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Measurement of Efficiency at Trinity by Sampling

The 100 Ton Shot Preparations — Susan Roth 6/18/98

Preliminary to the final test of the gadget it is planned to shoot 100 tons of H.E. This shot is intended to provide some experience in measuring large explosions and will serve as a practice episode. The radioactivity which will be encountered in the final shot will be simulated here by distributing among the boxes of H.E. a solution of a 100 day Hanford slug having about 300 curies of activity. While the geometry and the general nature of the explosion of this 100 ton shot differ in several remarkable respects from that of the final shot, it is expected to afford a much better basis for anticipating the conditions of the gadget shot than is now had. In particular, we hope to learn:

(1) What is the general utility of a lead shielded army tank (M4) as a means to enter the radioactive area to obtain samples. What is the extent and depth of the debris from the crater and how does it affect the maneuverability of the tank.

(2) What is the level of radiation over active region and how effective is the shielding of the tank.

(3) What happens to the radioactivity; what fraction deposits superficially over the ground nearby, what fraction is mixed with the earth thrown up from the crater, and what fraction is essentially lost through having been thrown up in the air and dispersed over a much wider area.

(4) What amount of segregation takes place among the several fission products after these are isolated by chemical extraction from samples taken from a number of positions in the active area.

In addition, practice will be afforded in the manipulation of the tank and the sampling devices, in the measurement of the samples of earth, and in the chemical analysis procedure for extracting fission products from Trinity earth.

Plans and Status

(A) Dissolution of Hanford Slug

A suitable lead shield was available and this is being fitted on a truck which will take it to Hanford. The slug will be inserted in the shield there and should be returned to Trinity before May 1.

A stainless steel dissolver has been designed and the shop now has the drawings for this from the drafting room. A concrete sarcophagus (3-1/2' thick) to contain the dissolver will be stationed SSE of the wooden tower at a distance of 75 ft. The design for the concrete structure has been submitted to and should be completed by April 15. The concrete structure

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with lead bricks (8" x 4" x 2") and will be capped with an 8" lead top made of these bricks. This shielding should be sufficient to allow a working time of the order of 4 hours above the apparatus.

The dissolver is to be provided with a 2" tube through which the slug is introduced. A bed of dry ice will protect the walls of the dissolver from the impact of the slug when it falls into the dissolver. A suction device has been designed which transfers the slug from its shield on the truck to the entrance tube of the dissolver. The shop is fabricating a funnel which guides this transfer. The transfer device will be operated from behind a wall made of concrete bricks and observation will be by telescope using mirrors mounted above the carrier.

The dissolving will be effected by periodic addition of conc. HNO_2 and fuming HNO_3. During the dissolving a stream of He or N_2 will be passed through the solution by way of the lead-out tube to sweep the active gases out of the system and to prevent plugging of the lead-out. The dissolver and lead-out will be wound with heating elements dissipating about 1-2KW to accelerate dissolution. Around 2400 liters of NO_2 will be liberated over the period of solution estimated to take from 36-43 hours. This gas will be diluted around 2-3 fold with He or N_2, thus giving around 6000 liters in all. The active gases present in the slug (mostly 5.3 day Xe^{133} and the 8 day I^{131}) known to distil during dissolution will be present in the gas stream. The activity of these constituents will be $1x10^{-6}$ curies/cc and $3x10^{-6}$ curies/cc, respectively. The γ radiations of 5.3 Xe consist of a 35 kv X-ray and an 85 kv γ-ray, whereas that of 8dI is a .4 Mev γ-ray. The tolerance dosage is of the order of $5x10^{-10}$ curies/cm^3. This would entail a dilution of 10,000. Since the gases will be vented at a distance of 1000 ft. from the dissolver, it appears that no arrangements need be made for gas removal other than dilution at the end with a blower. The gases will also carry some spray which may deposit near the vent. An area around the vent (2200' diameter) should be roped off to prevent contamination of shoes, clothing, etc., and also direct hazard to personnel.

After solution of the slug, the volume will be made up to about 15 liters by adding water and testing for the level by a bubbling technique (to be worked on). The gas lead into the dissolver and the acid and gas vent leads will then be disconnected, and a gas lead connected to the inlet side for pumping up the solution. It is estimated that 30 lbs. pressure will be needed to pump the solution up into the pile. The tubing to be used in the pile will be saran tubing, 3/4" O.D., 1/2" I.D. arranged in 4 layers, 4 strings per layer. Under the present design, around 1/3 of the tubing will be outside of the pile, or roughly 1/12 of the total activity will be distributed at each face of the pile. At the foot of the tower it is estimated that the working time for a tolerance dose (.1R1 day) will be the order of one hour, but will be considerably more dangerous in close proximity to the saran tubing, once the solution is pumped over. Some control will have to be exercised over personnel working near the pile once the solution is in place.

