

SECRET

FINAL REPORT
FIELD TEST FT-34
ANNEX D
APPENDIX D2
CONTRACTOR ASSAY
TEAM DEBRIEFING
JANUARY 1969

SECRET

D2-1

227

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D2

CONTRACTOR ASSAY TEAM DEBRIEFING

A. GENERAL

At the conclusion of the special assay exercise for specialists from the Oak Ridge complex, a debriefing session was held during which the specialists were informed of the evasion methods used against them. A general discussion of assay evasion procedures and methods which could be used to counter evasion tactics was conducted. The debriefing session was recorded, and a transcription of the recorded proceedings was made. Because the debriefing session was highly informal, it was necessary to edit the transcription and condense the material for a better, more coherent presentation. The original tape used to record the debriefing session is on file at the Field Operations Office of ACDA/WEC.

The debriefing session involved three general topics: (1) the evasion used in the special assay test and the results of the evasion calls of the contractor team, (2) other evasion methods which could be used, and (3) methods which could be used to counter evasion. Participants in the debriefing session were:

OR-TSR	Oak Ridge Technical Support Representative
PX-TSR	Pantex Technical Support Representative
RF-TSR	Rocky Flats Technical Support Representative
OR-LS	Oak Ridge Laboratory Supervisor
OR-MSS	Oak Ridge Mass Spectroscopy Supervisor
OR-MST	Oak Ridge Mass Spectroscopy Technician
CAS-MS	Contractor Assay Scientists Mass Spectroscopist
CAS-C	Contractor Assay Scientists Chemist
CAS-BS	Contractor Assay Scientists Emission Spectroscopist
RF-LS	Rocky Flats Laboratory Supervisor
OR-SC	Oak Ridge Site Commander
OR-LT	Oak Ridge Laboratory Technician
FTA	Field Test 34 Analyst (ACDA)

B. DEBRIEFING SESSION INFORMATION

1. Contractor Assay Test. Members of the contractor assay team were told that they had not made correct calls for evasion on the two samples for which calls were made. The calls were based upon the strange behavior of the potentiometer during titration, but the samples called suspect were actually control samples for which no evasion was used. It was pointed out that, if the CAS chemist had considered the two samples real, then the other samples might possibly have been called evaded. It was a matter of choice, and the choice had been made in the wrong direction. The chemist indicated that he suspected evasion in the Mettler balance and even looked in all the drawers of the balance table but could find nothing unusual. He was told that the adjacent balance table contained the evasion switch. Gravimetric analysis of oxides would have revealed evasion, but these methods were prohibited by the ground rules of the test.

The mass spectroscopist indicated that he was puzzled by the unusual wiring he saw in the spectrograph and also by the unusual electronic equipment which was in the machine. However, he was not familiar enough with the particular instrument to detect anomalies or to positively call evasion. His attempts to look for residual lines during analysis were almost successful in discovering evasion; if he had turned the filament current up to the point of burnout while the hidden filament was being used, he would have discovered evasion.

The emission spectroscopist indicated that he mistrusted the direct reading spectrograph (quantometer), because the very nature of the instrument made it exceptionally susceptible to evasion tactics. He did not, however, discover the means used to evade. His efforts in "fingerprinting" samples and adding materials for the optical spectrograph would have been successful for certain types of evasion but did not compromise the emission spectrograph evasion used in the test.

The general methods of evasion used throughout the test were discussed, and diagrams of the evasion methods and apparatus were brought in to clarify points. After the discussion,

the inspectors were conducted on a tour of the equipment areas to observe the exposed evasion schemes.

Later, the Rocky Flats representative discussed the evasion methods used against the military inspectors and the similarities to and differences from evasion used at Oak Ridge. Conditions were considerably different at Rocky Flats, and the evasion practiced was done in a manner different from that at Y-12. One of the most obvious giveaways at Rocky Flats was the tarnished appearance of the substitute filaments for the mass spectrograph. None of the inspectors caught this giveaway.

