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THE OPERATING PRACTICES USED IN PLUTONIUM ANALYTICAL LABORATORIES

By
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CFSTI PRICES

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United States Atomic Energy Commission
New Brunswick Laboratory
New Brunswick, New Jersey

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ABSTRACT

A compilation of the replies to a questionnaire concerning plutonium containment sent to eighteen laboratories in the United States is presented.

THE OPERATING PRACTICES USED IN PLUTONIUM ANALYTICAL LABORATORIES

C. J. Rodden

The question as to what type of laboratory facilities are used in the United States for the analysis of plutonium has been raised on several instances. In order to obtain an overall picture of the practices in various facilities a questionnaire (Table I) was sent to 18 laboratories analyzing plutonium in the United States.

Atlantic Richfield Hanford Company
Argonne National Laboratory
Babcock and Wilcox
Battelle Northwest Laboratory, A Division of Battelle
Memorial Institute
Dow Chemical Company
E. I. DuPont, Savannah River Plant
E. I. DuPont, Savannah River Laboratory
General Electric Company, Vallecitos Nuclear Center
Idaho Nuclear Corporation
Lawrence Radiation Laboratory
Los Alamos Scientific Laboratory
Monsanto Research Corporation
New Brunswick Laboratory
Nuclear Fuel Services, Erwin, Tennessee
Nuclear Fuel Services, West Valley, New York
Nuclear Materials and Equipment Corporation
Oak Ridge National Laboratory
United Nuclear Corporation

The questionnaire was only concerned with the analytical laboratories and not with production facilities. Most of the questions are self explanatory with the possible exception of number 17. This was included since in some installations if uranium is handled in the same facility all alpha counting is reported as plutonium.

A compilation of the replies to the questionnaire is given in Table II.

As can be seen from the table it appears there is a difference in handling methods for plutonium analysis in the United States.

Questions 1 and 2. Open port boxes used? Gloved boxes used? Opened-face hoods used?

There appears to be about an even split as to the number of laboratories working only in gloved boxes compared to those employing both gloved boxes as well as open front boxes. An open front box may be the same as a gloved box except gloves are removed or it may be the same design as a glove box with a fixed open slot for hand manipulation.

It is interesting to note that the laboratories using both open and closed boxes perform the greatest number of plutonium analyses made in the United States. The use of opened-face hoods is not as common as open port boxes and they are generally used for low amounts (less than 1 to 2 mg) of plutonium.

Question 3. Milligrams of plutonium used per analysis?

As would be expected there is a very large range of amounts of plutonium used per analysis. Generally the precision improves with the size of sample.

Question 4. Grams of plutonium permitted per gloved box?

Most of the laboratories allow 200 to 300 g of plutonium per gloved box and in fact many allow only this much in the laboratory room itself. Only in a few instances are amounts as high as 2 kg or so allowed in the dry state in a gloved box.

Question 5. Grams of plutonium permitted per open port box?

The answer to this question is much in keeping with the policy of the laboratory of whether or not open face boxes are used for solutions of plutonium. There appears to be a considerable variation in the amount of plutonium allowed per box. While one laboratory allows as much as 350 g of

plutonium per box most are considerably lower in the 5 to 15 g range. One laboratory uses the approach that the concentration of the plutonium in the solution is the important factor.

Question 6. Type of box used?

The trend appears to be to metal boxes either stainless steel or steel coated. The size appears to vary quite markedly; the wider boxes may have certain advantages. It appears there is nothing standardized on the type of box used.

Question 7. Water from taps in boxes?

There appears to be a distinct practice throughout the laboratories in not allowing water in closed gloved boxes where solid plutonium compounds may be stored.

Question 8. Vacuum used in boxes?

Vacuum is used in the boxes in general but a couple of laboratories do not allow vacuum in the gloved boxes.

Question 9. Compressed air used in boxes?

The overall answer to this seems to indicate that compressed air is not allowed to be used in gloved boxes. A few laboratories allow its use.

Question 10. Gas used in boxes?

The answer to this question is almost an unanimous no.

Question 11. Heat lamp-hot plates used?

Electric heaters and hot plates are used universally.

Question 12. Organic solvents used in closed boxes?

While most of the laboratories used organic solvents in closed boxes, all appeared to take precautions as to the amount used. Only a few laboratories allow as much as 500 ml in a gloved box, the usual amount being 25 to 100 ml.

