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EXPLOSIVE DEMOLITION OF ACTIVATED CONCRETE

MASTER

D. L. Smith

EG&G Idaho Inc.
Idaho National Engineering Laboratory

This paper describes the removal of a radiologically contaminated concrete pad. This pad was removed during 1979 by operating personnel under the direction of the Waste Management Program of EG&G Idaho, Inc.

The concrete pad was the foundation for the Organic Moderated Reactor Experiment (OMRE) reactor vessel located at the Idaho National Engineering Laboratory (INEL). The pad consisted of a cylindrical concrete slab 15 ft in diameter, 2 ft thick, and reinforced with steel bar. It was poured directly onto basalt rocks approximately 20 ft below grade.

The entire pad contained induced radioactivity and was therefore demolished, boxed, and buried rather than being decontaminated. The pad was demolished by explosive blasting.

INTRODUCTION

This paper discusses the explosive demolition of a radiologically activated concrete pad.

The concrete pad was the foundation for the Organic Moderated Reactor Experiment (OMRE) reactor vessel located at the Idaho National Laboratory (INEL). The OMRE Facility before decontamination and decommissioning (D&D) is shown in Figure 1.

The OMRE was D&D'd during 1978 and 1979. The last phase in the D&D included removal of the vessel support pad. Successful removal of the activated pad allowed the pit to be backfilled and the area released for unrestricted use. Figure 2 shows the OMRE site after D&D.

DESCRIPTION OF PAD

The pad consisted of a cylindrical concrete slab 15 ft in diameter, ∿2 ft thick, and reinforced with steel bar. The slab was 20 ft below grade, and had been poured onto the prepared basalt. This made the concrete thickness nonuniform. The pad during construction is shown in Figure 3.

Because it was near the reactor core, the pad became activated and produced the radiation field shown in Figure 4. The curie content, isotopes present, and activation depth in the concrete pad are shown in Table 1. The nuclide content of the INEL surface soil is shown for comparison in Table 2.

REASONS FOR BLASTING

LESS EXPENSIVE

A pneumatic jackhammer and hydraulic splitter were used initially in an attempt to break the concrete. This method was extremely slow and

