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DEEP EXPLORATORY TEST HOLES FOR WASTE REPOSITORY INVESTIGATIONS

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Since 1970 a total of nine deep boreholes have been drilled by AEC and its successor agency, ERDA, within six different study areas of Kansas and New Mexico to provide geologic and hydrologic data that would aid in establishing the utility of the areas for the storage of radioactive wastes. The drilling of the first three wells was directed by the Union Carbide Corporation- Nuclear Division through the Oak Ridge Operations Office of AEC-ERDA, while the last two drillings were directed by the Sandia Corporation through the Albuquerque Operations Office of ERDA. In addition, certain geophysical logs, rock cores, and hydrologic data were acquired during the drilling of oil and gas test holes by private firms within some of the study areas.

As seen in Figure 1, the deep boreholes are all located within the Permian Salt Basin and in particular, in central and western Kansas and southeast New Mexico. Pertinent data regarding the exact location, depth, geophysical logging and other properties for each borehole are summarized in Table 1.

Boreholes designated as UCCND-AEC #1 and UCCND-AEC #2 were drilled in the late summer and fall of 1970 at the so-called Lyons, Kansas study area. The first hole was cored for its entire depth of 1300.8' while only the salt section from 739'-1099.6' was cored in the second hole. Both holes were hydraulically tested at the critical horizons above and below the salt, and extensive geophysical logging of the open boreholes was accomplished. Also within the Lyons area, a specific suite of geophysical logs was acquired from a private firm that reopened and tested a 3502' deep oil and gas hole, known as Dressler #1, during the fall of 1970. Geophysical logs and hydraulic data were also acquired in November 1970 for a deep borehole, Stockham #2, that was drilled by private interest in the Lyons area in search of oil and gas. Later, in October 1971, another privately drilled oil and gas test hole, Wright #1, provided cores, logs and hydraulic data on the same area. The cores, logs and hydraulic tests from these boreholes all showed the salt deposits in the area to be structurally and stratigraphically sound; however, because of some concern over nearby mining operations and the rather high density of boreholes within the area, coupled with some negative actions by state officials and other parties, studies in the Lyons area were suspended; other areas were subsequently investigated to the north and to the west of Lyons.

In May of 1972, UCCND-AEC #3 was drilled in northern Lincoln County, Kansas to a depth of 1100' to test the thickness of salt and to obtain other geologic data. Within the same month, UCCND-AEC #4 was drilled to a depth of 1275' in

the southern part of Lincoln County to test another area. Later on in the fall of 1972, the fourth study area in Kansas was penetrated and tested with a borehole to a depth of 2450'. Hydraulic testing and geophysical logging were conducted in all three boreholes. For the two study areas in Lincoln County, it was concluded, after assessing the core data and other information, that the salt was thinner than anticipated even though other geologic and hydrologic factors were extremely favorable. The only apparent negative aspect of the western Kansas area was the abnormally high concentrations of clay in the salt. Thus, even though the rock salt deposits in all of these areas probably would have proven to be quite capable of containing any emplaced wastes, each study area processed some undesirable, but not necessarily unacceptable traits which prompted the continued search for "better sites."

UCCND-AEC boreholes #7 and #8 were drilled during 1974 to test the first of two study areas in southeast New Mexico. Previously, in 1973, some cores and geophysical logs were procured from the owner of a nearby deep oil and gas test well known as Badger Unit Federal #1. The geologic and hydrologic data generated from these borings suggested that the area might prove to be suitable for a pilot plant repository. However, a later exploratory hole, Sandia-ERDA #6, revealed the presence of a localized "flow structure" in the salt deposits that cast some doubt as to the worthiness of the area. Subsequently, another study area was selected for investigations a few miles to the southwest of the previous one. The first borehole, Sandia-ERDA #9, to test this area showed favorable subsurface conditions. Obviously, though, the utility of this latest study area for waste storage can only be ascertained after several more deep drill tests are made within it.

In summary, a significant number of deep boreholes has been drilled within the Permian Basin to investigate subsurface geologic conditions for waste storage utility. As these investigations have yet to reveal a single "acceptable site," it is quite clear that many deep test holes can be expected to be drilled and several study areas "abandoned" before specific sites for pilot plants and/or for permanent repositories are selected. Indeed, this has been the case in the Permian Basin, and there is little reason to believe that similar patterns would not prevail for other salt deposits and even for non-saline rock formations that are undergoing investigations as waste storage repositories. These time-consuming and, at times, seemingly unproductive iterations are due in part to the general lack of detailed knowledge of the important characteristics of rocks in the subsurface that can only be obtained by drilling closely-spaced boreholes within the area of interest. In addition, the long-term nature of the problem which makes it imperative that the wastes be contained for periods of up to hundreds of thousands of years, requires an unprecedented amount of detail in the investigative work.