The Oak Ridge laboratory supervisors explained that the assay evasion was done on a small basis--only about 2-percent evasion was used. The meticulous attention necessary to cover evasion in one area of assay by techniques used in another was discussed in detail. Time and money available limited the scope of evasion used at Oak Ridge. Somewhat more sophistication and less risk of detection could have been realized, but practical considerations were overriding. The evasion apparatus used in the mass spectrograph, for example, could have been broken up into smaller packages and been more easily concealed than it was. The use of an external electromagnet in the Mettler balance could have been avoided if the balance arms could have been reconstructed of proper materials.

The Oak Ridge laboratory supervisor stated that some laboratory benefit was accrued from the evasion work. The evasion carrier material used to hide aluminum lines proved to be useful enough to be used in other laboratory work.

2. Other Evasion Methods. The second topic of the debriefing session involved extensions of the evasion methods used in the test. One of the more important points of this discussion was concerned with how much evasion could be used before the risk of detection became high enough to negate any possible gains made by the use of evasion. During this discussion, it became obvious that limitations on the procedures used for assay could provide a means toward massive evasion. If, for example, only the mass spectrograph were

SECRET

used for assay, almost total evasion would be possible, in that U-238 could be made to appear as U-235. This was too obvious to be useful, however, and the topic was changed to include all normal analytical phases of material assay. With the checks and balances of normal assay, the concensus was that an upper limit of 2- to 3-percent evasion might be successfully practiced without undue risk of exposure. A 5-percent evasion was probably too high because it would probably increase exposure risk out of proportion to the gains of evasion. The 2- to 3-percent level was applied to both uranium and plutonium.

An extension of the automatic triggering method of evasion used in the direct reading spectrograph was made for uranium evasion. It was proposed that a small quantity of plutonium or other radioactive material be blended with the weapon-derived uranium during smelting and casting operations in the foundry. The inclusion of this gamma ray emitter, coupled with a gamma ray detector set to respond to the particular energy level or spectrum of the emitter, could enhance automatic evasion for all phases of assay and reduce or eliminate the need for careful control of samples by color coding and other identification methods. With a detector in each piece of assay equipment, including analytical balances (electric or chainomatic), evasion could be triggered automatically when the proper material was being processed. Extraneous samples or counterevasion samples without the proper gamma ray emitter would respond normally to analysis techniques.

A technique for evading photographic (optical) emission spectroscopy was discussed. This included monitoring a spectrum (with a direct reading spectrograph) while it was being arced and blocking the photographic plate from recording the spectrum of the sample being run. If the monitored spectrum indicated that a normal sample was in the machine, a pre-selected evaded sample would be arced external to the machine (in an adjacent room where monitoring was taking place, for example) and piped back to the unblocked film location. If an abnormal or counterevasion sample were monitored, the monitor would use the direct readout to reconstruct the sample and feed it back to the photographic plate at the correct rack position. Such a scheme, may be technically feasible

SECRET

D2-6

232

SECRET

but would be complex and require a large amount of equipment to be properly implemented. In addition, it would require rapid monitoring, readout, and sample reconstruction to enable a near real-time reconstruction of abnormal samples.

Other methods discussed included the addition of reducing agents in air lines for titration, the use of liquid rather than solid reductors, and the use of other clandestine measures applicable to analysis equipment. Some of these would have to be used intermittently to reduce exposure to alert inspectors, but all were believed to be technically feasible.

The Rocky Flats laboratory supervisor mentioned that distracting the attention of inspectors could be useful in performing overt evasion tactics. He related how this was done to the military inspectors at Rocky Flats. While the inspectors were observing titration being performed in a glove box area, the laboratory supervisor started a conversation which had nothing to do with inspection activities. All the inspectors present joined in the conversation and left the laboratory technician completely unobserved for a period of minutes. During this time, overt evasion could have been performed without detection. This tactic worked, of course, for U. S. personnel in a U. S. plant but may have been much less effective had the inspectors been foreign and had they not spoken English well. It did serve to point out the need for alertness on the part of inspectors, however, and the need to avoid distractions.

Other equipment modifications discussed included the use of a multiple element filament holder for mass spectrometer evasion filaments so that changing of filaments would not be required so often.

