waste stream denoted as containing mixed waste.

- **Waste Stream Generation Process**

The ^{238}Pu for all those efforts was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified ^{238}Pu contains no RCRA constituents (*TWCP–1044*). The ^{238}Pu processes at TA-55 use no organic solvents. Also, the oxide feed materials do not contain any organics. If the oxides did contain organics, the latter would be boiled off or destroyed by the high temperatures used in the fabrication processes.

Figures 2, 3, and 4 illustrate the three processing paths for the heat sources. The first step in each of the processes is O^{16} isotopic exchange that occurs at 775 C. In General Purpose Heat Source (GPHS) and Lightweight Radioisotope Heater Unit (LWRHU) processing, that exchange is followed by heating to 1000 C to release the alpha decay helium from the PuO_2 crystal structure. The milliwatt processing scheme later seasons all the granules at 1600 C while GPHS and LWRHU season a portion at 1600 C and a second portion at 1100C. The latter two processes ultimately hot press the pellets at 1530 C and later heat treat the pellets at 1000 C and finally at 1527 C. By contrast, the milliwatt process mixes the PuO_2 with powdered yttrium metal and heats it at 1350 C to form a sub-stoichiometric plutonium oxide. These temperatures are so high as to ensure that any organic material that might have been present in the initial feedstock would not survive in the fuel.

The primary chemicals used in processing are a mixture of nitric and hydrofluoric acid in water for decontaminating the fuel clads. Those solutions are corrosive. The clad heat sources are immersed in the solution a minimum of three times to allow the acids to dissolve any PuO_2 particles on the clad surface. Each time, the heat sources are removed from the acid solution and placed on a rag that is damp with water. A rubbing action removes contamination while the heat of the source causes the acid solution and water in the rag to evaporate at a fairly rapid rate. The damp rags presented for disposal have inadequate liquid to allow testing for pH and therefore cannot exhibit the corrosive characteristic (*TWCP-1037*). The TRU acid solutions generated by the decontamination steps are neutralized to precipitate the plutonium, and the filtrate is discarded through the caustic waste line to TA-50. The plutonium precipitate is discarded as waste stream TA-55-48. The only other process chemical, UCAR C-34, is a cement for sealing the graphite aeroshell of the LWRHU heat source assembly. The cement is not RCRA-regulated (*TWCP-1027*).

- **Process Flow Diagrams**

Simplified process flow diagrams of the three TA-55 processes that generated the ^{238}Pu waste streams are included as Figures 2, 3, and 4 for convenience of the reader.

- **Material Inputs to the Waste Generation Process**

Physical Waste Form Identification

The ^{238}Pu activities generate contaminated combustible waste from consumable materials used in all process activities:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment (PPE) such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

Noncombustible waste consists primarily of metallic or glass waste. Metallic waste is generated from materials such as metal scrap, small tools, cans, small equipment items, motors, pumps, and process equipment. Glass waste is generated from facility and equipment operations and maintenance and includes broken glass, discarded labware, windows, and bottles. HEPA filters are generated from facility and equipment operations and maintenance.

The material content of each waste item generated after May 1, 1987 was documented on a Waste Origination and Disposition Form (WODF) completed and signed by the waste generator according to controlled procedures. The waste generator's supervisor also is identified on the WODF. TRU waste drums, containing one or more waste items, were packaged by group NMT-7 (also known at various times as MST-12, MST-17, or NMT-2) according to procedures referenced in the applicable version of the *TA-55 Attachments* to the *Certification Plan*. *Attachments* referenced as *TWCP-701* (1987) and *TWCP-700* (1995) clearly indicate that waste items were independently verified before packaging (*see for example TWCP-701, Section 3.5.2, page 11 of 34*). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item ID number and record its matrix material. This form was signed by the waste packager, reviewed and approved by QA personnel, and verified by an NMT-7 staff member. Both the WODFs and DWLS for each TRU waste drum have been maintained as hard copy records by the generator and by the EM-SWO records management center; copies of the forms are available from those sources by request.

Radionuclide Content Identification

The primary plutonium material inputs for the ^{238}Pu activities at TA-55 are listed in reference *TWCP-698*. The material type MT83 was documented on the WODF and DWLS. This material type gives the major radionuclide components of the waste but gives a range for the ^{241}Am content by calculation (*TWCP-698*).

Raw data on the actinide impurities in several PuO_2 as-received fuel lots is available *(TWCP -1040)*. Analyses of actinide impurities in the feed for LWRHU production have been summarized in a LANL report (*TWCP-1030*) and are reproduced in Table 1. The isotopic compositions given in Table 1 are not necessarily representative of the isotopic content over the entire time period of generation of the ^{238}Pu wastes. Therefore, the content of any additional radionuclides present in detectable quantities in the waste will be determined on a container-by-container basis using gamma spectroscopy. The characterization information obtained by gamma spectroscopy will be compared with the acceptable knowledge baseline represented by Table 1 according to *Reconciliation of Waste Stream Information* (TWCP-QP-1.1-028).

Table 1. Actinide Impurities in PuO^2 Fuel Lots for Cassini

	Los Alamos Fuel Lot (ug/g Pu)				
Isotope	**272**	**274**	**275**	**285**	**286**
232Th	1700	1800	2300	2190	1845
234U	300	190	1070	720	615
236Pu	<1	<1	<1	<1	<1
237Np	1030	1060	1460	1500	1545
241Am	46	49	71	29	36

Chemical Content Identification

According to process descriptions (*TWCP-1037*), the only chemicals present in the waste are PuO_2, yttrium, nitric acid and hydrofluoric acid residues, and UCAR C-34 cement residues.

Other chemicals of concern for disposal at WIPP that are not included in the EPA listings are bromoform; cyclohexane; 1,1-dichloroethane; *cis*-1,2-dichloroethylene; formaldehyde; 1,1,2,2-tetrachloroethane; antimony; beryllium; vanadium; and zinc. The organic chemicals are not present in the waste because they were not introduced during processing and because the high temperatures used in processing would have destroyed these compounds if they had been present in the input material or in the process. Beryllium and zinc are known from analysis to be present in trace amounts in the PuO_2 input material. Analyses for antimony and vanadium were not conducted.

3. Division of the Waste Stream into Sub-Streams

The waste streams produced through ^{238}Pu heat-source fabrication activities at TA-55 will be divided into sub-streams based on the TWCP characterization and certification schedule of activities.

4. Correlation Among Waste Streams

The ^{238}Pu wastes generated from TA-55 between 1979 and the present were all generated as part of the same heat source fabrication processes, which were physically separated from all other TA-55 activities. Thus the ^{238}Pu waste streams, TA-55-43 through-47, are all closely related to each other but not at all related to other waste generation activities at TA-55 involving ^{239}Pu. Another TA-55 waste stream is differentiated from waste streams TA-55-43 and TA-55-44 because it includes items generated from process R8.

5. Assignment of Waste Matrix Parameter Code

Waste Streams TA-55-43 and TA-55-44

This waste matrix consists of mixed combustible/noncombustible waste. The waste matrix parameter code S5000 is the most detailed that can be assigned to the entire waste stream. Individual containers will qualify for codes S5300 or S5400 based on glass or metal content. These detailed codes may be assigned on the basis of generator records (WODFs) and/or radiography examination. Cellulosic and plastic materials were not segregated at TA-55, so assignment of codes more detailed than S5300 is not possible [waste segregation practices are described in the *TA-55 Waste Management Procedure, 1996 (TWCP-351)*, and a description of past segregation practices is contained in *TWCP-701, Section 2.1, page 4 of 43*].

The following are other codes applied to the waste from the Transuranic Waste Baseline Inventory Report (TWBIR), the Radioactive Solid Waste Disposal form (RSWD), and the Item Description Code (IDC).

- MWBIR LA-T12, LA-T16 (for items in TA-55-43) and
  LA-M12, LA-M16 (for items in TA-55-44)
- TWBIR LA-T004 and LA-T005
- RSWD A14, A15, A16, A18, A19, A35, A47, A60, A61, A72, A74, A77
- IDC 004, 005

Waste Streams TA-55-45 and TA-55-46

The waste matrix parameter code S5111 can be assigned to waste stream TA-55-45 based on knowledge of the waste matrix from generator records (WODFs) and process knowledge indicating the absence of lead and cadmium. The waste matrix parameter code S5112 can be assigned to waste stream TA-55-46 based on knowledge of the waste matrix from generator records (WODFs).

The following are other codes applied to the waste from the TWBIR, the RSWD, and the IDC.

- MWBIR LA-T10 (for items in TA-55-45) and LA-M10 (for items in TA-55-46)
- TWBIR LA-T005
- RSWD A30, A31, A50, A51, A52
- IDC 005

Waste Stream TA-55-47

The waste matrix parameter code S5410 is assigned to this waste stream based on specific statements by the generator on the WODF that the waste matrix contains HEPA filters.

The following are other codes applied to the waste from the TWBIR, the RSWD, and the IDC.

- MWBIR LA-T12
- TWBIR LA-T004 and LA-T005
- RSWD A55
- IDC none specific for segregated HEPA filters

6. Assignment of Waste Material Parameters

The following waste material parameters are assigned to waste streams TA-55-43 and TA-55-44 based on (1) waste segregation practices described in the *TA-55 Waste Management Procedure, 1996 (TWCP-351)*; (2) description of past segregation practices *(TWCP-701, Section 2.1, page 4 of 43)*; and (3) generator descriptions of waste items on the WODFs:

- Cellulosics
- Plastics (waste materials)
- Rubber
- Iron-based Metals/Alloys
- Aluminum-based Metals/Alloys
- Other Metals
- Other Inorganic Materials
- Steel (packaging materials)
- Plastics (packaging materials)

These materials are compatible with the descriptions for TRUCON code LA116 and LA125.

The following waste material parameters, are assigned to waste streams TA-55-45 and TA-55-46 based on (1) waste segregation practices described in the *TA-55 Waste Management Procedure, 1996 (TWCP-351)*; (2) description of past segregation practices *(TWCP-701, Section 2.1, page 4 of 43)*; and (3) generator descriptions of waste items on the WODFs:

- Iron-based Metals/Alloys
- Aluminum-based Metals/Alloys
- Other Metals
- Plastics (waste materials) (<5% by volume)
- Steel (packaging materials)
- Plastics (packaging materials)

These materials are compatible with the description for TRUCON codes LA117 and LA118.