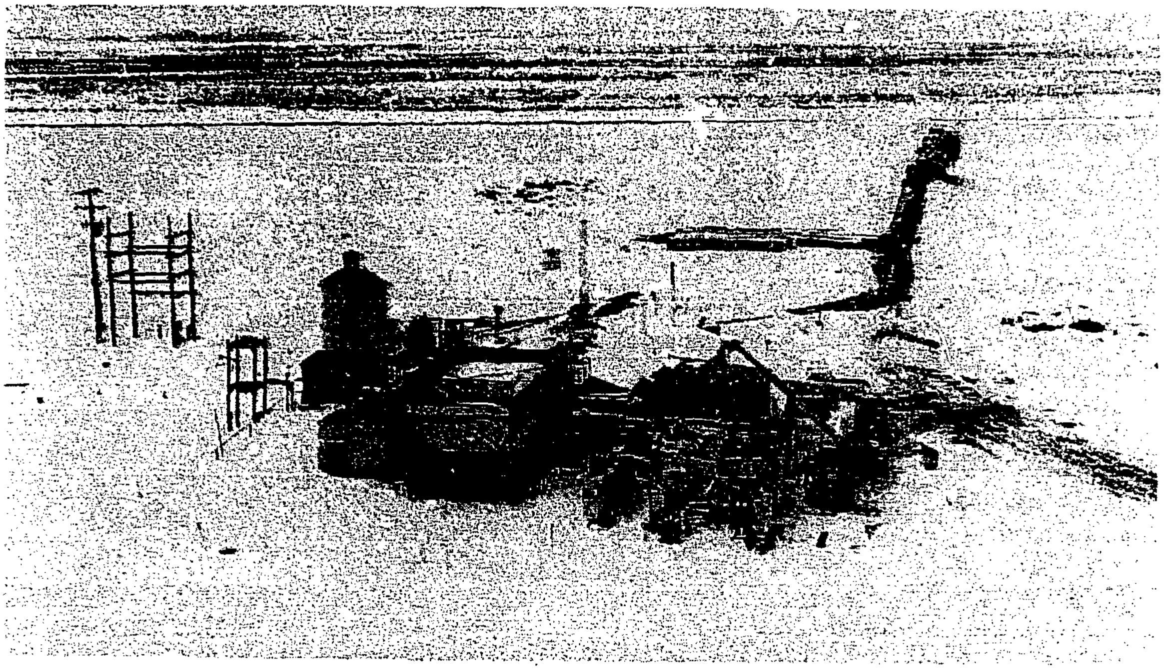

FIGURE 1. OMRE Facility Before D&D

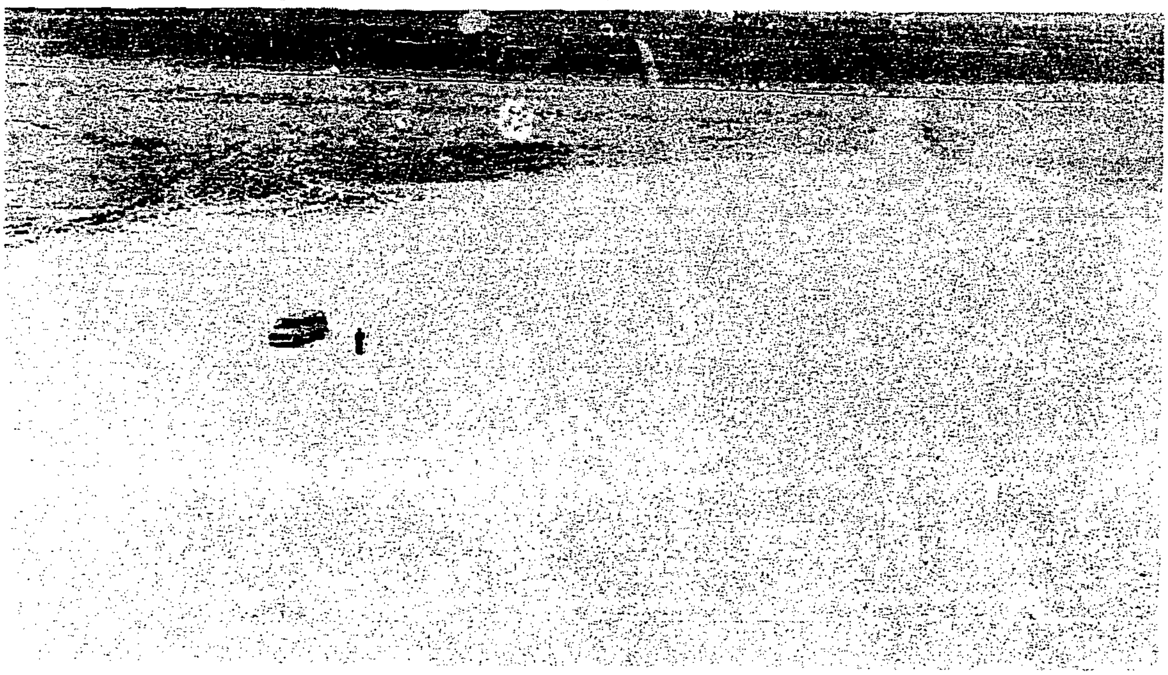

FIGURE 2. OMRE Facility After D&D

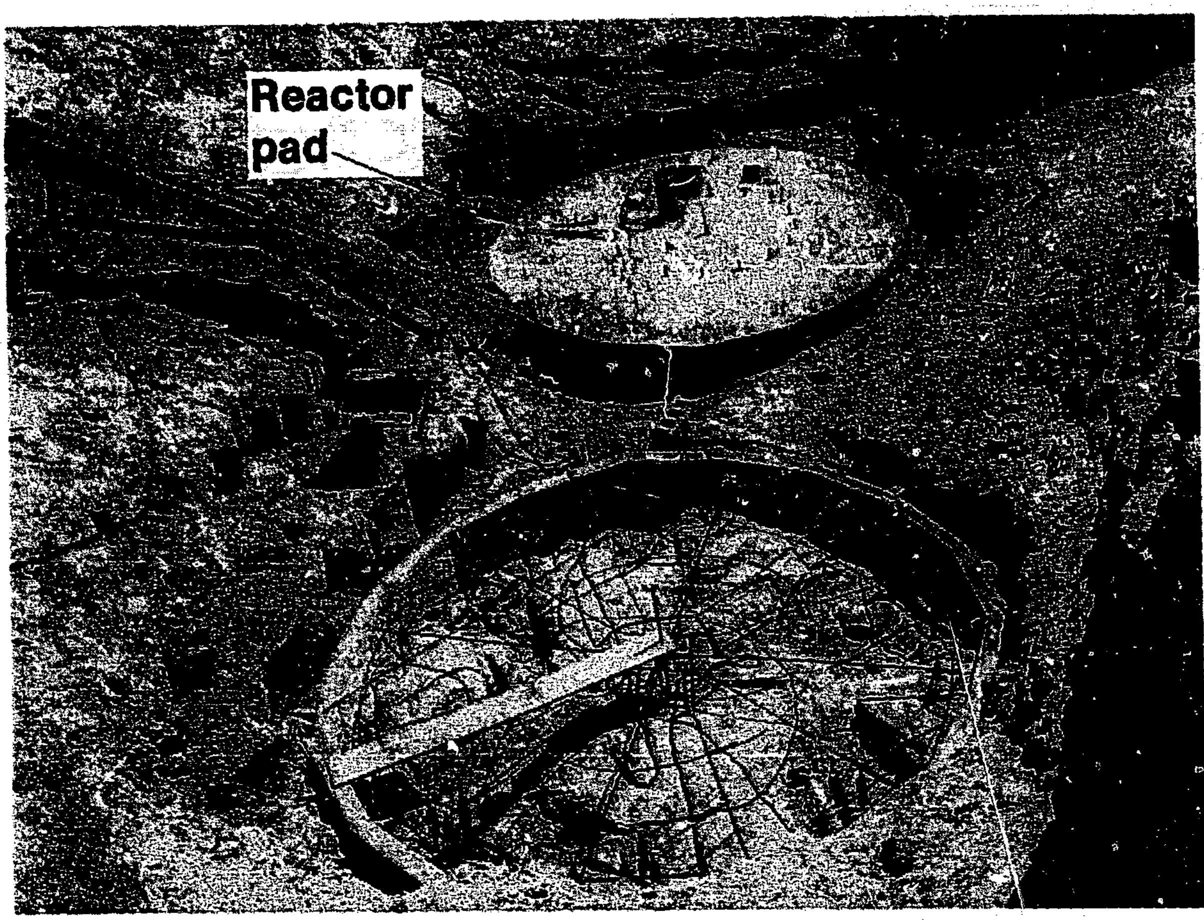

FIGURE 3. OMRE Pad During Construction

ineffective because the concrete was well reinforced and poured on a rock foundation. Demolition using this method would have cost too much in both money and radiation exposure to personnel. An estimate to perform the demolition using explosives indicated blasting would require the least amount of time and, therefore, cost less money and result in less radiation exposure.

DEVELOPMENT OF EXPERTISE

We wanted to gain expertise in explosive demolition of activated concrete because of its potential application to the INEL. A primary objective was to determine how to control contamination spread.