The Rocky Flats laboratory supervisor had several general comments on evasion used in the field test, particularly in the area of training. It was brought out that for FT-34 the assay training provided for inspectors was conducted by personnel who were responsible for originating evasion methods used in the test. This dual role was a difficult one because of the need to protect evasion methods while teaching normal assay procedures. It was suggested that for any similar work

SECRET

D2-7

233

in the future, a definite separation between training personnel and evasion practitioners be made. For such a case, training should cover not only assay procedures but also the methods available for evasion detection. The evasion practitioner would then be working independently and against informed inspectors; as a result, assay evasion would be less one-sided than it was during FT-34 operations.

3. Counterevasion. The most obvious method of assay counterevasion is to eliminate the opportunity to be evaded by sending samples from the field back to a home laboratory. If this were done, the only evasion which could be used by a host nation would be practiced either in the foundry area where fissile materials are smelted and cast or in the materials incorporated in the weapons. It was suggested that, if samples were sent home for assay, it could be appropriate to divide sample materials from a given ingot into three parts. One part would be used for assay by the host nation, a second part would go to the inspecting nation, and the third part would go to neutral observers. Each group would perform assay in its own laboratory, and results would be compared. If the results were within acceptable laboratory tolerances, they would be accepted and applied to the ingot from which the sample was taken; the ingot would then be certified for inclusion in the safeguarded materials. Should agreement not be reached, the ingot would be subjected to resampling, and the assay process would be repeated until agreement could be reached. This process would involve some delay between sampling and certification, but it would preclude assay evasion in a laboratory. It would also require agreement upon the individual assay methods used by the different laboratories and some definition of acceptable tolerances prior to operations.

As a corollary to the discussion of assay under controlled conditions, the subject of maintaining control of a laboratory in host nation territory was included. From this discussion, it appeared feasible to provide a portable laboratory for use on foreign soil. Such a laboratory could contain all the equipment and apparatus necessary for all the analytical phases of assay. The laboratory equipment could be packaged in a ship, in a trailer (or series of trailers), or in a

SECRET

cargo aircraft. The particular method of packaging would depend upon the location of the operation site and access to the site as determined by agreement.

As a conclusion to the session, particular counter-evasion methods were discussed. A list of evasion methods and counterevasion methods is shown in Figure D3-1.

SECRET

D2-9

235

FIGURE D2-1. Evasion and Counter Evasion List

Evasion Method	Counterevasion Method
Sleight of hand. (Practiced at Rock Flats only.)	Observe very closely. Keep alert, know procedures. Mark equipment. Check all reagents for impurities. Calibrate burettes. Examine equipment thoroughly.
Add iron to sample. (0.8% iron titrates like about 2% uranium.) Add ballast of inert material (aluminum) to give correct weight. Mask impurities (iron and aluminum) on quantometer by using trigger material (Ge) in sample and sense to alter impurity output.	Do gravimetric analysis; use optical spectrograph and direct burn; do not use direct reading spectrograph. Use unimetric titrator with mercury-pooled cathode. Will detect presence and amount of iron. Also make spot check with thiocyanate or ferrous cyanide indicator. Can use cerium to evade thiocyanate.
Add impurity to sample (such as aluminum) Rig metal balance (electromagnet/remote switch) to read low. Use same impurity in carrier to cover.	Insist on aluminum analysis and direct burn without carrier. Use a variety of carriers.
Add trace of radioactive trigger material (Pu?) to billet in foundry. Add detector crystal and single channel analyzer to the balance electromagnet. Detection of emission would actuate electromagnet automatically.	Use spark source mass spectrometer to look at all the elements. Would also uncover a nonmetallic impurity.
Substitute preshot spectrographic plates for the real ones.	"Fingerprint" the real plates by adding an iron spectrum or jerking the arc or racking unexpectedly, etc. Check tackiness of unexposed plate prior to loading. (cont on next page)

FIGURE D2-1. Evasion and Counter Evasion List (cont)