The following waste material parameter codes are assigned to waste stream TA-55-47 based on (1) waste segregation practices described in the *TA-55 Waste Management Procedure, 1996 (TWCP-351)*; (2) description of past segregation practices *(TWCP-701, Section 2.1, page 4 of 43)*; and (3) generator descriptions of waste items on the WODFs:

- Cellulosics
- Plastics (waste materials)
- Iron-based Metals/Alloys

- Aluminum-based Metals/Alloys
- Other Metals
- Steel (packaging materials)
- Plastics (packaging materials)

These materials and the waste matrix are compatible with the description for TRUCON code LA119.

7. Assignment of EPA Hazardous Waste Numbers

The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents (*TWCP–1044*). The ^{238}Pu processes at TA-55 use no organic solvents. Also, the oxide feed materials do not contain any organics. If the oxides did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C.

Strict acceptance specifications control the level of impurities allowed in the final heat source fuel. In the course of processing the $^{238}PuO_2$ fuels at TA-55, none of the steps intentionally purify the fuel. Thus, if the final heat source pellets are to meet impurity specifications, the impurity levels in the oxide powder feed and/or the seasoned granules must be known. This leads to analysis of all lots of the ^{238}Pu process input material, and many of the processed granules, used in the TA-55 processes (*TWCP-1025,1026, and 1030*). Often process personnel can blend several feed or granule lots to bring the specific impurity levels within specification, but occasionally a feed lot is unusable due to high impurity level(s). The Cassini GPHS units generally had higher impurity specifications and used more impure feed material than with any of the other heat sources because most of the available feed material was needed for the heat sources. The complete data for Cassini GPHS are shown in Table 2 to provide a sense of the influence and control that all the measured impurities exert on the overall purity of the oxide feed. (The highest impurity level was determined by scanning the analysis results for the Cassini program [*TWCP-1040*] indexed with sample numbers L*nnn*S1 and L*nnn*S3, where *nnn* represents all numbers present between 255 and 604.) With so many purity requirements placed upon the oxide, it is not feasible to handle or process the fuel in a way that would introduce impurities, measured or unmeasured, without compromising its integrity. These criteria are the basis for limiting the chemicals and process steps used in the heat source fabrication and for excluding RCRA metals as reagents in the processing steps.

Of the RCRA toxic metals, arsenic, mercury, and selenium were not analyzed in the process input $^{238}PuO_2$ used at TA-55. These three metals were not introduced into the processes either directly or as impurities in the reagents by SRS personnel (*TWCP-1044*). Experts from SRS further stated that they had no reason to expect those metals to be present in the oxide feed that was shipped to Los Alamos for use in the heat source fabrication programs (*TWCP-1037*). The three metals tend to be volatile as the oxide or metal at the processing temperatures described in the "Waste Stream Generation Process" section. Sublimation information, taken from the Handbook of Chemistry and Physics, is summarized in Table 3. No analyses were performed for these elements, but one can conclude that heating the powder at 740°C during the conversion of oxalate precipitate to the oxide at SRS and at 775°C during the O^{16} isotopic exchange would remove any of these species if they had been present and the subsequent processing at even higher temperatures would ensure the removal.

Table 2. Specifications and Highest Analysis Results for Impurities in Cassini GPHS

Element	Impurity Specification, ppm	Highest Impurity Level Found, ppm [A]
Al	500	2200
B	5	70
Be	5	3
Ca	300	600
Cd [B]	**50**	**10**
Cr [B]	**500**	**4050** [C]
Cu	200	8250
Fe	800	3350
Mg	100	130
Mn	50	160
Mo	250	100
Na	250	250
Ni	500	1650
P	25	1900
Pb [B]	**100**	**150**
Si	750	1685
Sn	50	10
Zn	50	625
Al+Ca+Mg+Si	1500	NA
Total [D]	2550	NA

[A]- Based on 565 analyses of 283 feed lots.
[B]- RCRA-regulated metal.
[C]- Avg. Cr value from all lots is 270 ppm.
[D]-Total of measured impurities.

Table 3. Some RCRA metal and oxide behaviors at elevated temperatures

Hazardous Species	Behavior at Elevated Temperatures
As	sublimes at 613°C
As_2O_5	decomposes at 315°C
As_2O_3	sublimes at 193°C, boiling point is 457°C
Hg	boiling point is 356°C
Hg_2O	decomposes at 100°C
HgO	decomposes at 500°C
Se	boiling point 685°C
SeO_2	sublimes at 315° - 317°C
SeO_3	decomposes at 180°C

The SRS aqueous processing to achieve purification of the Pu employs ion exchange (*TWCP-1044*). This process separates mercury from plutonium very well so that mercury should not be present in the product (*TWCP-1038*). The ion exchange eluate is then treated to prepare a plutonium oxalate precipitate in dilute nitric acid. The mercury oxalates are slightly soluble in nitric acid. Selenium and arsenic should, if present, exist chemically as selenious and arsenious or arsenic acid. Both are soluble in dilute nitric acid. Therefore all three of these species will associate with the filtrate rather than finding their way into the plutonium oxalate precipitate and ultimately into the oxide feed. Thus, there is no reason to expect these elements as contaminants in the feed (*TWCP-1037*).

There were no specifications for either silver or barium in this fuel. Some of the initial feeds were analyzed for silver before a decision was made not to expend resources on a constituent that did not have a specification. The highest analytical value found for silver was a relatively low 10 ppm, very similar to cadmium (*TWCP-1040*). There were no analyses for barium, but an upper bound on barium can be set by assuming that all the impurity in the fuel is due to the presence of barium oxide. Pure plutonium oxide has a theoretical plutonium content of 88.2 weight percent. The plutonium content of the typical oxide feed lots was 85.5 to 87+ weight percent (the lowest plutonium content was 83.3 weight percent). Using this worst case value and assuming that all the impurity is barium oxide

$$\text{w\% } PuO_2 = \frac{83.3\text{ \% Pu/g oxide}}{0.882\text{g Pu/g } PuO_2} = 94.44\text{ w\%},$$

$$\text{w\% BaO} = 100\% - 94.44\text{ \% } PuO_2 = 5.56\text{ w\%},$$

$$\text{w\% Ba} = \frac{\text{w\% BaO (at. wt. Ba)}}{\text{(mol. Wt. BaO)}} = \frac{5.56\text{ w\% (137.34)}}{(153.34)} = 4.98\text{ w\% or 49,800 ppm}$$

For comparison purposes, it is helpful to place analytical concentrations in terms of a reference value termed "chromium equivalents" and arbitrarily defined as the ratio of the analytical concentration of an element to the value of its RCRA-defined regulatory threshold limit multiplied by the chromium regulatory threshold value (for totals analysis) of 100 ppm. Because the RCRA limit for barium is 20 times greater than that for chromium, the calculated maximum barium concentration of 49,800 ppm is equal to 2490 ppm in chromium equivalents. The RCRA limits for silver and lead are the same as for chromium. The RCRA limit for cadmium is five times less than chromium so the highest value found for cadmium is equal to 50 ppm in chromium equivalents. When one compares the analytical values for the measured RCRA metals and the worst case barium value in equivalent terms, the highest level is the chromium value in Table 2. In the worst case, chromium is the limiting RCRA metal constituent for the waste stream.

There are no analyses on chromium in the ^{238}Pu waste streams. But there are non-destructive assay (NDA) values for plutonium in the waste and limits on the amount of plutonium that can be contained in the waste matrix. If the plutonium content exceeds the latter value, the item cannot be discarded as waste, but rather must have the plutonium recovered. Because there is no purification built into the processing steps, we know the relationship between the plutonium content and the associated chromium. That is, in the worst case, the chromium is at 4050 ppm in the PuO_2. The highest plutonium discard limit for ^{238}Pu is 18.6g/kg waste associated with the combustibles waste matrix (*TWCP-351, Appendix J*). The maximum total chromium content of combustible waste with the maximum plutonium content is then

$$[Cr] = \frac{\text{ppm Cr/g PuO}_2\text{ (wt PuO}_2)}{\text{1kg waste}} = \frac{\text{4050 ppm Cr (18.6g Pu)}}{\text{1kg waste (0.882g Pu/g PuO}_2)} = 85 \text{ ppm}$$

Recall that this represents the worst case feed and that the feed average for total chromium was a factor of 15 less than this value, or about 6 ppm. Comparing the worst case value of 85 ppm with the regulatory level for total chromium of 100 ppm demonstrates that none of the RCRA metals in the Cassini GPHS oxide feed would cause any of the wastes to be RCRA-regulated.

By comparison, Tables 4, 5 and 6 show that the LWRHU and Milliwatt oxide feeds are even more innocuous in this respect. Only the RCRA metal analytical values are shown for these streams, but due to generally more restrictive specifications for these fuels, the comments regarding feed purity are even more relevant.

Table 4. RCRA metal analytical values for Cassini LWRHU fuel

Impurity Element	Specification, ppm	Average Fuel Value, ppm	Range of Fuel Values,ppm	Source
Cd	none	<10	<10	pellets
Cr	200	106	62-140	pellets
Pb	none	30	5-90	as-received
Total [a]	2550	NA	NA	

[a] - Total of measured impurities.

The data in Table 4 are based on analyses of five feed lots and their subsequent products. Analyses were made on the as-received oxide, the seasoned granules and one pellet from each of 14 pellet lots. (Data are reported in Tables II, III, and IV of *TWCP-1030.*) The results shown in the last column in Table 4 are the highest results from any of the three sources. The specification for chromium was 300 ppm lower than that for the Cassini GPHS fuel. The maximum values for each of the three analyzed RCRA metals were also lower, suggesting an overall better fuel purity. This conclusion is supported by lower results for all but two of the non-RCRA analytes not shown in the table for the LWRHU fuel (TWCP-1030, Tables II and III). Finally, the lowest plutonium content found in this fuel was 86.2 wt %, or 2.9 wt % higher than the minimum for the GPHS fuel (see page 5 of *TWCP-1030*). Again chromium exhibits the highest values when compared on an equivalent basis. We have assumed, on the basis of the volatility of arsenic, mercury, and selenium, that they would not have been present in significant quantities. Furthermore, the better purity of the fuel and preparation by the same processing steps at SRS ensure that the silver and barium levels are lower than chromium on an equivalent basis. Thus, the highest chromium value of 140 ppm compared with 4050 ppm in the GPHS fuel supports the premise that no mixed waste generation resulted from the feeds to the Cassini LWRHU processing.

