

answer to these questions. We believe the shale beds on the naval reserves are too shallow to be safely or productively utilized for atomic experiments. However, some of the older mine workings on Naval Oil Shale Reserve No. 1 might be utilized for any limited underground retorting experiments which might be required prior to engaging in major atomic undertakings elsewhere.

It is possible that an atomic device will not prove practical for use in the *in situ* retorting of shale oil, and certainly not in all locations. As previously alluded to, one of the major problems to be solved in *in situ* retorting is the creation of an extensive fracture system through which fluids can flow. Oil shale is a dense, impermeable rock in its native state. Conventional hydraulic fracturing techniques known to the oil industry today may not be applicable because they create a few large fractures, and what will be needed for *in situ* processing of oil shale is a highly fractured, broken rock zone. The Bureau of Mines is studying explosive fracturing methods whereby a liquid explosive is pumped into the rock, following small fractures or fissures back into the formation, and then detonated. Preliminary results from this process look promising. The Navy has modestly supported this research with funds for several years and has offered to provide a location on Naval Oil Shale Reserve No. 2 in Utah for field tests of this process in an oil shale formation.

In connection with anticipated research, the matter of spent shale disposal is of considerable interest to us. Unless vast piles of spent shale are to spoil the landscape as a result of oil shale mining and surface retorting, a research effort must be undertaken leading toward some practical means for the economic utilization or disposal of spent shale.

In conclusion, I would like to state that my office stands ready to assist this committee, the Department of the Interior, and industry in carrying out this oil shale program in any way consistent with legislation controlling the naval oil shale reserves.

This is the end of my prepared statement, however, members of my staff and I will attempt to answer any questions you may have on this matter.

Senator Moss. Thank you, Captain Moore, for a very fine statement. It answers one or two questions I had in my mind about the extent of the naval reserve holdings. I understand it is about 145,000 acres.

Captain MOORE. That is right, sir. We only have approximately 12 billion barrels of recoverable oil on shale reserve No. 1 and about 3.8 on Naval Shale Reserve No. 2 in Utah. It is relatively small compared to the whole basin.

Senator Moss. Has the mineral entry been forbidden also on the naval reserve?

Captain MOORE. Yes. Our interpretation of the law, Senator Moss, is that when withdrawn, it be withdrawn for exclusive use of the Navy. At least in 1962 administration over it was given, by the legislation to which Senator Allott referred, for all purposes to the Secretary of the Navy, so we think that the dawsonite claims and nahcolite claims that are filed are not valid with respect to the reserves.

We don't know of any valid ones there to date.

Senator Moss. Well, are there some that have been filed that will have to be contested legally to determine it?

Captain MOORE. There are approximately 87 claims. The Department of the Interior has by administrative action rid itself of 70-