Evasion Method	Counterevasion Method
	Mix half sample and half known standard, (or other proportion) and arc. Look at diluted sample. This will "fingerprint" the exposed plate as well as detect if someone is dropping a shaded filter over your plate or deflecting your lightbeam.
Substitute reducing gas for the inert gas used on the titration (SO ₂).	Inert gas through oxidizing agent (scrubber) "permanganate." Would neutralize reducing gas. Use your own Bottle of N ₂ gas.
Substitute higher concentration of indicator solution to change the blank. Use tube within a tube approach--channelize the reductor.	Close inspection--use own equipment and solutions.
Use a colorless liquid oxidant or reductant on the glassware to bias results.	
Use altered computers or calculators.	Use hand calculations for a check. Do your own calculation.
Use prerecorded signal and feed to output, possibly from remote duplicate.	"Fingerprint" the correct signal by nonconventional machine operation. Check isotopic shift on a good optical grating spectrograph. Spike the sample with your standard in a ratio known only to you. (If assay expected is known.)
Insert spurious signal in potentiometer during back titration indicating potential break other than actual break.	Check potentiometer thoroughly, if possible.

FIGURE D2-1. Evasion and Counter Evasion List (cont)

Evasion Method	Counterevasion Method
<p>Duplicate emission spectrograph in adjacent area. Block, reflect, and analyze emission from No. 1 source on No. 2 machine. When No. 1 has racked up on plate, insert false information from machine No. 2 onto blank (previously blocked) portion of spectrographic plate. Evades changing order of arced samples. Use trace trigger like Ge to actuate blocking mechanism.</p>	<p>Add some known standard or trace element to arced sample. You may still be fooled.</p>
<p>Add filament with "good" material on it to source. Switch heater current to this filament instead of sample filament to evade.</p>	<p>After obtaining record, raise heater current to maximum and burn/break filament. Examine on removal to see if broken.</p> <p>Touch check removed filament. Should be hot or you have been evaded.</p> <p>Switch to your own standard filament, if possible.</p>
<p>Bias ratio of U-235/U-238 inside machine.</p>	<p>Possibly detect by removing signal; raise the zero and scan the magnet. When you pass the crossover point where ratio is being altered, there may be a slight bounce or kick on the recorder.</p>
<p>Add small known concentration of molybdenum to sulphuric acid used to wash down the Jones reductor.</p>	<p>Clean all beakers, glassware, etc., and make up fresh acid.</p>
<p>Conceal pair of electrodes in titration, using coulometric ion generation, put charge of electricity through sample solution to reduce some of the excess potassium dichromate.</p>	<p>Inspect apparatus thoroughly.</p>

SECRET

D2-12

238

FIGURE D2-1. Evasion and Counter Evasion List (cont)

Evasion Method	Counterevasion Method
<p>Add silver or cadmium to the zinc mercury amalgam in the Jones reductor to reduce other impurities added to the uranium. These would then titrate like uranium.</p>	<p>Build your own Jones reductor with your own materials. Take material for more than one kind of reductant and cross check.</p> <p>Check Jones reductor with H₂SO₄ and K₂CR₂O₇ blanks before using.</p>
<p>Add a volatile impurity (such as iodate or bromate) that will vaporize up the stack in the muffle furnace. Rig balance to cover presence of additional weight.</p>	<p>Weigh U₃O₈ after metal oxidation. Compare with weight before oxidation detect volatile element loss.</p>
<p>Alloy or preplate filaments with material so that combined assay with unknown will give desired evaded result.</p>	<p>Inspect filaments with magnifying glass before loading.</p>
<p>Insert filters, shielded quartz or reflectors to remove the light path of a fraction of the burn during the emission excitation. Would cover up an impurity.</p>	<p>"Fingerprint" exposed plates.</p>
<p>Alter excitation conditions by use of a "faulty" amp-meter giving <u>low excitation</u> and masking impurity.</p> <p>High concentrations of (SO₄)⁻² in the U₃O₈ could also depress the excitation of impurities.</p> <p>A carrier with a lower boiling point could prevent the excitation of many elements.</p>	

FIGURE D2-1 Evasion and Counter Evasion List (cont)

Evasion Method	Counterevasion Method
<p>Add ceric sulfate (same color to potassium dichromate. Takes greater weight to oxidize U^{+4} to U^{+8} than $K_2Cr_2O_7$ and therefore acts like more U present.</p>	<p>Detect presence of ceric sulphate spectrographically.</p>

~~SECRET~~