The LWRHUs prepared for the Galileo mission in 1984 and 1985 used feed materials that exhibited a similar pattern. The analytical values for the three measured RCRA metals shown in Table 5 were based upon the highest values obtained from the analyses of four lots of as-received oxide, two lots of processed granules, and one pellet from each of 13 pellet lots (*TWCP-1025*, Tables II, III, and VIII). Not surprisingly, the highest values arose from the pellets, as the impurities tend to increase in successive processing steps unless the impurity is volatile.

Table 5. RCRA metal analytical values for Galileo LWRHU fuel

Element	Impurity Specification, ppm	Average Fuel Value, ppm	Range of Fuel Values, ppm	Source
Cd	none	<10	<10	pellet
Cr	none	92	25-260	pellet
Pb	none	6	<5-10	pellet
Total[a]	2550	NA	NA	

[a]- Total of measured impurities

While there were specifications for fewer elements, the total measured impurity specification remained unchanged. There was a specification for silicon, for example (*TWCP-1025*, Table II), that was more restrictive at 200 ppm versus 500 ppm for the Cassini LWRHU and 750 ppm for the Cassini GPHS fuel. All but two of the non-RCRA analytes, which are not shown in Table 5, registered lower values in this fuel than in the Cassini GPHS fuel (*TWCP-1025*, Tables II, III, and VIII). The lowest plutonium content in this fuel was 83.2 wt% (*TWCP-1025*, Table IV). These facts point toward a higher fuel purity in the Galileo units.

Chromium exhibits the greatest RCRA impurity level on an equivalent basis, assuming that arsenic, mercury, and selenium are not present in significant quantities due to their volatility at processing temperatures. We assumed that silver and barium levels are less significant due to the better fuel purity and same processing source. The lower maximum chromium value of 260 ppm versus 4050 ppm found in the Cassini GPHS fuel clearly demonstrates that no mixed waste generation resulted from impurities in the feed materials used in the Galileo LWRHU processing.

Milliwatt generators were fabricated from the beginning of ^{238}Pu operations at TA-55 in 1979 through September of 1990. Since then, personnel have disassembled these generators in the same gloveboxes to the present time. The oxide material in 180 feed lots was analyzed spectrochemically for impurities, including five of the RCRA metals. The results were reported as <u>averaged values</u> rather than individual values for feed lots in each of seven different time periods ranging from one to 8 ½ years and incorporating one to 43 lots (*TWCP-1026*). The results in Table 6 show the highest average fuel value for each impurity from any of the seven reporting periods. Some of the specifications varied through this 19-year time frame. In those instances, the specification is given as a range. There was no total impurity specification in this program because there were generally lower specifications on the individual impurities.

This program had specifications for silver and barium for five of the reporting periods including 168 feed lots. Chromium had the highest specification, shown in Table 6, and the highest average levels for silver and barium are significantly less than that for chromium on an equivalent basis. These results are very supportive of the conclusions that silver and barium were lower than chromium on an equivalent basis in the previously discussed fuels, since all the fuels were prepared at SRS. The chromium and lead specifications for this fuel are lower than seen in the above fuels.

Table 6. RCRA metal analytical values for Milliwatt Program fuel

Impurity Element	Specification, ppm	Highest Average Fuel Value, ppm
Ag	none-25	10
Ba	none-25	<6
Cd	25	<10
Cr	150	95
Pb	50	45

The highest average fuel values for cadmium, chromium, and lead are comparable with the average values recorded in Tables 4 and 5 and significantly less than the maximum Cassini GPHS levels shown in Table 2. Comparison of the non-RCRA metal values (not shown, but available in *TWCP-1026*) reveals that the highest average values from Milliwatt were somewhat higher than for the LWRHU fuels for five analytes, comparable for another five analytes, and lower in the case of one analyte. The comparisons suggest a higher fuel purity for Milliwatt than Cassini GPHS.

Because of the common source for the feed material and the previous arguments regarding the unlikely presence of significant arsenic, mercury, and selenium, the data in Table 6 point to chromium as the limiting RCRA material on an equivalent basis. The highest average chromium value of 95 ppm in Milliwatt fuel is well below the 270 ppm average found in Cassini GPHS fuel. This clearly indicates that no mixed waste generation resulted from impurities in the feed materials used in the Milliwatt Program.

The potential also exists for the presence of toxicity characteristic compounds due to off-gassing and the decomposition of the waste itself. In TRU wastes, the decomposition process is accelerated by radiolysis, the reaction of energetic particles produced by the decay of transuranic elements with the material in the waste. Radiolysis leads to the well-known generation of hydrogen in TRU wastes. Experimental studies have demonstrated that radiolysis also can lead to the generation of several organic compounds through decomposition of waste materials, particularly polyvinyl chloride plastic *(TWCP-1051)*. Breakdown of off-gas products in the gas phase through radiolysis is also possible. Many different organic compounds have been observed to form through radiolytic decomposition of the original waste materials, with acetone detected as the compound produced in highest concentration from all waste materials tested *(TWCP-1051)*.

Compounds formed through radiolytic decomposition would not be noted in the process knowledge for the waste generation process.

Some mixed waste does arise because the waste matrix is hazardous. The waste materials that fall into this category are leaded gloves and any lead metal used in the gloveboxes as shielding. The WPRF identify these wastes back to May 1, 1991 when the Laboratory implemented the use of those forms. That information is verified up by the WODF at TA-55. The latter requested generator information on hazardous constituents in the waste beginning on July 6, 1987. The TA-55 Waste Management Team began recording hazardous materials such as lead containing waste on the Discardable Waste Log Sheet (DWLS) and the Certified Waste Storage Record (CWSR) on May 1, 1987 (*TWCP-1037*). Clear records of leaded gloves and lead metal in TRU waste go back at least that far, and are summarized in the TA-55 TRU Waste Database. Only leaded gloves were used in the ^{238}Pu operations prior to that time (*TWCP-1037*). A search of individual container records will be used to determine if leaded gloves and lead metal are clearly identified in the waste container prior to May 1987. Radiography will be used to confirm the presence or absence of lead because it can easily identify lead objects.

8. Verification that ignitable, reactive, and corrosive wastes were excluded

Description of the processes used in producing the ^{238}Pu wastes indicates that the waste is not ignitable, reactive, or corrosive (not applicable for non-aqueous waste). After 1984, the waste generator indicated this in signed statements based on knowledge of process and recorded on the WODF or WPRF. Studies conducted in 1983-1985 to verify the waste content of 18 older drums of ^{238}Pu waste found no reactive, ignitable, or corrosive wastes (TWCP-1028, Appendix 2). Only one waste container was observed to contain a can of damp material, which had a measured pH of 3 (*TWCP-1028, page 55*). This material was labeled in the report as "corrosive," although this is not consistent with the current EPA definition which defines an acidic corrosive material as having a pH less than or equal to 2.

9. Verification that incompatible chemicals were prohibited

Descriptions of the processes used in heat source fabrication indicate that only a few chemicals, limited to acids and adhesives, were involved (*TWCP-1037*). Since the rags used to wipe parts dipped in the acids were essentially dry when discarded, they are assumed to contain only trace amounts of the acids. Thus, the rags are compatible according to the chemical lists for the TRUCON codes LA116 and LA125. Waste packaged under TRUCON codes LA117 and LA119 do not contain these rags as components of the waste.

10. Verification that there are no compressed gases, free liquids, nonradionuclide pyrophorics, sealed containers greater than 4 L in volume, nor >1% radionuclide pyrophorics

Descriptions of the processes used in heat source fabrication indicate that no compressed gases or pyrophorics were used. The ^{238}Pu is maintained in the oxide form for heat source production, so that radionuclide pyrophorics were not present in the processes producing these wastes. Waste generated after the 1987 implementation of the *Certification Plan, Generator Attachments for TA-55*, associated waste packaging procedures, and QA system has a generator-signed statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The *TA-55 Attachment* to the *LANL Certification Plan* describes how these restrictions were verified by waste management personnel (*TWCP-701, Sections 3.8.5-3.8.7*). Waste management packaging records did not specifically mention exclusion of sealed containers greater than 4 L; however, knowledge of this process shows that waste was not packaged in sealed containers. Closures on plastic bags used for packaging were limited to tape closures (*TWCP-701, Section 3.5.3.2, first sentence on page 13 of 34*). The absence of compressed gas cylinders, free liquids, and sealed containers (other than taped plastic bags) greater than 4 L in volume will be confirmed for each waste container through radiography. Studies conducted in 1983-1985 to verify the waste content of 18 older drums of ^{238}Pu waste found no compressed gases, free liquids, or powder or other items specifically described as pyrophoric or explosive (*TWCP-1028*, Appendix 2).

11. Verification that there are no PCBs

The processes involved in heat source fabrication are known not to involve use of PCBs (*TWCP-1037*) and statements from SRS indicate that the input ^{238}Pu material had been calcined near 750°C, "which ensures that organics would be decomposed and driven off" (*TWCP-1044*). High temperatures used in the heat source fabrication process also would destroy any PCBs present.

12. Determination of the number of confinement layers

The metallic waste streams TA-55-45 and TA-55-46 generated since 1991 have been packaged according to TRUCON code LA117A or LA118A. The HEPA filter waste stream TA-55-47 generated since 1991 has been packaged under TRUCON code LA119A. Packaging configuration for containers packaged before then will be determined from generator records (mainly WODFs) and verified by radiography. Containers with an indeterminate number of layers of packaging will be repackaged before shipment to the WIPP.

Containers in waste streams TA-55-43 and TA-55-44 essentially all have been packaged above the thermal wattage limits for shipping. Therefore, containers in this waste stream will be repackaged, and an appropriate TRUCON code will be assigned at the time of repackaging according to the LANL Certification Plan; the Transuranic Waste Interface Document for the Waste Characterization, Reduction, and Repackaging Facility; and procedures referenced in those documents.