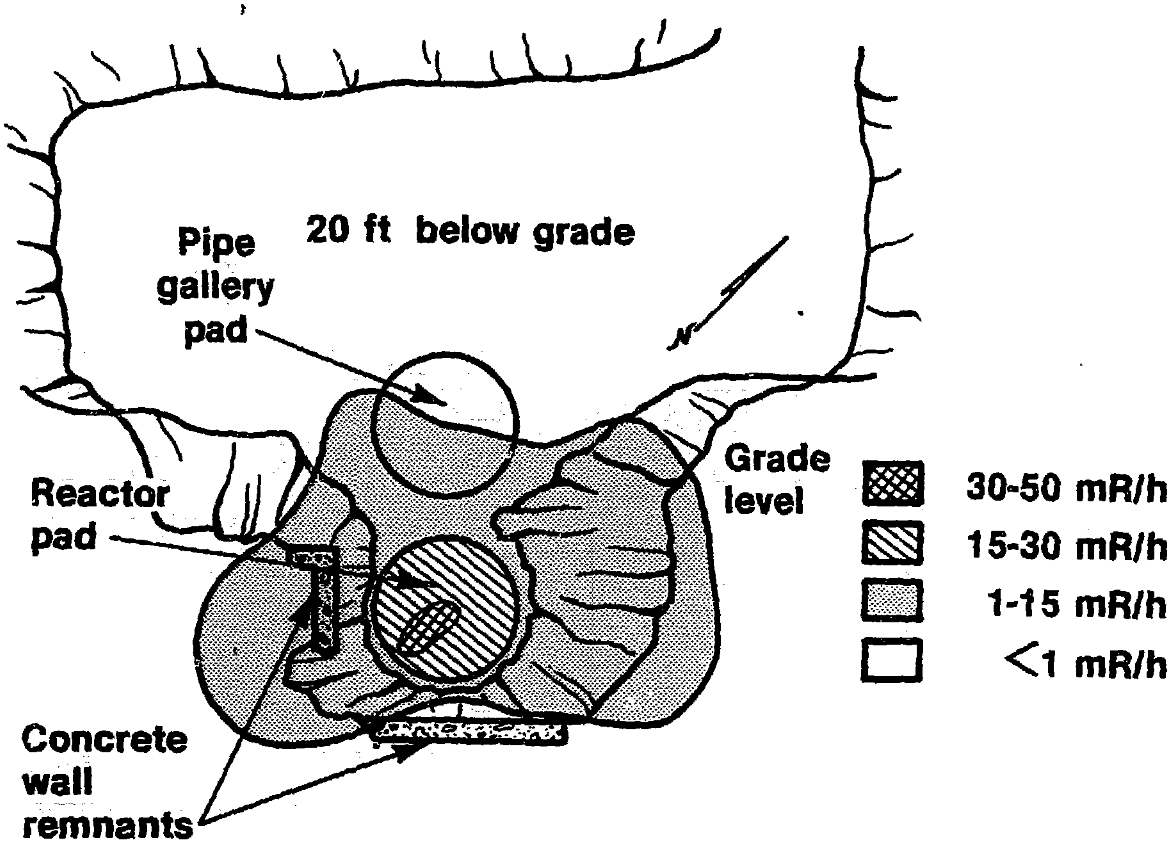

FIGURE 4. Top View of Pit Showing Radiation Fields

CONTAMINATION CONTROL

Although explosive demolition limits the time personnel are exposed to radiation, the possibility exists for contamination spread to be extreme if precautions are not taken.

TABLE 1. Nuclide Content in OMRE Reactor Pad (pCi/g)

Depth	^{154}Eu	^{60}Co	^{134}Cs	^{137}Cs	^{152}Eu
Surface	230	410	16	ND[a]	2400
6 in.	48	215	ND	ND	556
12 in.	20	78	ND	0.8	243
18 in.	12	45	ND	0.5	117

(a) ND = Not detected (detection limit = 0.1 pCi/g)

TABLE 2. INEL Background Nuclide Content

Isotope	Nuclide Content (pCi/g)
^{60}Co	0.1
^{134}Cs	ND[a]
^{137}Cs	1.0
^{152}Eu	0.1
^{154}Eu	ND

(a) ND = Not detected (detection limit = 0.1 pCi/g)

Two methods were used to limit contamination spread during explosive demolition.