Question 13. Organic solvents used in open boxes?

With the opened front boxes more leeway is allowed in the use of solvents. The quantity of inflammable solvents is limited in most cases. Fume hoods are considered much like the open port boxes for use of solvents.

Question 14. Are safety aspects satisfactory?

In most all instances the laboratories appeared to be satisfied with the safety aspects of their operations. One laboratory thought a study of air flows in boxes should be made.

Question 15. Primary filters used in boxes?

Most of the laboratories used a primary air filter in boxes of the CWS type.

Question 16 and 17. Is uranium used in same facility?

Many of the laboratories used uranium in the same facility however it appears that the handling practices are based on the supposition that all contamination is plutonium.

TABLE I

In the following questions it is assumed that unirradiated plutonium of production grade isotopic composition (ca 93% Pu-239 and less than 0.1% Pu-238) is being analyzed. The following questions apply only to analytical work and not to production work. It is also assumed that only plutonium in solution or covered with a liquid is employed in open port boxes.

1. Is the analysis performed in closed gloved boxes or in open port boxes?
2. Are opened faced chemical hoods ever used?
3. How many milligrams of plutonium are used per analysis?
4. How much plutonium is permitted in a gloved box?
5. How much plutonium is permitted in an open-port box or train of open port boxes?
6. Can you indicate type of box employed?

TABLE I (CONTINUED)

7. Do you use water, distilled or process water dispensed from taps in the boxes?
8. Do you use vacuum in the boxes?
9. Do you use compressed air in boxes?
10. Do you use gas for heating in boxes?
11. Do you use heat lamps or hot plates for heating?
12. Do you allow use of organic solvents in closed glove boxes? If so what solvent and how much is permitted in a box or train of boxes?
13. Do you allow use of organic solvents in open port glove boxes? If so what solvent and how much is permitted in a box or train of boxes?

TABLE I (CONTINUED)

14. In so far as health and safety aspects are concerned
are you satisfied with your present system?
15. Do you have primary filters in the boxes?
16. Do you handle uranium in the same facility?
17. Are your present practices based on plutonium
or if uranium is used in the facility does its
presence influence your practices?

TABLE II

<u>Lab.</u>	¹ <u>Open Port Boxes Used?</u>	¹ <u>Gloved Boxes Used?</u>	² <u>Open-Face Hoods Used?</u>	³ <u>mg of Pu Used per Analysis?</u>	⁴ <u>Grams of Pu Permitted Per Gloved Box?</u>	⁵ <u>Grams of Pu Permitted Per Open Port Box?</u>
A	Titration in open-port boxes	Weighing and dissolution in gloved boxes	Yes for solutions	1000	350 g maximum	350 g maximum/hood
B	yes	yes	yes	Gloved Boxes- no limit set but in prac- tice - 10 g Hoods-100 mg of course this depends on the operation	200 g in train of boxes	1 g estimate Control by amount in each sample and number of samples.
D	yes	yes	yes	50-1000	From 1 kg to 2 kg in solid, dry form as metal or oxide in specified storage arrays. Only 200 g in solution or as wet solids	Only liquids or massive metal are permitted in open port boxes. Normal limits are 200 g.
G	Open port boxes only for less than 1mg	yes	yes for less than 1 mg	10 mg	267 g; same as room limit	1mg
I	Open port boxes if Pu solutions are involved	Closed gloved boxes if Pu containing solids are involved	No	From 1 mg to 1 g	Usually up to 100 g in a box 36" long	Approximately 100 g per 36" box length

TABLE II (CONTINUED)