13. Determination of the radionuclide isotopic composition

The primary radionuclide material inputs for the ^{238}Pu activities at TA-55 are listed in Table 1. For waste streams resulting from ^{238}Pu activities, the ^{238}Pu content and additional radionuclides present in detectable quantities will be determined on a container-by-container basis using gamma spectroscopy. The characterization information obtained by gamma spectroscopy will be compared with the acceptable knowledge baseline represented by Table 1 according to *Reconciliation of Waste Stream Information* (TWCP-QP-1.1-028).

Acceptable Knowledge Roadmap

Waste Streams: TA-55-43, -44, -45, -46, and -47

Documents are in the TWCP Records Center

AK Binder/ TWCP Number	Information	Source	Summary	Limitations
LANL WAC	Describes Waste Profile Form system.	LANL on-line document.	Describes the LANL system for reporting RCRA information on waste.	First implemented in 1991, so that waste generated before that date does not have a WPRF.
TWCP-351	Pu-238 Discard Limits	TA-55 Waste Management procedure 539-GEN-R02, 10/18/96. Appendix J	Lists Pu-238 Discard Limits in various process materials.	None.
TWCP-415	TA-55 Pu-238 processes	FSAR for TA-55, Sec. 2.5.9 on NMT-9, pp.2-164 to 2-166.	Document describes the TA-55 Pu-238 operations.	Document does not give information about RCRA constituents introduced or present in the processes.
TWCP-697	Waste was controlled to meet WIPP WAC requirements as early as 1984.	Los Alamos Certification Plan, 1984, WCP-HSE7-CPL-01,R2.	Waste was controlled to meet WIPP WAC requirements as early as 1984. Generator Attachments were used to describe and reference specific generator procedures.	Overview document - Generator Attachments provide more detailed information.
TWCP-698	Gives Material Type compositions	Memo from Bill Schueler, NMT-7.	Gives Material Type compositions	Does not give information on actual material used in the Pu-238 processes.
TWCP-700	*Generator Attachment* to the *Certification Plan*	*TA-55 Attachment, 1995,* TRU-TA55-CPA-03,R00	Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished.	Information is not extremely detailed.
TWCP-701	*Generator Attachment* to the *Certification Plan*	*TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00	Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished.	Information is not extremely detailed.
TWCP-813	TRU Database Modifications	Memo from Davis Christensen, EM-SWO:97-201.	Clarifies the history of assigning EPA Hazardous waste codes in the TRU Database to waste generated before 1993.	Indicates that EPA assignments made on the basis of AK in 1992 are subject to change through additional AK information.

AK Binder/ TWCP Number	Information	Source	Summary	Limitations
TWCP-815	Background and Training Information for Jim Foxx	Memo from C.L. Foxx, NMT-7-WM/EC-97-149	Background and training for Jim Foxx indicates that he is an experienced and expert resource on past waste management practices at TA-55.	Foxx should only serve as an AK expert for processes at TA-55 and at TA-21 before 1979.
TWCP-885	Guidance for Use of Information as Acceptable Knowledge	Memo from CAO	Provides guidance on rejecting some concentration information listed on WPRFs.	N/A
TWCP-887	Segregation of Defense and Non-Defense TRU Waste	Memo from Jim Foxx	Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997.	None.
TWCP-934	Pu-238 and Pu-239 wastes were segregated.	Memo from Waste Management Expert C.L. (Jim) Foxx	Pu-238 and Pu-239 processes and the wastes generated from those processes were segregated at TA-55.	None.
TWCP-954	Guidance for the Use of Information as Acceptable Knowledge	Memo from CAO	Guidance for the Use of Information as Acceptable Knowledge	None.
TWCP-1021	TRU Waste Storage Record #LA56090	TA-55 Records Center	Describes material content and packaging of drum #56090.	Each drum has its own set of TRU Waste Storage Records.
TWCP-1025	Summarized analyses of Pu-238 materials used in the Galileo LWRHU process.	LANL Report number LA-11166-MS pp. 8, 9, 14.	Provides tables of summarized analysis results for as-received and partially processed Pu-238.	Materials in these waste streams would have been produced as the result of processing many of the lots.
TWCP-1026	Summarized analysis results for the Milliwatt Generator program.	LANL Progress Report numbers LA- 9170-PR LA-9672-PR LA-11217-PR LA-11220-PR LA-11346-PR LA-12236-PR LA-13258-PR	Tables of trace element analysis results show that some RCRA metals are present in the waste below regulatory threshold limits and allow calculation of maximum concentration limits for other RCRA metals.	None.
TWCP-1027	MSDS for cement used in Pu-238 process. (UCAR C-34)	Union Carbide Corporation	Indicates that the cement used in the Pu-238 process does not contain any RCRA-regulated materials.	None.

AK Binder/ TWCP Number	Information	Source	Summary	Limitations
TWCP-1028	Results of visual examination of 18 Pu-238 waste containers conducted in 1983-1985.	LANL Report Number LA-10479-MS, pp. 43-60.	Visual examination shows no WAC-prohibited materials or free liquids in the waste containers.	Visual examination did not specifically look for pyrophoics and explosives.
TWCP-1029	The Milliwatt Generator Program is defense related.	Screen dump from LANL financial management software program.	The Milliwatt Generator Program is funded under code DP04, which is a Defense Programs code.	Screen dump is for FY98 only, but personal communication with Foxx indicates that this program has always been defense funded.
TWCP-1030	Summarized analyses of Pu-238 materials used in the Cassini LWRHU process.	LANL Report number LA-13143-MS pp. 5-6, 7-8, 17-18.	Provides tables of summarized analysis results for as-received and partially processed Pu-238.	Materials in these waste streams generally would have been produced as the result of processing many of the lots.
TWCP-1033	Waste Profile Form #21593	TA-55 Records Center	Describes material and chemical content of some Pu-238 wastes.	Valid only for some waste drums. Other WPF#s apply to other drums.
TWCP-1040	Analysis results for Cassini program.	LANL CST-3 analytical services Laboratory Information Management System.	Provides record of results of all trace element and isotopic analyses conducted by CST-3 for the Cassini program.	Contains results of analyses not relevent to RCRA determinations, so that CD must be searched for trace element analyses.
TWCP-1037	Detailed information of all facets of Pu-238 fabrication activities	Written information obtained from a TA-55 waste management expert.	Information supports conclusion that these waste streams are non-mixed waste.	References to documents providing additional information are not provided in the memo, but have been added to the AK Summary Report.
TWCP-1038 UCNI	Anion exchange in nitric acid.	LANL report LA-11610, pp. 1-3.	Describes the behavior of several elements on ion exchange from nitric acid.	Does not include Se.
TWCP -1044	Pu-238 purification process information.	SRS Memo NMS-EHB-970073, March 12, 1997	Describes the SRS process for producing the Pu-238 that was used at TA-55 and presents analyses for metals in the Cassini material.	No flow diagram included.
TWCP-1043	TA-55 TRU Waste Databasaes	ACCESS Computer files from TA-55.	Describes items contained in each TRU waste drum generated at TA-55.	Final storage location is not listed. Filter vents not listed for older drums.
TWCP-1045	Milliwatt Generator Program is a Defense Weapons Activity.	SLA-74-0046 and Memo from Gary Rinehart.	Describes the Milliwatt Generator Program as providing power sources for nuclear weapons.	None.
TWCP-1051	Organic compounds formed by radiolysis.	Mat. Res. Soc. Symp. Proc. Vol. 333, 1994, pp 233-240.	Lists concentrations of several organic compounds formed in experiments of radiolysis of typical waste materials.	Concentrations expected in waste containers not calculated.

LOS ALAMOS NATIONAL LABORATORY
WASTE PROFILE SYSTEM
WPF #: 21593

09-Jan-1996 04:08 PM n.1

Generator:	GRUETZMACHER, KATHLE	MS:	E501	PH:	54356	Z#:	099731
WMC:	GRUETZMACHER, KATHLE	MS:	E501	PH:	54356	Z#:	099731
CSR:	ART, KELLIE	MS:	J593	PH:	75909	Z#:	112794
Status:	ACTIVE	Activated Date:	27-JUL-95			Expired Date:	27-JUL-96
Account Info-CC:	6107	PC: KB12	CA: 5000	WP:		VI:	
Group:	NMT7	TA:	55	BLDG:	0000*4	ROOM:	432

RMMA : RADIOACTIVE MATERIALS MANAGEMENT AREA (RMMA) 55-003
Waste Accumu : N/A
Method of Char : KNOWLEDGE OF PROCESS (KOP)

Waste Type : PROCESS WASTE/SPENT CHEMICAL
Waste Classes: ON-GOING GENERATION
RADIOACTIVE
Assoc Docum: WM SOP# DP-01
Other SOP# WODF

Waste Category: NOT APPLICABLE

Waste Sources : DECON/DECOM
MAINTENANCE
MATERIAL PROCESSING
RESEARCH AND DEVELOPMENT

Waste Matrix : SOLID

Matrix Type : HETEROGENEOUS

Waste/Proc Desc : TRUWM-TA55-DP-01 INSPECTION AND PACKAGING OF CERTIFIABLE COMBUSTIBLE AND NON-COMBUSTIBLE TRU WASTE. WASTE ORIGINATION AND DISPOSTION FORMS (WCDF) TRUCON CODES 116C AND 116J - COMBUSTIBLE SOLID WASTES FROM PLUTONIUM 238 PROCESSING ACTIVITIES - GLOVEBOX TRASH - WITH NO KNOWN HAZARDOUS CONSTITUENTS (GLOVES. BAGS. PAPER. PLASTIC. ETC.)