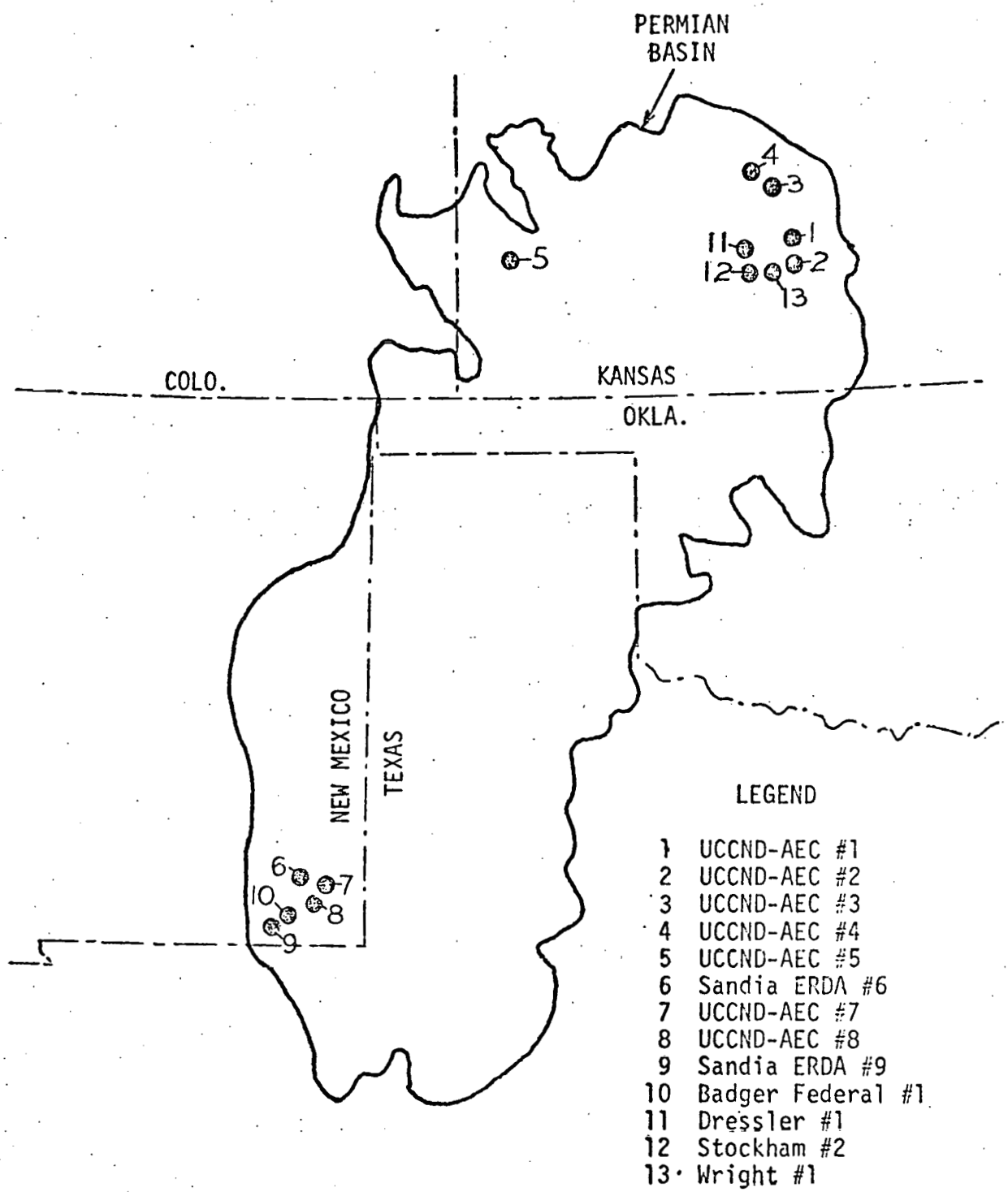

Figure 1. Location of Deep Exploratory Boreholes in the Permian Basin

Table 1 - DEEP EXPLORATORY TEST HOLES FOR RADIOACTIVE WASTE REPOSITORIES

WELL IDENTIFICATION AND LOCATION	DATE COMPLETED	TOTAL DEPTH (Feet)	CORED INTERNAL (Depth - Feet)	LOGS	HYDRAULIC TEST HORIZONS (Depth-Feet)	POTENTIA EMPLACEME FORMATIO (Depth-Fee
UCCND-AEC #1 C NE NE NE NW S 26 T19S R8W Rice County, Kansas	October 1970	1300.8'	0'-1300.8'	Gamma Ray - Neutron Sidewall Neutron Porosity Dual Induction - Laterolog Microlaterolog - Microlog (w/caliper) Borehole Comp. Sonic Comp. Fm. Density Compressional Amplitude Compressional Shear Amplitude Variable Density High Resolution Temp. Caliper 3-dimensional Velocity	236' - 321' 802' - 1300.8'	Hutchinson S 815' - 1084.
UCCND-AEC #2 C N/2 N/2 S 35 T19S R8W Rice County, Kansas	October 1970	1215.6'	739'-1099.6'	Gamma Ray - Neutron Sidewall Neutron Porosity Dual Induction - Laterolog Fm. Density Compensated Borehole Comp. Sonic (w/caliper) Compressional and Shear Amplitude Variable Density Microlaterology High Resolution Temp. Caliper 3-dimensional Velocity	296' - 1212.6'	Hutchinson S 755' - 1002.