1. The first method was to select the size of the explosive needed to break the concrete yet minimize rock throw and dust generation. This was attempted by using small charges initially and applying the experience and knowledge gained to subsequent detonations.

   This application was difficult, however, because the pad thickness was nonuniform and the pad had been altered through the use of the jackhammer and hydraulic splitter.

2. The second method was to use a blasting blanket over the area. This consisted of a covering of three layers (about 10 mils thick total) of Turco 5580-G over the concrete. This, in turn, was covered with layers of tarpaper and rubber-backed carpet to absorb the blast and limit rock throw. The pit walls and bottom were also covered with Hypolon to contain any escaping contamination. The Hypolon covering is shown in Figure 5.

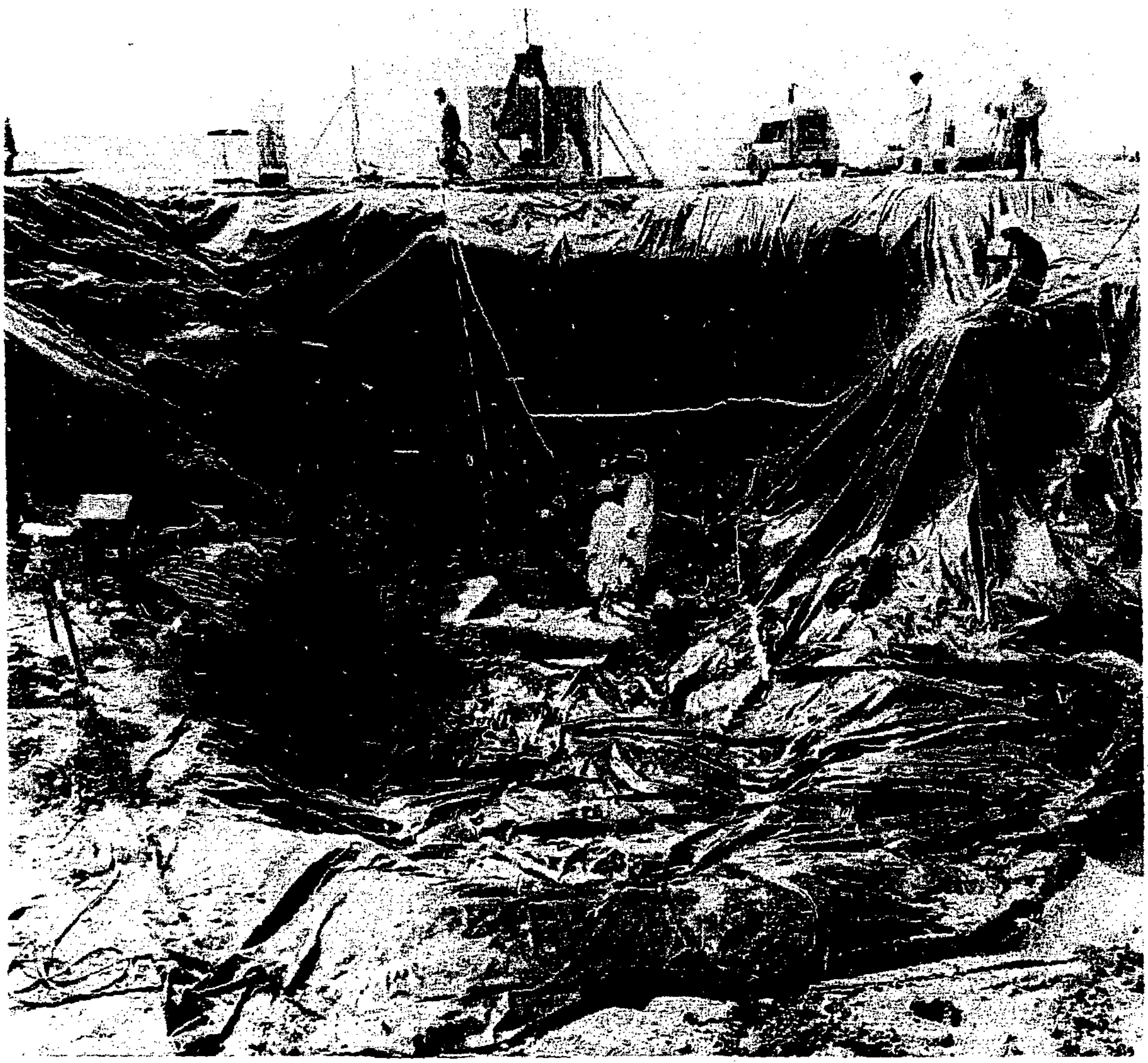

FIGURE 5. Hypolon Covering

DEMOLITION PROCEDURE

Demolition consisted of seven steps. The first step was performed on the unactivated concrete pad, and the other steps were all performed on the reactor pad.

Separate figures show each step in the demolition procedure. Each figure shows the location of the charge and a sketch representation of the results.

1. Step 1 is shown in Figure 6. This step consisted of detonating a single charge (3.5 oz of dynamite) in a hole 18 in. deep and 9 in. from the edge of the unactivated pad. The purpose of this shot was to gain knowledge and experience before beginning the test shots on the reactor pad.

2. Step 2 (Figure 7) consisted of detonating a single charge (3.5 oz of dynamite) in a hole 30 in. deep and 9 in. from the edge of the reactor pad. The depth of the hole was 30 in. instead of 18 in. to get deeper breakout of the concrete. No concrete breaking was obtained by this shot. Apparently the charge was detonated too deep, causing the energy to vent to the basalt.

3. In step 3 (Figure 8) a charge (3.5 oz of dynamite) was placed and detonated in each of two holes bored 18 in. deep and 9 in. from the edge of the pad. The holes were 1 ft apart. Concrete breakout was obtained about three-fourths through pad depth. Cracks formed toward center due to the cavity made during jackhammering. Rock throw was minimal, and dust generation was very light.