Ignitability : NOT IGNITABLE

Corrosivity : NOT AQUEOUS

Reactivity : NON REACTIVE

Boiling Point : NOT APPLICABLE

Toxicity Characteristic Metals : N/A

Toxicity Characteristic Organic Compounds: N/A

Additional Chemical Constituents and Contaminants :

Constituent	CAS NO	MIN	MAX	UOM
ANTI-C CLOTHING		0	100	%
PAPER		0	100	%
PLASTIC		0	100	%
RAGS (CELLULOSE)		0	100	%
RUBBER		0	100	%
WOOD		0	100	%

LOS ALAMOS NATIONAL LABORATORY
WASTE PROFILE SYSTEM
WPF #: 21593

09-Jan-1996 04:08 PM p.2

Radiological Characteristics:

Radionuclide	Min	Max	Unit
AM241	0.000E+00	6.700E-04	CIG
NP237	0.000E+00	1.370E-07	CIG
PU238	0.000E+00	1.400E-01	CIG
PU239	0.000E+00	1.077E-05	CIG
PU240	0.000E+00	9.000E-06	CIG
PU241	0.000E+00	5.500E-04	CIG
PU242	0.000E+00	1.030E-10	CIG
PU244	0.000E+00	2.040E-13	CIG
U235	0.000E+00	2.580E-10	CIG
U238	0.000E+00	4.010E-11	CIG

Rad Contamination Type : **SURFACE CONTAMINATION**

Waste Water Contaminants : N/A

WASTE CHARACTERIZATION INFORMATION

Radioactivity Category : **TRANSURANIC**

Waste Classification : **NON-HAZARDOUS CHEMICAL WASTE**

EPA Hazardous Waste Code : N/A

Attachment 3

WASTE ORIGINATION AND DISPOSITION FORM

SECTION I To be completed by waste generator operator

DATE 4/6/92

ITEM ID PLS142 MATRIX Plastics MTs 83 Pu240 ____

ROOM NUMBER/PHONE 204/7-2370

AMOUNT OF WASTE (kg) / (liters)			
gross	tare	net	volume
1.87	.540	1.33	

EXTRA BAG STUBS # 0 #PKGS(BAGS) ____

BAG SIZES: 11LB ___ 14LB ✓ 26LB ___

HAZARDOUS/PROHIBITED MATERIALS (LIST) None

FOR: ✓ DISCARD or ___ ASSAY

LEAD SHIELDING (DESCRIBE,kg) None

SAFE TO OPEN OUTER CAN: YES ☑ NO ☐ CONTAINS ORGANICS YES ☑ NO ☐

ASSAY TYPE: ___Neutron ✓ Gamma ___Cal ___iso ___242 ___R00 ___BC01

I certify that this item contains no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix, except as listed above. Current SOPs were followed in the origination of this item and I believe it will meet current approved discard limits.

Jody E. Martinez [signature] — Operator's name printed and signature

John Huang [signature] — Supervisor's name(printed) & P/S

SECTION II To be completed by NMT-7 Waste Management Inspector(s)

☐ for ☐ NOT ☑

Certified Cement Certifiable

[signature] 4/6/92
Inspector's signature Date

WM OBSERVATIONS: Chkd wt 1.87 kg

PASSES WIRE TIE RESTRICTIONS: YES ✓ NO ___
INSPECTORS INITIALS [initials] # PKGS 1

Weight verification for cementation: Inspectors initials ____

gm Pu / kg net, l or # units = .025 / 1.33 = 0.19

EDL VALUE 5.60
UNITS g/kg

ITM MEETS EDL: YES ☑ NO ☐

[initials] Inspector initials

Confirmatory init for cementation

NEW ID	Pu(g)	___(g)	PKG SERIAL #	NEW ID	Pu(g)	___(g)	PKG SERIAL #
			LA000000 55452	C			
A				D			
B				E			

SECTION III To be completed by NMT-4 Count Rm ☒ or NMT-7 WM ☐ Personnel

MEASUREMENT CODE G03

Eligio Garcia
NAME (printed)

Pu(g) 0.252 +/- 0.090

( ) ________ +/- ________

[signature] 5/14/92
SIGNATURE DATE

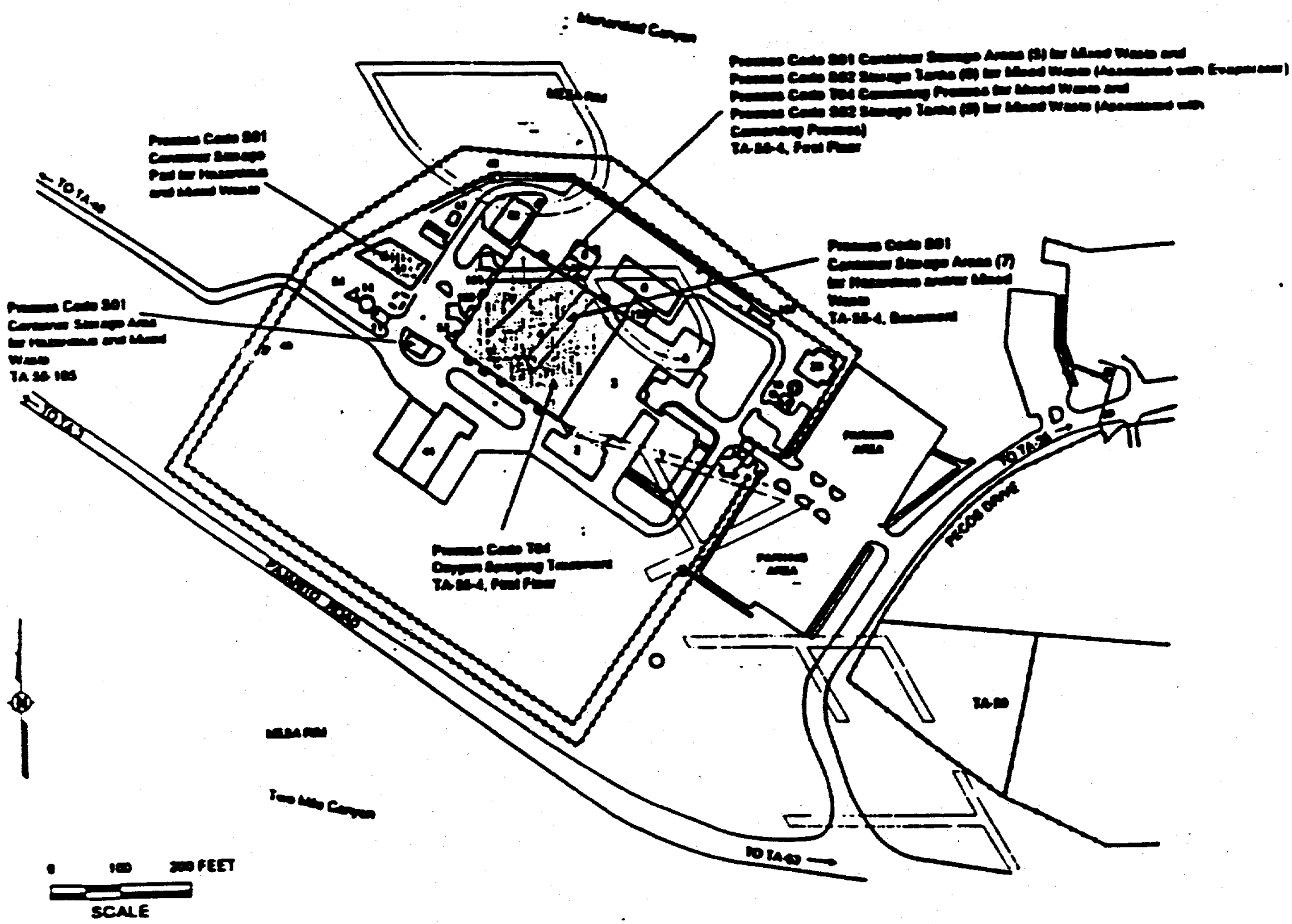
COMMENTS ____

TRU-NMT7-DR-01, R04

Figure 1

Map of TA-55 Facility

(1 page)