Lab.	1 Open Port Boxes Used?	1 Gloved Boxes Used?	2 Open-Face Hoods Used?	3 mg of Pu Used per Analysis?	4 Grams of Pu Permitted per Gloved Box?	5 Grams of Pu Permitted per Open Port Box?
K	Yes	Yes	Yes	10-250 milligrams	Not in excess of 50 g per box	Generally not in excess of 5 g per box
L	Open port boxes are not used	Pu analysis are performed in gloved boxes and in open face chemical hoods	Open face hoods are used, though with a limited opening of a maximum of nine inches	Normally 0.5 g samples are taken, dissolved, and diluted to volume. Approximately 10 mg of Pu are titrated	A definite limit is not placed on a particular hood or box. A maximum of 250 g of fissile material is permitted in the wet analytical laboratory at any one time. The 250 g includes total plutonium, total uranium-235, or uranium-233.	Same as question 4. Rarely are over 10 g of Pu collected in any one hood because of the requirement that only sample solutions be permitted in a hood.
6 0	Open port box is used for plutonium solutions containing not greater than 35 g of Pu per liter. Open port boxes have a rectangular opening approximately 2 ft. 8 in. x 9 in. through which an air flow of 270 cu. ft/min. is maintained.	Closed gloved box is used for the analysis or handling of plutonium metal samples, concentrated plutonium solutions and plutonium compounds in solid form.	Open face chemical hoods are used in place of open port boxes for a limited number of analytical operations, such as planchet flaming.	In closed gloved boxes up to 250 mg of dissolved Pu per analysis (potentiometric assay); in open port boxes, up to 6 mg of Pu per sample	No distinction is made between closed gloved boxes and open port boxes. We attempt to keep the plutonium in any closed glove or open port box at an operating minimum. The allowable limits are based on safe storage of fissionable material. We permit a maximum of 44 g of plutonium in a 2 liter container and a maximum of 400 g of plutonium in any room designated as a storage location. Rooms not designated as storage locations are limited to a maximum of two 2 liter bottles containing not more than 44 grams of plutonium per bottle.	

TABLE II(Continued)

Lab.	¹ Open Port Boxes Used?	¹ Gloved Boxes Used?	² Open-Face Hoods Used?	³ mg of Pu Used per Analysis?	⁴ Grams of Pu Permitted per Gloved Box?	⁵ Grams of Pu Permitted per Open Port Box?
P	Open port boxes	Yes. For solids. Difficult operations. Large amounts of solution.	Yes	150-400 mg	200 g in solution. 200 g as solid (less than 20% H ₂ O content). 2000 g total in laboratory. Generally, Pu levels run about 20 g (solution) and 150 g (solid); less than 500 g (laboratory).	15 g (train) 10 g (box)
Q	Yes	Yes	Yes, Analysis of Pu solutions is often done in open face fume hoods	Up to 1 mg	Up to 230 g	Up to 0.5 g
N		Yes	Only for decontamination with limit of 25 micrograms plutonium	150 mg maximum	250 g limit for boxes designated as wet criticality zone.	None used.
M		Yes	Some, depending on concentration	Depends on method. Approximately 5 mg for coulometry	It is based on criticality. We allow up to 300 g in one 24 ft. x 24 ft. room	1 mg per box
J		Yes	Not normally only less than 1 millicurie (ca 15 mg) is allowed in open face fume hoods	10-20 milligrams plutonium	45 grams	See question No. 2

TABLE II (Continued)

Lab.	¹ Open Port Boxes Used?	¹ Gloved Boxes Used?	² Open-Face Hoods Used?	³ mg of Pu Used per Analysis?	⁴ Grams of Pu Permitted per Gloved Box?	⁵ Grams of Pu Permitted per Open Port Box?
H		Primarily closed boxes	Yes	Could be up to 500 for chemi- cal analysis by wet chem- istry for trace impurities	as metal - 2600 g in solution - 220 g	None
F		Closed gloved boxes	Limited use	Mixed Pu, U pellets or powder weighing 0.5 to 1 g are dissolved, a concentration assay is per- formed by amperometry on a 25 mg sample. Impurity analyses for N, Cl, and F generally involve from 1-5 g of the solid sample	A laboratory limit of 250 g fissile U + Pu is permitted, without limitation with respect to box location	Not applicable
E		Closed gloved boxes	Yes, but total quantity of Pu is kept below 1.5 mg for normal chemical operations	1-10 mg nor- mally, but in certain routine operations such as emission spec. analysis, 50 mg may be used.	Not in excess of 150 g unless authorized in writing	Do not use open port boxes

TABLE II (Continued)

<u>Lab.</u>	¹ <u>Open Port Boxes Used?</u>	¹ <u>Gloved Boxes Used?</u>	² <u>Open-Face Hoods Used?</u>	³ <u>mg of Pu Used per Analysis?</u>	⁴ <u>Grams of Pu Permitted per Gloved Box?</u>	⁵ <u>Grams of Pu Permitted per Open Port Box?</u>
C		Closed gloved boxes	No	2-10 mg/analysis	220 g/unit, 2 glove boxes/unit	not used
R	Amperometric titrations in open boxes	All work on dry materials in closed boxes and most all sample prep- aration in closed boxes	No	Coulometric - 1-5 mg Amperometric - 10-25 mg Potentiometric 100-250 mg	250 grams	250 mg as solution only. And only that portion in use may be without covers