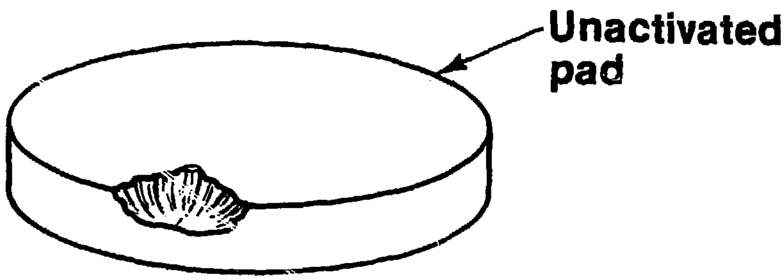

FIGURE 6. First Step in Explosive Demolition

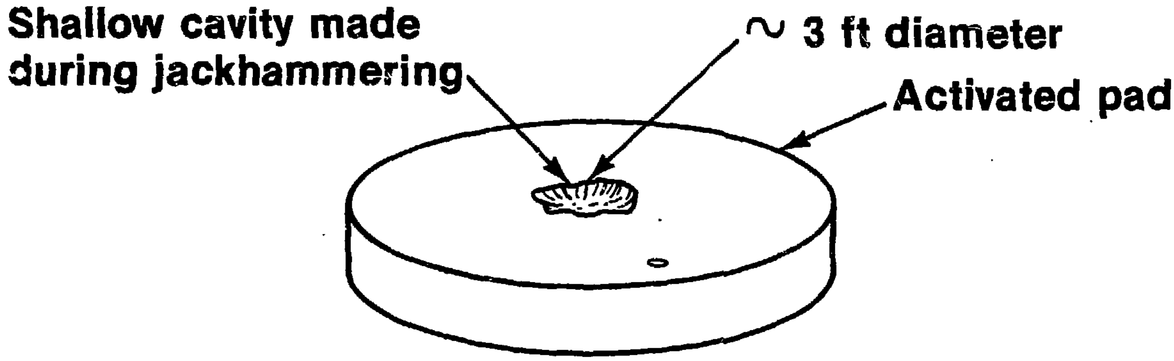

FIGURE 7. Second Step in Explosive Demolition

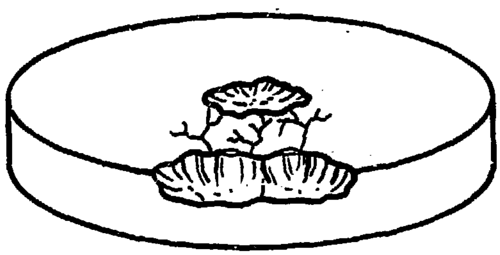

FIGURE 8. Third Step in Explosive Demolition

4. Step 4 (Figure 9) consisted of detonating two 3.5-oz charges in a single hole 32 in. deep and 9 in. from the edge of the pad. One charge was placed 32 in. deep and the other 18 in. deep.

Radial cracking was very good, concrete breakout went through the entire pad thickness, and rock throw and dust generation were minimal.

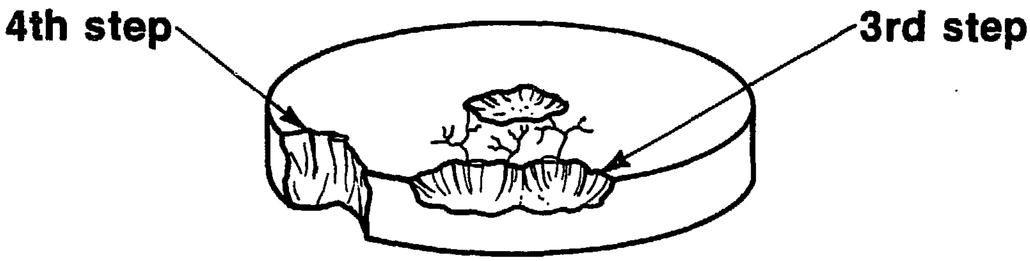

FIGURE 9. Fourth Step in Explosive Demolition

5. Step 5 (Figure 10) was designed to break a larger section of concrete. Four holes were bored 30 in. deep, 1 ft apart, and 1 ft from the edge of the pad. Two charges, consisting of 5.3 oz of dynamite plus 1.8 oz of nitrogenated fuel oil, were detonated in the bottom of each hole. Unexpectedly, the concrete broke inward instead of outward. This was probably caused by the cavity in the center of the pad. A high speed film of this detonation was made and will be shown at the workshop. The rock throw was about 50 ft, and considerable dust was generated. There was, however, no detectable contamination spread, and essentially all debris was contained within the excavation.

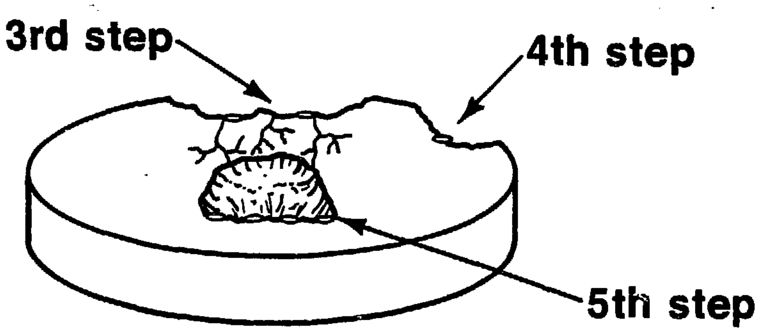

FIGURE 10. Fifth Step in Explosive Demolition

6. Step 6 (Figure 11) consisted of detonating a larger charge (7.1 oz of dynamite) in each of two holes. The holes were 28 in. deep, 1 ft apart, and 1 ft from the edge of the pad. Good concrete breakout was obtained with satisfactory control of rock throw and dust generation.