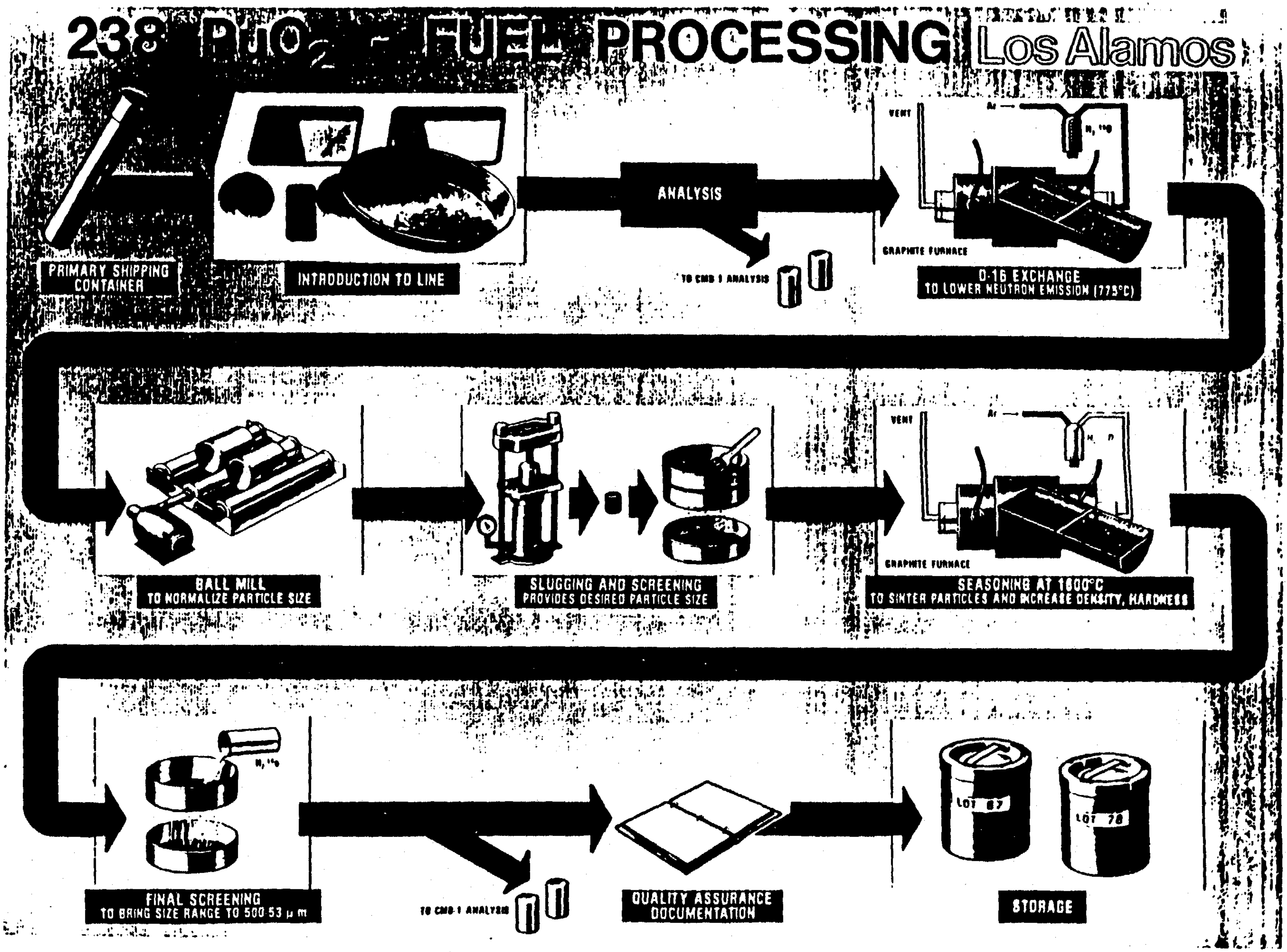


Figure 2 - Milliwatt Heat Source Fuel Processing

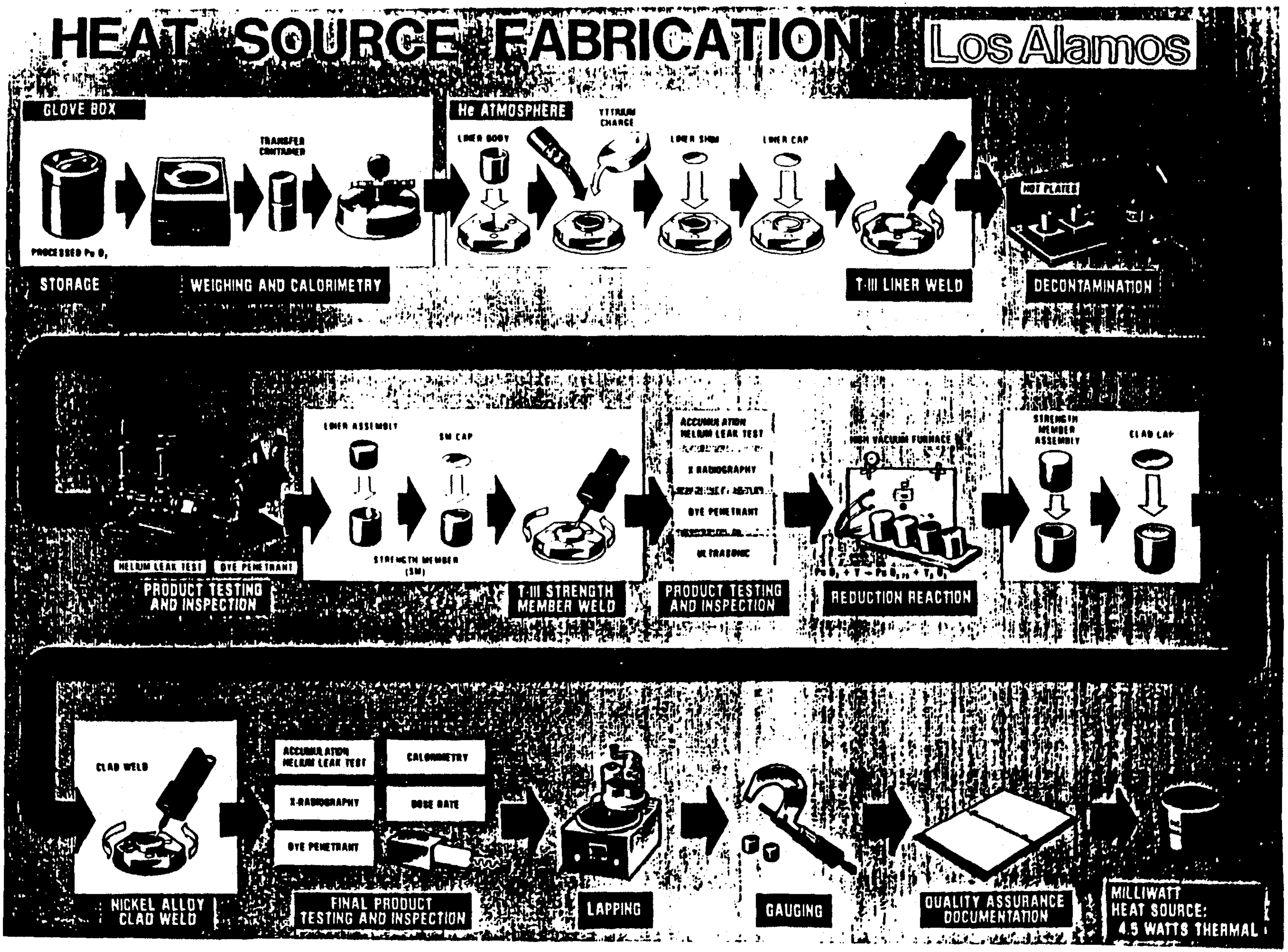


Figure 2 - Milliwatt Heat Source Fuel Processing cont.