TABLE II (CONTINUED)

Lab.	6	7	8	9	10	11
	Type of Box Used?	Water from Taps in Boxes?	Vacuum Used in Boxes?	Compressed Air Used in Boxes?	Gas Used in Boxes?	Heat Lamp Hot Plate Used?
A	Open faced fume hoods modified to open port hoods by inserting plexiglass shields with ports. Gloved boxes are enclosed and work done through neoprene gloves.	No	Yes	No	No	Yes
B	See Appendix A	Yes	Yes, Self contained system output of pump dumped back to boxes	Yes	No	Yes
13 D	Gloved boxes, stainless steel or mild steel with painted interiors or teflon lined interiors. Open front boxes and chemical fume hoods	Only in boxes where liquid samples are normally processed. No water is permitted in boxes where solids are stored.	Yes	No	Only in open front hoods or boxes.	Yes
G	Blickman-stainless steel	Yes	Yes	No	No	Both, heat lamps are explosion proof
I	New design of Los Alamos Boxes with plenum chamber designed to greatly improve air flow in boxes	Yes, both types	Yes, mostly to aid in transferring solutions to waste bottles	Yes, a limited amount	No	Yes, electric heaters, hot plates and steam baths are used

AND FUMING
FOR DISSOLUTION WORK WE HAVE
SEVERAL HIGH AIR THROUGHPUT BOXES

APPENDIX A

TABLE II(Continued)

Lab.	6 Type of Box Used?	7 Water from Taps in Boxes?	8 Vacuum Used in Boxes?	9 Compressed Air Used in Boxes?	10 Gas Used in Boxes?	11 Heat Lamp Hot Plate Used?
K	a) 7 ea. sloped front gloved boxes, approx. 26 in. x 36 in. x 36 in. b) 3 ea. square boxes, approx. 48 in. x 48 in. x 48 in. gloved c) 2 ea. open face sloped front boxes, approx. 48 in. x 36 in. x 26 in. d) 3 ea. open face sloped front boxes, approx. 36 in. x 36 in. x 26 in.	Both,	Occasionally	No	No	Both
L	Standard glove box is 84 in. long, 42 in. wide x 42 in. height, stainless steel	No	Yes	Yes	No. Gas is used for heating only in open faced hoods and even then only on a limited basis.	Hot plates and heat lamps are the preferred heaters in all areaa.
O	Closed gloved boxes and open-port boxes are constructed of fire retardant "Hetron-92 Special" polyester resin with 20-30% fiberglass reinforce- ment. Both the inside and outside surfaces have been treated with a 10-20 mil fire retardant coating.	No water is dispensed in closed boxes. Open port boxes are equipped with process water taps.	Vacuum is used in both closed gloved boxes and open port boxes.	Compressed air is not used in closed gloved boxes; it is used in open port boxes, chiefly those used for alpha mounting.	Gas is not used in closed gloved boxes; it is used in some open port boxes for planchet flaming; most of this work, however, is per- formed in open face chemical hoods.	Heat lamps and hot plates are used for heating in both closed gloved boxes and open-port boxes.

TABLE II (Continued)

Lab.	6 Type of Box Used?	7 Water from Taps in Boxes?	8 Vacuum Used in Boxes?	9 Compressed Air Used in Boxes?	10 Gas Used in Boxes?	11 Heat Lamp Hot Plate Used?
P	stainless steel with safety plate glass window - 2-8 in. diam. glove openings per window. Interior of box painted for corrosion resistance and visibility	1) Process water from taps 2) Distilled water from storage bottle outside of box with dispensing line inside box	Yes	No	No	Yes; heat lamps mostly
Q	Gloved boxes used are Hanford-designed boxes. Open face fume hoods are a standard down-draft hood.	Not in gloved boxes	Not in gloved boxes	Not in gloved boxes	No	Yes, in gloved boxes and fume hoods
N	Carbon steel box with glass ports, corrosion resistant coating on interior	Distilled water	No	No	No	Hot plates
M	Stainless steel boxes designed at ORNL	Yes	Yes	No	Temporary basis-disconnected after using	Yes
J	Stainless steel closed glove box	Deionized distilled water	Yes	Yes	No	Hot plates (Corning)