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The plans for transferring the solution to the H.E. pile are still in an elementary state but in general the idea is, force the solution out of the lead by applying pressure above the liquid in the dissolver until it fills the saran tubing and enters a glass sighting tube under observation through a telescope. A valve will be provided in the lead out which will then be closed from behind some conrete protection. In case of need, this valve can be opened and the liquid returned to the dissolver.

Following is a list of the major equipment which will be required to carry out the operations mentioned:

1. A motor generator to supply 3 kw for heating equipment and other electrical apparatus.

2. A steam generator for bending the saran tubing.

3. 6 large cylinders each of N_2 and He.

4. A 4 ton crane for lifting heavy shielding, etc.

5. Possibly a centrifugal air blower for diluting the radioactive gases. This problem will be discussed separately below.

6. Possibly 6 large metal filled with liquid N_2 (25 li) for cooling traps to admit active gases. (See comment under 5.)

7. Saran tubing (3/4" O.D., 1/2" I.D.) for leading away active gases and for holding the solution. 3000 ft. of tubing and connectors will be ordered.

8. Lead bricks for shielding the dissolver. 3-1/2 tons of 8" x 4" x 4" and 1-1/2 tons of 8" x 2" x 2" (bricks will be ordered).

9. 18 tons of concrete blocks, 2' x 1' x 1' (density 3).

10. Cold water lines for cooling traps, etc.

11. Two megavac pumps.

12. 5 gal. conc. HNO_3 and 5 gal. of fuming HNO_3.

13. 100 lbs. dry ice.

There are many other small items not included which will be sent to the site in the course of the experiment and perhaps some bigger equipment not anticipated now.

The following schedule of operations is contemplated at Trinity. Dummy runs will be made in the period April 20 - May 1 in which the dissolving and the

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subsequent pumping operations will be tested. The dissolving of the irradiated W slug and filling of the tubes in the H.E. should take place in the period May 1 - May 3.

(B) Modification of M4 Tank for Sampling

Lead Protection - It is autisipated that the radiation in the active area may be of the order of 100 R/hr. In order to remove samples from areas where the radiation level is of this order, an M4 tank is being fitted with lead protection so that the observer and driver will receive about 1/50 of the radiation outside the tank. A total of 11,000 pounds of lead will be installed by the plumbing shop; they have completed about half of the job at this writing.

Air Supply - Clean air will be supplied to the observer and the driver by means of compressed air tanks mounted externally above the engine hatch. Four tanks will provide 660 cu. ft. of air, enough for 2-1/2 hours for the two men. This air will be supplied to the men through lucite window pressure masks and will provide positive pressure protection against inhaling of radioactive dust, especially dust containing plutonium.

Core Drill - The sampling will be done by means of a core drill which has been prepared for us by the Independent Exploration Co. This core drill, which is driven by a gasoline engined 'Johnny Motor', operates through a hole in the bottom of the tank. It takes a core bit which cuts a 2" diameter core. To this bit is coupled a core catcher which permits the core to pass upward into the core barrel but not in the reverse direction. The core barrel comes in 2' sections which can be coupled to one another in series to produce a core of arbitrary length within the power of the motor. The complete outfit has been shipped and is expected on the site by April 15. Lead protected storage space for the core barrels is provided next to the observer inside his lead shielded compartment.

Radiation Meters - Samples will be removed only from areas where the level of radiation is sufficiently high so that easily measurable amounts of radioactive substances can be expected to be present. In general this means that the level of radiation should be of the order of 1 R/hr. or more. Two radiation meters will be placed under the tank for a continuous reading of the local intensity. A third radiation meter will be arranged so that it can be inserted in the hole made by the core drill to explore possible stratification of the radioactivity. A radiation meter will be installed on the side of the tank to give the general radiation level outside the tank. Finally, radiation meters will be provided in the observer and in the driver compartments to give the radiation level to which the men are being subjected. Extension leads to the external meters will be provided so that all readings and adjustments may be made from a panel in the observer's compartment. For the final shot the range of the external meters must be from .1R/hr. to 100 R/hr.; the internal mdters from 0.01 R/hr. to 10 R/hr. Dick Watts is modifying his standard direct reading ionization meters for external mounting; the chamber which is to fit in the core hole is yet to be designed and will [illegible] not be

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