

We feel that the Government must have, on its own, not through someone they contract with, the ability to receive and then analyze the data. So I think the answer to your question, sir, is, Yes, the Department of Interior has a role wherein they will provide the reservoir evaluation and provide the expertise, as it were, with regard to the oil and gas business and we will try to provide the expertise as far as the nuclear explosive is concerned.

Senator Moss. I wanted to ask one question about the probability of radioactive contamination of the oil that is ultimately extracted in this *in situ* process.

Mr. KELLY. Having never actually done the experiment, it is hard to be very definite about this. Our theoretical analysis and studies do not indicate any way that the radioactivity would become intermixed in the oil.

As I indicated earlier, most of the radioactivity would be collected in the form of fused rock at the bottom of the chimney which would probably be located outside of the Kerogen bearing area.

The small amount that is distributed within the chimney is in the voids and floats around and when one is burning the rock, and burning the carbon fractions in the rock the liquid vapor comes out and it is not clear that these airborne gases in the voids would mix with that oil at all. If they did, certainly there are ways that they could be separated and taken out.

Senator Moss. Thank you, Mr. Kelly and Mr. Davy. We do appreciate your coming here and giving the Committee the benefit of your testimony.

You see the Senator from Wyoming, the Senator from Colorado, and the Senator from Utah stayed right on to listen to all of this.

(Following the hearing the following additional information was received from Mr. Kelly:)

ATOMIC ENERGY COMMISSION,
Washington, D.C., March 1, 1967.

Mr. JERRY VERKLER,
Staff Director,
Committee on Interior and Insular Affairs, U.S. Senate.

DEAR MR. VERKLER: During the hearings on February 21 and 22, 1967, regarding the Department of Interior's five-point oil shale development program, I agreed to submit further information in response to questions I was asked following my prepared testimony.

Senator Moss inquired as to whether the rock in which it is planned to conduct the Gasbuggy project is more dense than the kind of rock found in the oil shale area. I answered that I thought they were roughly comparable, which is in fact correct. Generally, the bulk densities of the rock in both areas ranges from 2.2 to 2.4 grams per cubic centimeter. The bulk densities of some of the types of rock in which we have already conducted nuclear explosions are as follows: Granite and Dolomite, 2.7; salt, 2.2; Tuff, 1.85; and Alluvium, 1.7. Also, the Committee may be interested in noting, as pointed out by an official of the U. S. Bureau of Mines, that although density is partly a function of porosity, it is also a function of the type of minerals or other substance composing the rock. Rather than density, it is the porosity and the permeability that affect the flow and storage of fluids. The Pictured Cliffs sandstone (Gasbuggy) has an average permeability of 0.14 millidarcy, and an average porosity of 11 percent. The Green River oil shale has a porosity and permeability so small that it cannot even be measured accurately.

Senator Allott raised the possibility that sodium in the groundwater in the Piceance area might be more susceptible than ordinary water to the absorption of nuclear activity. Sodium in the water should not present a special problem