TABLE II (Continued)

Lab.	6 Type of Box Used?	7 Water from Taps in Boxes?	8 Vacuum Used in Boxes?	9 Compressed Air Used in Boxes?	10 Gas Used in Boxes?	11 Heat Lamp Hot Plate Used?
H	Allied Engr., Berkeley, BMI, and LRL designed	Yes for cooling	Yes	Yes. Compressed gases, no air	No	Yes
F	Boxes have been fabri- cated by site personnel but a commercial vendor Stainless Equipment Co. Englewood, Colorado, fabricates most demands from designs prepared by our Design Engineer- ing component.	Not from taps. Cooling water that is required is circulated inter- nally by a self- contained pumping system, which dumps its heat load to a second- ary system, by means of a heat exchanger, to the exterior of the box. Thus, in the event of a leak in either part, only a limited amount of water can flood into the box.	Yes. One of the capabilities available is a vacuum hot extraction apparatus. The furnace head, and the two mercury dif- fusion pumps, are located in the box, while the measurement system is located exter- nally. In general, however, the use of vacuum for solution transfer, pipet drying, etc. is avoided.	Entry for bottled gas lines is provided, with close control of pressure regulation externally.	No. Electrical only	Yes
E	Have used large number of fiber-glass boxes (as well as a few wooden boxes) in past years, but new boxes and replacement boxes are now of stainless steel	No	Yes	In general no, but valve is available for connection	In general, no, but valve is available for connection, and special approval must be given for its use	Yes, both

TABLE II (Continued)

Lab.	6 <u>Type of Box Used?</u>	7 <u>Water from Taps in Boxes?</u>	8 <u>Vacuum Used in Boxes?</u>	9 <u>Compressed Air Used in Boxes?</u>	10 <u>Gas Used in Boxes?</u>	11 <u>Heat Lamp Hot Plate Used?</u>
C	High integrity stainless steel slant front box	Yes, distilled water tap in box	Negative pressure in box, but no vacuum outlets per se	No	No	Yes, both
R	Stainless steel. Plexiglass windows and tops. 48" wide at base, gloves both side sloped fronts	Yes	Yes	Not to date but do have capability	No	Yes, both

TABLE II (Continued)

Lab.	12 Organic Solvent Used in Closed Boxes?	13 Organic Solvent Used in Open Boxes?	14 Are Safety Aspects Satisfactory?	15 Primary Filters Used in Boxes?	16 Is Uranium Used in Same Facility?	17 Practice Based on Pu?
A	No	Yes, acetone, 125 ml maximum per hood	Yes	No	No	Present prac- tices are based on plutonium
B	Yes, acetone, xylene, CCl ₄ , etc. Amount, one container of 500 ml, No ether	Same as No. 12 but less control on amounts	Yes	See Appendix A	Yes	Yes
D	Yes, cyclohexane, chloroform, perclene, alcohols, methylene chloride, carbon tetrachloride and other chlorinated or fluorinated solvents. Only small quantities of flammable solvents allowed	Same as gloved boxes except benzene, petroleum ether, ketones, alcohols and other solvents are also allowed. Total amount of flammable solvents is restricted to small containers with normal storage in flame proof contain- ers	Yes	Yes and also exhausts from boxes are passed through absolute filter banks (2) before they are released to outside	Only occasionally	Based on plutonium
G	Yes maximum used- 25 cc kerosene or hexone	Yes, 25 cc/box	Yes	Yes	Yes	If both, base practices on plutonium
I	No	Yes Acetone - 500 cc and Hexone - 500 cc in storage bottles. Various ketones. The air flow in all open port boxes is a minimum of 125 ft. per minute across entire opening.	Yes. It works well. Occasionally a hot spot is found on the floor, but is usually removable with masking tape.	No, except for incoming air for the closed glove boxes.	Not in the same boxes	Present prac- tices are based on Pu, even in those laboratories where U is handled.