GENERAL PURPOSE HEAT SOURCE FUEL PROCESS

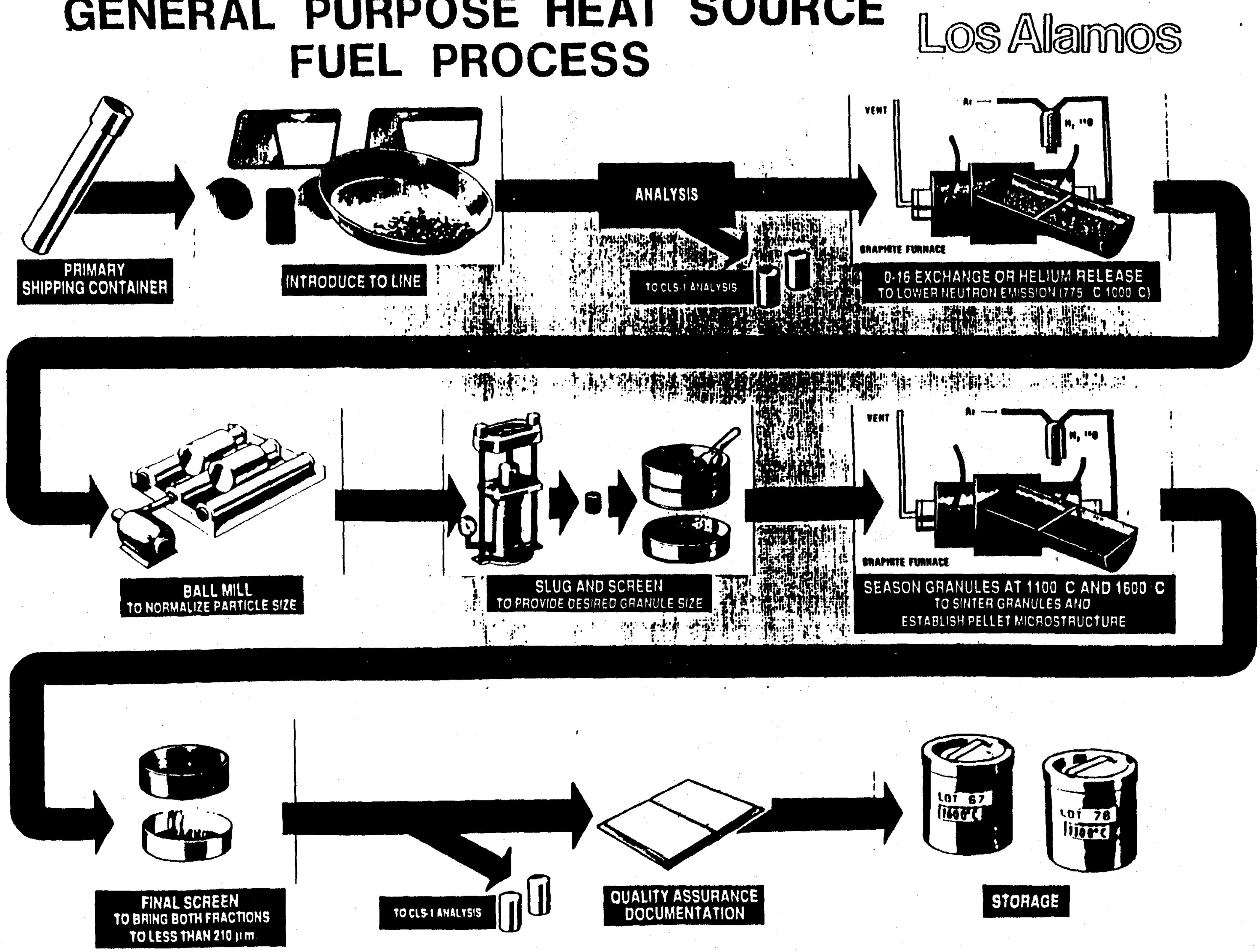


Figure 3

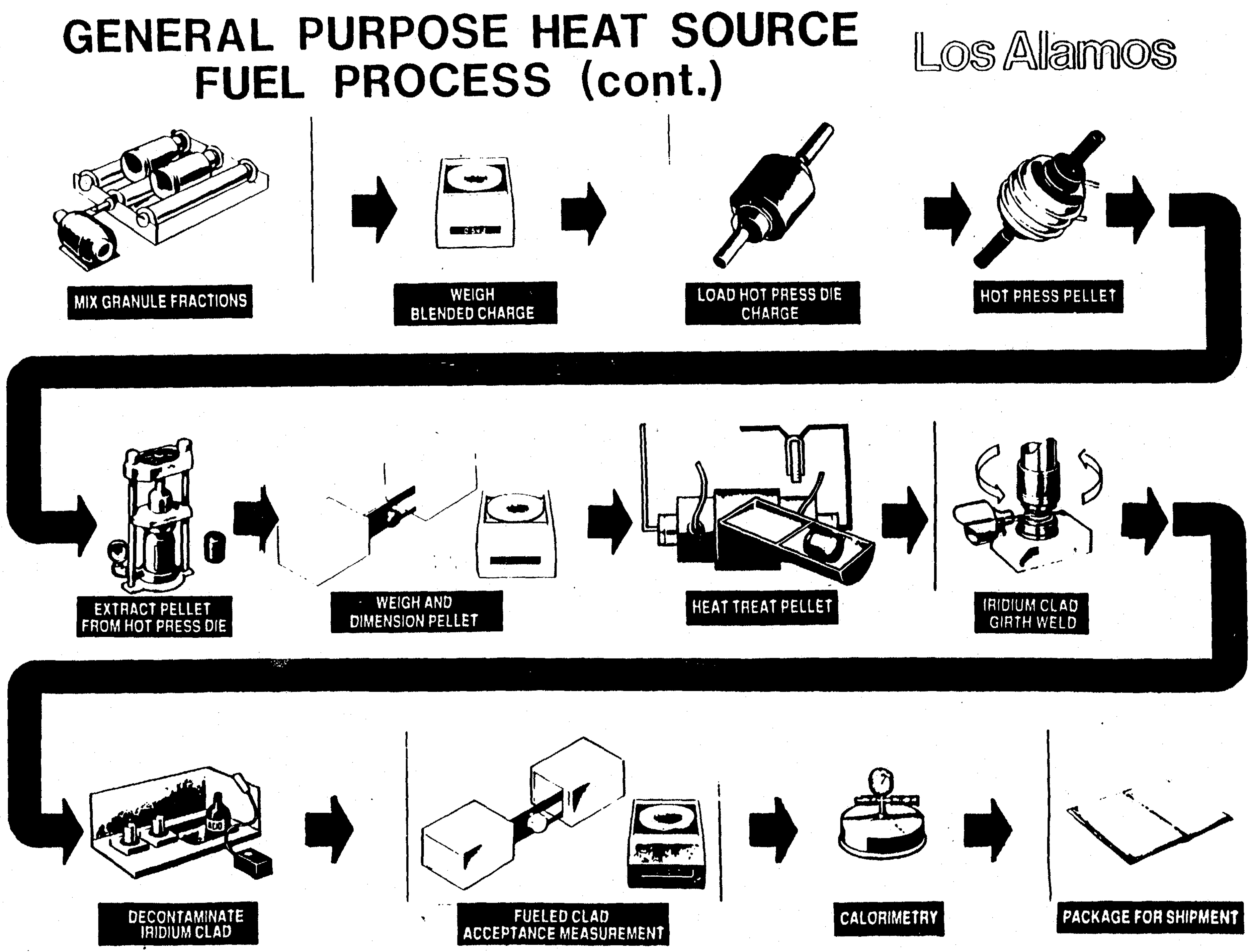


Figure 3 - cont.

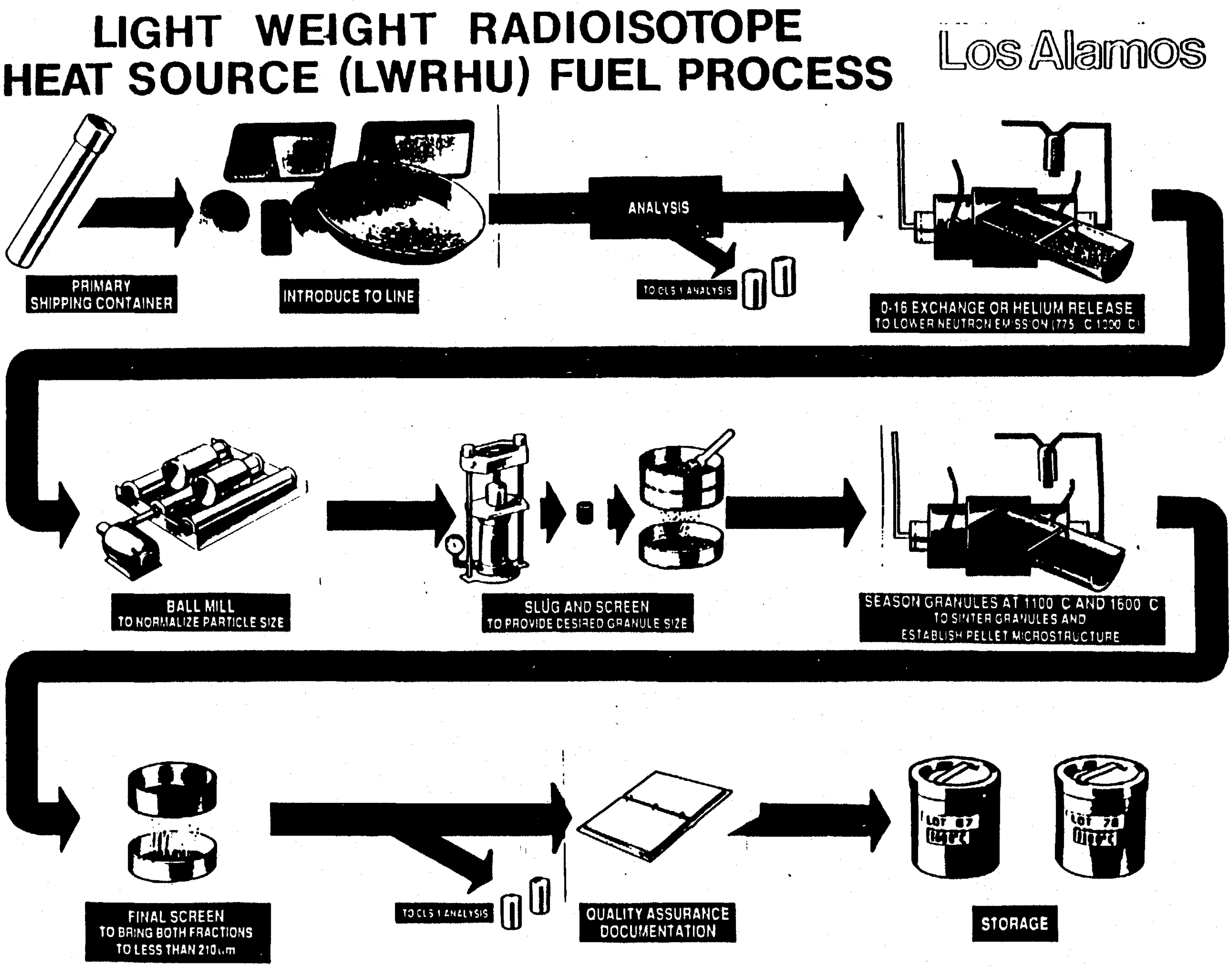

LIGHT WEIGHT RADIOISOTOPE
HEAT SOURCE (LWRHU) FUEL PROCESS
Los Alamos
PRIMARY
SHIPPING CONTAINER
INTRODUCE TO LINE
ANALYSIS
0-16 EXCHANGE OR HELIUM RELEASE
BALL MILL
TO NORMALIZE PARTICLE SIZE
SLUG AND SCREEN
TO PROVIDE DESIRED GRANULE SIZE
SEASON GRANULES AT 1100 C AND 1600 C
TO SINTER GRANULES AND
ESTABLISH PELLET MICROSTRUCTURE
FINAL SCREEN
TO BRING BOTH FRACTIONS
QUALITY ASSURANCE
DOCUMENTATION
STORAGE

Figure 4

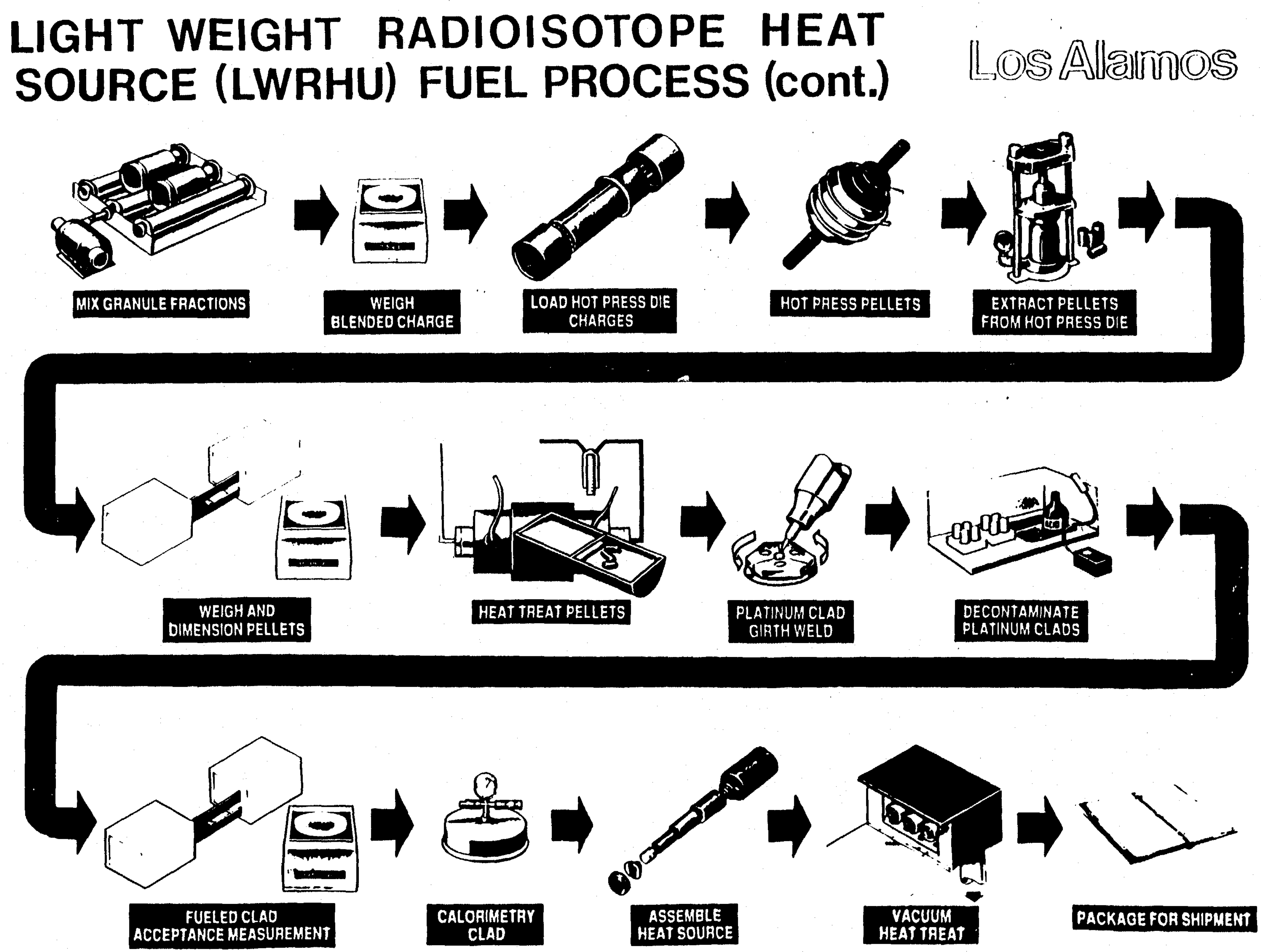


Figure 4 - cont.