WELL IDENTIFICATION AND LOCATION	DATE COMPLETED	TOTAL DEPTH (Feet)	CORED INTERNAL (Depth - Feet)	LOGS	HYDRAULIC TEST HORIZONS (Depth-Feet)	POTENTIAL EMPLACEMENT FORMATION (Depth-Feet)
Dressler #1 C NE/4 NE/4 NE/4 S 27 T19S R8W Rice County, Kansas	November 1970	3502'	None	Laterolog Gamma Ray - Neutron Borehole Compensated Sonic (w/caliper)	None	Wellington Salt 811' - 1057'
Stockham #2 C NE/4 NW/4 NE/4 S 34 T 19S R8W Rice County, Kansas	November 1970	3467'	None	Laterolog Gamma Ray - Neutron Borehole Compensated Sonic (w/caliper) Formation Density	3378' - 3388' 3440' - 3466'	Wellington Salt 775' - 1062'
Wright #1 150' NW/C S/2 NW/4 S 35 T19S R8W Rice County, Kansas	October 1971	3583'	1415' - 1455' 2564' - 2604' 2783' - 2823' 3003' - 3043'	Radiation - Guard Acoustic Velocity Fracture Finder/Micro-Seismogram	1416' - 1455' 2565' - 2604' 2784' - 2823' 3004' - 3043'	Wellington Salt 759' - 1036'
UCCND-AEC #3 150'S 150'W NE/4 SE/4 S22 T13S R8W Lincoln County, Kansas	June 1972	1100'	750' - 1000'	Radiation - Guard Density Comp. Acoustic Velocity Caliper	226' - 380' 967' - 1100' 409' - 1100'	Wellington Salt 969' - 1096'
UCCND-AEC #4 100'E 100'N SW/4 S 9 T11S R10W Lincoln County, Kansas	June 1972	1275'	990' - 1217'	Radiation - Guard Density Comp. Acoustic Velocity Electric Caliper Self Potential Resistivity	408' - 573' 1186' - 1275' 650' - 1275'	Wellington Salt 1020' - 1186'

WELL IDENTIFICATION AND LOCATION	DATE COMPLETED	TOTAL DEPTH (Feet)	CORED INTERNAL (Depth - Feet)	LOGS	HYDRAULIC TEST HORIZONS (Depth-Feet)	POTENTIA EMPLACEME FORMATIO (Depth-Fee
UCCND-AEC #5 150'N 150'E C S 22 T19S R37W Wichita County, Kansas	June 1972	2450'	1540' - 2058'	Electric Radiation - Guard Density Comp. Acoustic Velocity Caliper	742' - 980' 1950' - 2150' 1179' - 2150' 1214' - 2150' 1259' - 1376' 1380' - 2150'	Blaine Salt 1614' - 1961
UCCND-AEC #7 2040' NL 2040' EL S 31 T21S R32E Lea County, New Mexico	April 1974	3918'	1040' - 3918'	Radioactivity (Gamma ray - Neutron) Comp. Density Comp. Acoustic Velocity Temp.	690' - 780' 780' - 910' 910' - 1014'	Salado Salt 997' - 2699'
UCCND-AEC #8 937' NL 1980' WL S 11 T22S R31E Eddy County, New Mexico	May 1974	3028'	31' - 3028'	Radioactivity (Gamma ray - Neutron) Comp. Density Comp. Acoustic Velocity	687' - 777' 777' - 931' 931' - 1036'	Salado Salt 993' - 2980'
Badger Unit Federal #1 1980' SL 1980' WL S 15 T22S R31E Eddy County, New Mexico	September 1973	15,225'	None	Neutron Lifetime Laterology Acoustilog Dual Induction Focused Densilog	None	Salado Salt
Sandia - ERDA #6 NE/4 SE/4 S35 T21S R31E	September 1975	2775'			39'-650', 650'-682' 39'-657', 657'-700' 39'-730', 730'-745' 671'-692', 687-708'	Salado Salt 810'- 0'-835'
Sandia - ERDA #9 SE, SE, SE S20 T22S R31E	June 1976	2880'	1190'-2880'			Salado Salt 860'-2830'

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