

APPENDIX C

**EFFECTS OF THE COLLAPSE OF CIVILIZATION ON THE
PROBABILITY OF EXPLORATORY DRILLING AT THE WIPP**



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date: April 2, 1990

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subject: Effects Of The Collapse Of Civilization On The Probability Of Exploratory Drilling At The WIPP

A preliminary scenario analysis for the WIPP (Guzowski, 1990) indicated that the integrity of the disposal system depends on whether or not future drilling occurs into the waste-filled rooms and drifts. In dealing with future human intrusion, the question arises as to how long into the future exploratory drilling for resources is likely to occur. At the WIPP, the only natural resource at depths greater than the disposal rooms and drifts with the potential to be present in economic quantities is natural gas (Powers and others, 1978). Based on estimates of the quantities of reserves and undiscovered resources for oil and natural gas (Mast and others, 1989; Kerr, 1989) and the current rate at which the reserves are being consumed (Kerr, 1989), the trend suggests that all of the oil and natural gas resources in the continental U.S. for practical purposes will be consumed within a relatively short period of time. The question arises as to how long exploratory drilling will continue. Depletion of a resource in an area generally will result in an end to exploratory drilling for that resource at that location. For some undefined time after depletion, the possibility exists that industry will go back to an area for "one more look." This rechecking of areas also will eventually stop if no new resources are discovered. Another question arises as to what conditions are required for exploratory drilling to begin again. In various discussions on the subject, a number of people have stated the opinion that exploratory drilling would begin again as society redeveloped after the collapse of civilization even if exploratory drilling had previously been abandoned. The purpose of this memo is to consider the factors that have allowed drilling technology to develop to its present level, and to consider whether these same factors would be available after the collapse of civilization.

DEGREE OF COLLAPSE

In this discussion on the reestablishment of drilling technology, collapse of civilization is considered to occur at a time after the period of active institutional controls of the WIPP and to include complete loss of knowledge of drilling technology, the geologic controls for hydrocarbon accumulation, and the exploitation of natural resources by a previous civilization.



FACTORS THAT CONTROLLED THE DEVELOPMENT OF DRILLING TECHNOLOGY

Several factors were required for the development and advancement of the petroleum industry. In the past, natural gas usually was burned at the well as a waste product. At some locations, this practice continues today. The following discussion is based on the factors in oil discovery that led to advancement in drilling technology. Advancements in drilling for oil also apply to drilling for natural gas. These factors are:

- (1) In the early stages of oil discovery, shallow reservoirs supplied enough petroleum so that once uses were found for the material, supply was sufficient or could readily be located to maintain the demand for the product.
- (2) Oil reservoirs were associated with certain geologic settings. The distribution of reservoirs was not random. A theory was developed as to the origin and accumulation of oil and gas. Through time, the number of geologic settings where hydrocarbons could be found increased, although the basic theory as to why hydrocarbons accumulated remained basically the same. A relatively consistent association was noted between production and geologic setting when moving from one region into new but geologically similar region. This association confirmed the theory of the origin and accumulation of oil and gas.
- (3) Once the targets of hydrocarbon accumulation were identified, progressively deeper targets were investigated as demand increased and techniques were developed to locate deeper targets. Improved drilling techniques had to be developed before boreholes could reach greater depths.

REDEVELOPMENT OF DRILLING TECHNOLOGY AFTER CIVILIZATION COLLAPSE

In order to develop the capability to drill to depths greater than the waste-filled rooms and drifts, the same basic steps would have to be followed as listed above. For the following reasons, the steps cannot be followed. These reasons are:

- (1) Except for possibly small occurrences, all of the shallow oil and gas reservoirs have been located and exploited. Any remaining reservoirs are not likely to supply sufficient material to create enough demand to encourage drilling for additional supplies.
- (2) Because of the previous exploitation of reservoirs and the use of secondary and tertiary recovery techniques, little if any production is likely to occur from previously worked reservoirs. As a result, no association between the accumulation of productive amounts of oil and gas with particular geologic settings is likely to be recognized. If the location of hydrocarbon reservoirs is not observed or is not predictable, a theory of hydrocarbon accumulation cannot be developed or confirmed.
- (3) With no consistent association between shallow geologic settings and productive hydrocarbon reservoirs, no reason would exist to suspect that deeper geologic settings would be more productive than the shallower

settings. With no incentive for deep drilling, drilling technology would not progress beyond the early stages, if any development occurs at all.

CONCLUSIONS

The technology that enables drilling to considerable depths evolved from a technology that was initially limited to drilling to shallower depths. As shallower resources were consumed and demand continued to increase, the economic incentive developed to encourage deeper drilling. Progressively deeper drilling required the development of progressively more sophisticated drilling techniques. A total collapse of civilization would result in the loss of drilling technology. Because of previous exploitation of hydrocarbon resources, all of the factors that led to the evolutionary development of drilling technology are not currently present and will not be present again in the future. As a result, a collapse of the current civilization or the projection of what the current civilization will develop into would mean that the next civilization, if one develops at all, will not redevelop to the level of a hydrocarbon-based industrialized economy.



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