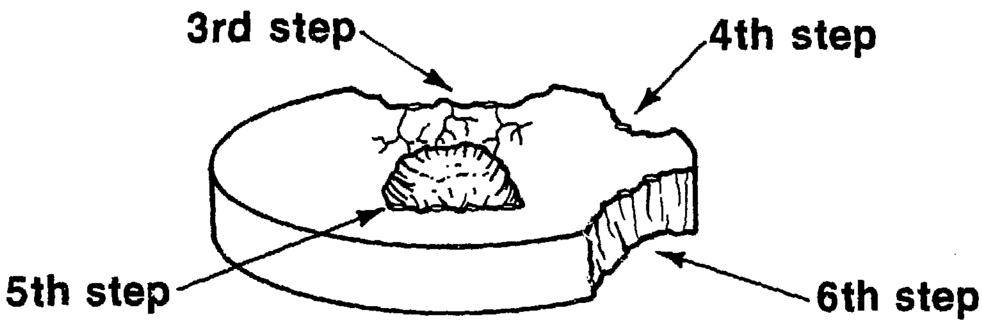

FIGURE 11. Sixth Step in Explosive Demolition

7. Step 7, the final step (Figure 12), consisted of detonating 7.1 oz of dynamite in each of 10 holes. The holes were bored in a circular pattern about 3 ft from the edge of the pad and approximately evenly spaced. The holes were bored to a depth of 28 in. Rock throw and dust generation were severe, but the debris was well contained within the covered pit area.

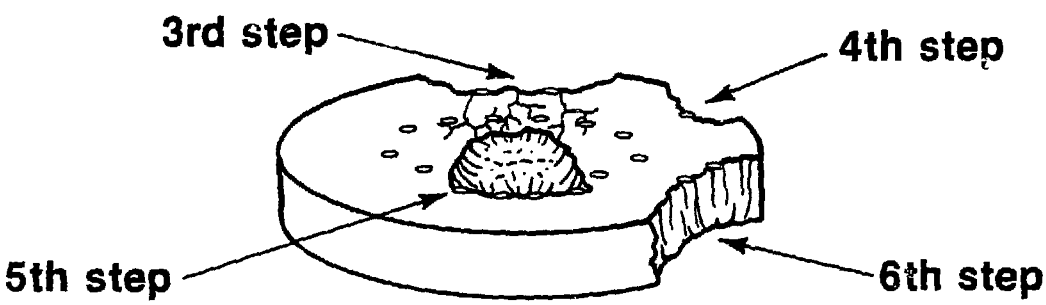

FIGURE 12. Seventh and Final Step in Explosive Demolition

A radiological survey following the final detonation showed no detectable contamination outside the pit area.

The largest piece of concrete remaining after the blast was a circular piece (~7 ft in diameter) from the pad center (Figure 13). This piece was loose from the basalt and was easily removed using a clam shell shovel.

FIGURE 13. Largest Concrete Piece Remaining After Blasting

CONCLUSIONS

It is possible to explosively demolish activated concrete without significantly spreading radioactive contamination. The demolition was adequate to allow safe removal of the activated concrete.

More effort should be devoted to the analytical and experimental determination of explosive charge size and placement to accomplish incipient breaking of the concrete.

Additionally, other materials to cover the concrete should be tried to better control rock throw and dust generation.