TABLE II (Continued)

Lab.	12 Organic Solvent Used in Closed Boxes?	13 Organic Solvent Used in Open Boxes?	14 Are Safety Aspects Satisfactory?	15 Primary Filters Used in Boxes?	16 Is Uranium Used in Same Facility?	17 Practice Based on Pu?
K	Very limited use - approx. 25 ml of CCl ₄ and acetone.	Same as No. 12	Yes, but much training is required before an analyst works in open face box.	Yes, on gloved boxes only	Not routinely	Present practices based on plutonium
L	Chloroform and carbon tetrachloride are permitted in glove boxes for metal sampling washings. Only one 500 cc bottle is taken into a box at any one time.	No restrictions on organic solvents in open faced hoods.	I believe some improvements need to be made in the design of hood faces to attain a more laminar air flow at the opening which has the bottom closure necessary for protection against solution spills in the plutonium hood.	We have absolute filters on all exhaust air. We have absolute filters on air coming into the glove boxes.	Yes	Present practices are influenced by experience with uranium in production quantities.
O	Organic solvents are permitted in both closed boxes and open-port boxes. The most common solvents used are acetone (for pipet washing) and xylene (as a diluent for extractants). The solvent volume is maintained at a practical minimum, normally not more than 500 ml per box.		We have had no difficulties with the operation of our present boxes from either a health or safety point of view.	All boxes have CWS primary filters.	Uranium samples are handled chiefly in open port boxes and fume hoods; however, if a uranium sample contains any plutonium, it is handled as if it were a plutonium sample.	

TABLE II(Continued)

Lab.	12 Organic Solvent Used in Closed Boxes?	13 Organic Solvent Used in Open Boxes?	14 Are Safety Aspects Satisfactory?	15 Primary Filters Used in Boxes?	16 Is Uranium Used in Same Facility?	17 Practice Based on Pu?
P	Yes, generally acetone is used; less than 25 ml is in gloved box at any time. On occasion methyl ethyl ketone and xylene are used, 25 ml maximum, and are disposed of immediately after use <u>never stored in gloved box</u>	Yes, generally acetone is used; less than 50 ml is in boxes at any time. Occasionally ethyl alcohol up to 200 ml and immediately disposed of - not stored	Satisfied with most aspects; slight improvement could be made	Yes	Yes	Based on plutonium
Q	Only methyl alcohol.* Limited to about 100 ml	In fume hood, yes. Limited to about 500 ml per every 2 or 3 hoods	Yes	Yes	Yes	Any alpha contamination found outside a gloved box is presumed to be plutonium unless there is specific reasons to know that uranium is the source of the contamination
N	No	None used	Yes	Yes	Yes	Based primarily on plutonium
M	Yes, Acetone 200 ml per box	Yes, Acetone and Xylene 200 ml per box	Yes	Yes	Yes U-233 and U-232	Based on plutonium
J	Ethanol (only under supervised conditions) * under study	We do not use open port gloved boxes for the analysis of Pu-239	Yes, however, open port glove boxes would permit greater ease of analysis	Yes	Not presently involved in such analyses	Our present practices are based on Pu-239 only

TABLE II (Continued)

Lab.	12 Organic Solvent Used in Closed Boxes?	13 Organic Solvent Used in Open Boxes?	14 Are Safety Aspects Satisfactory?	15 Primary Filters Used in Boxes?	16 Is Uranium Used in Same Facility?	17 Practice Based on Pu?
H	Yes	Not Applicable	Yes	Yes	Occasionally	Practices based on plutonium
F	Yes, in very limited amounts, and high vapor pressure, low flash point solvents are avoided. Ethyl alcohol, acetone are limited to quantities less than 100 ccs.	Not applicable	Yes	Yes	Yes	Present practices are based upon plutonium.
E	Yes, common solvents such as acetone, TBP, etc. Quantity of solvent is generally limited to that required for a particular days work (50-100 ml)	Do not use open port boxes	Yes	Yes	Yes	Present practices based on plutonium

TABLE II(Continued)

Lab.	12 Organic Solvent Used in Closed Boxes?	13 Organic Solvent Used in Open Boxes?	14 Are Safety Aspects Satisfactory?	15 Primary Filters Used in Boxes?	16 Is Uranium Used in Same Facility?	17 Practice Based on Pu?
C	Yes, acetone-small quantities (practice discouraged)	Open port boxes not used	Yes, although a few minor aspects could use improvement	No	Yes	Uranium does influence our procedures
R	Yes, only when they are necessary for analysis and then only enough for that analysis. Methyl isobutyl ketone. Also may use nonflammable solvents.	Not at present, however, if they were needed for an analysis we could allow enough to do a particular analysis.	No. Not enough monitoring equipment and too much "Taboo" placed on plutonium.	Yes	Yes U-233	Probably about half and half