Acronyms

AK	acceptable knowledge
CST	Chemical Science and Technology
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOR	direct oxide reduction
DWLS	Discardable Waste Log Sheet
EPA	U.S. Environmental Protection Agency
ER	electrorefining
ESH	environment, safety, and health
HEPA	high-efficiency particulate air
IDC	item description code
LANL	Los Alamos National Laboratory
LLW	low-level waste
M	mixed waste
MSE	molten salt extraction
N	newly generated
NG	newly generated
NMT	Nuclear Material Technology
PFD	process flow diagram
PPE	personal protective equipment
QA	quality procedure
QAPP	Quality Assurance Program Plan
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RMDC	records management/document control
RS	retrievably stored
RSWD	radioactive solid waste disposal
RTR	real-time radiography
SAR	safety analysis report
SOP	safe operating procedures
TA	technical area
TRU	transuranic
TRUCON	TRUPACT-II content code
TWBIR	Transuranic Waste Baseline Inventory Report
TWCP	Transuranic Waste Characterization/Certification Program
WAP	Waste Analysis Plan
WIPP	Waste Isolation Pilot Plant
WODF	Waste Origination and Disposition Form
WPF	Waste Profile Form
WPRF	Waste Profile Request form

Acceptable Knowledge Summary

WSPR# LA-TA-55-43.01

Waste Stream: TA-55-43, TRU Combustible Waste Containing ^{238}Pu

Site: LANL

Facility Mission

The TA-55 facility, building PF4, 300 wing was used to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55. The ^{238}Pu activities consisted of heat source fabrication both for nuclear weapons (the Milliwatt Generator Program) and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled. The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location.

Area(s) of Operation: TA-55, PF4, 200 wing, rooms 204, 205, 206, and 207

Buildings Generating the Waste: TA-55, PF-4

Building PF4 was placed into service in 1979 and contains facilities for plutonium reprocessing, chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication.

Waste streams: Related waste streams include TA-55-44, TA-55-45, TA-55-46, and TA-55-47.

Process/Material Inputs

The TA-55-43 combustible/noncombustible debris waste stream includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during ^{238}Pu activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain noncombustible glass and metallic debris. Some of this waste was packaged in small, metal cans before being placed in 55-gallon drums. Explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process.

The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents. If the $^{238}PuO_2$ did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C.

Strict acceptance specifications control the level of impurities allowed in the final heat source fuel, so the impurity levels in the oxide powder feed and/or the seasoned granules are often determined by chemical analysis. Analysis results and high processing temperatures together indicate that no mixed waste generation resulted from impurities in the feed materials used in the heat source fabrication program.

Acceptable Knowledge Summary

WSPR# LA-TA-55-44.01

Waste Stream: TA-55-44, TRU Combustible Waste Containing ^{238}Pu and lead items
Site: LANL

Facility Mission

The TA-55 facility, building PF4, 300 wing was used to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55. The ^{238}Pu activities consisted of heat source fabrication both for nuclear weapons (the Milliwatt Generator Program) and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled. The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location.

Area(s) of Operation: TA-55, PF4, 200 wing, rooms 204, 205, 206, and 207

Buildings Generating the Waste: TA-55, PF-4

Building PF4 was placed into service in 1979 and contains facilities for plutonium reprocessing, chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication.

Waste streams: Related waste streams include TA-55-43, TA-55-45, TA-55-46, and TA-55-47.

Process/Material Inputs

The TA-55-44 combustible/noncombustible debris waste stream includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during ^{238}Pu activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain noncombustible glass and metallic debris. Some of this waste was packaged in small, metal cans before being placed in 55-gallon drums. Explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process. This waste stream may contain lead items.

The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents. If the $^{238}PuO_2$ did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C.

Strict acceptance specifications control the level of impurities allowed in the final heat source fuel, so the impurity levels in the oxide powder feed and/or the seasoned granules are often determined by chemical analysis. Analysis results and high processing temperatures together indicate that no mixed waste generation resulted from impurities in the feed materials used in the heat source fabrication program.

Acceptable Knowledge Summary

WSPR# LA-TA-55-45.01

Waste Stream: TA-55-45, TRU Metallic Waste Containing ^{238}Pu

Site: LANL

Facility Mission

The TA-55 facility, building PF4, 300 wing was used to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55. The ^{238}Pu activities consisted of heat source fabrication both for nuclear weapons (the Milliwatt Generator Program) and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled. The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location.

Area(s) of Operation: TA-55, PF4, 200 wing, rooms 204, 205, 206, and 207

Buildings Generating the Waste: TA-55, PF-4

Building PF4 was placed into service in 1979 and contains facilities for plutonium reprocessing, chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication.

Waste streams: Related waste streams include TA-55-43, TA-55-44, TA-55-46, and TA-55-47.

Process/Material Inputs

The TA-55-45 metallic debris waste stream is defined as a nonmixed waste stream. The waste is metal waste generated from facility and equipment operations and maintenance. This includes metal scrap, small tools, small equipment items, motors, pumps, and process equipment. Only a small fraction of plastic (used as packaging and not in direct contact with the waste material) is present in this waste stream. Most of this waste was packaged in small, metal cans before being placed in 55-gallon drums. Explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process.

The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents. If the $^{238}PuO_2$ did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C.

Strict acceptance specifications control the level of impurities allowed in the final heat source fuel, so the impurity levels in the oxide powder feed and/or the seasoned granules are often determined by chemical analysis. Analysis results and high processing temperatures together indicate that no mixed waste generation resulted from impurities in the feed materials used in the heat source fabrication program.

Acceptable Knowledge Summary

WSPR# LA-TA-55-46.01

Waste Stream: TA-55-46, TRU Metallic Waste Containing ^{238}Pu and lead items
Site: LANL

Facility Mission

The TA-55 facility, building PF4, 300 wing was used to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55. The ^{238}Pu activities consisted of heat source fabrication both for nuclear weapons (the Milliwatt Generator Program) and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled. The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location.

Area(s) of Operation: TA-55, PF4, 200 wing, rooms 204, 205, 206, and 207

Buildings Generating the Waste: TA-55, PF-4

Building PF4 was placed into service in 1979 and contains facilities for plutonium reprocessing, chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication.

Waste streams: Related waste streams include TA-55-43, TA-55-44, TA-55-45, and TA-55-47.

Process/Material Inputs

The TA-55-45 metallic debris waste stream is defined as a mixed waste stream. The waste is metal waste generated from facility and equipment operations and maintenance. This includes metal scrap, small tools, small equipment items, motors, pumps, and process equipment. Only a small fraction of plastic (used as packaging and not in direct contact with the waste material) is present in this waste stream. Most of this waste was packaged in small, metal cans before being placed in 55-gallon drums. Explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process. This waste stream may contain lead items.

The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents. If the $^{238}PuO_2$ did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C.

Strict acceptance specifications control the level of impurities allowed in the final heat source fuel, so the impurity levels in the oxide powder feed and/or the seasoned granules are often determined by chemical analysis. Analysis results and high processing temperatures together indicate that no mixed waste generation resulted from impurities in the feed materials used in the heat source fabrication program.

Acceptable Knowledge Summary

WSPR# LA-TA-55-47.01

Waste Stream: TA-55-47, TRU HEPA Filter Waste Containing ^{238}Pu **Site:** LANL
Facility Mission The TA-55 facility, building PF4, 300 wing was used to fabricate heat sources from ^{238}Pu feedstock supplied by SRS. The ^{238}Pu fabrication activities were strictly segregated from all other Pu-processing activities at TA-55. The ^{238}Pu activities consisted of heat source fabrication both for nuclear weapons (the Milliwatt Generator Program) and for nondefense applications such as the space program. However, the equipment and gloveboxes used for all fabrication activities were the same, and use of equipment and consumables on defense or nondefense materials was not tracked or controlled. The wastes from various activities were not segregated, but were intermingled in the final waste containers, without unique identifiers, to such an extent that segregation is not possible on the basis of waste generating process or glovebox location.
Area(s) of Operation: TA-55, PF4, 200 wing, rooms 204, 205, 206, and 207
Buildings Generating the Waste: TA-55, PF-4 Building PF4 was placed into service in 1979 and contains facilities for plutonium reprocessing, chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication.
Waste streams: Related waste streams include TA-55-43, TA-55-44, TA-55-46, and TA-55-47.
Process/Material Inputs The TA-55-45 HEPA filter debris waste stream is defined as a nonmixed waste stream. The waste is predominately HEPA filters generated from ^{238}Pu facility and equipment operations and maintenance. Explosives, flammable solvents, and pyrophoric materials were never used in the heat source fabrication process. The ^{238}Pu feed for heat source production was produced, separated, and purified at SRS. Information from SRS indicates that no RCRA-listed chemicals were used in the purification process and that the purified $^{238}PuO_2$ contains no RCRA constituents. If the $^{238}PuO_2$ did contain organic materials, the latter would be boiled off or destroyed by the high temperatures used in the heat source fabrication processes, which reach at least 1530°C. Strict acceptance specifications control the level of impurities allowed in the final heat source fuel, so the impurity levels in the oxide powder feed and/or the seasoned granules are often determined by chemical analysis. Analysis results and high processing temperatures together indicate that no mixed waste generation resulted from impurities in the feed materials used in the heat source fabrication program.