Entry to the Newcastle mine near Bellevue. This mine was the leading producer of coal in Washington from approximately 1870 to 1900.
MAILING ADDRESS:

Department of Natural Resources
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N. 222 Havana
Spokane, WA 99202
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Laura Bray, Editor

The Washington Geologic Newsletter, a quarterly report of geologic articles, is published by the Division of Geology and Earth Resources, Department of Natural Resources. The newsletter is free upon request. The division also publishes bulletins, information circulars, and geologic maps. A list of these publications will be sent upon request.
Taylor coal mine in King County. Geologists in the foreground are inspecting the shaft which was the main entry.

In 1977, Congress passed the Surface Mining Control and Reclamation Act (SMCRA) to ameliorate adverse effects of past coal mining and to regulate subsequent coal mining. SMCRA provided for a tax on current coal mines at a rate of 35 cents/ton for surface mines, 15 cents/ton for underground mines (or 10 percent of the value at the mine), and 10 cents/ton for lignite mines (or 2 percent of the value at the mine). The revenue from this tax is deposited in the Abandoned Mine Reclamation Fund. SMCRA also created the Office of Surface Mining (OSM) to administer the provisions of the act. OSM oversees state regulatory agencies which administer the act, or as in the case of Washington, directly regulates the coal mining industry of a state. In addition, OSM performs reclamation and provides technical assistance to state reclamation agencies. Washington has no reclamation agency, so reclamation here is performed directly by OSM. The Abandoned Mine Reclamation Fund provides revenue for these functions, and also provides for direct payments to state regulatory and reclamation agencies. The act provided that at least 50 percent of the proceeds should be used for these purposes in the state of origin when there is sufficient need for reclamation. As of the end of fiscal year 1983, more than $9 million had been collected from the Washington Irrigation and Development Company (WIDCO), and Palmer Coking Coal Company, operators of Washington's two active mines.

To determine the reclamation needs of the states, OSM contracted for a national inventory of abandoned mines. The inventory for the State of Washington identified 10 problem areas, four of which are in the vicinity of Roslyn and Cle Elum in central Washington. The other
Figure 1. — Study areas for abandoned coal mine inventory in western and central Washington (from Beikman and others, 1961).
Six problem areas were located near Centralia (two areas), Bellingham, Black Diamond, Newcastle, and Wilkeson.

By the end of fiscal year 1983, OSM had undertaken 21 emergency reclamation projects in Washington, only one of which was in an area included on the national inventory (these emergency projects cost OSM less than $150,000). Reference to figure 1 shows that the inventory was inadequate for dealing with the potential mine problems because the extent of coal mining in western and central Washington far exceeded that recognized in the inventory. One result of the sparseness of the inventory was that OSM transferred more than $3 million from Washington's 50 percent share of the coal production tax to other parts of the country, citing insufficient reclamation needs for the funds here.

In January of 1984 a cooperative agreement was signed between the Department of Natural Resources, Division of Geology and Earth Resources (DGER), and OSM. This agreement was the culmination of efforts by the Department of Natural Resources to rectify the inadequacies of the original inventory. The agreement called for the State of Washington to conduct an inventory of all abandoned coal mine lands within the state, and provide OSM with a final report along with site-specific descriptions and maps of the areas investigated. The final report will summarize the results of the inventory, by county, quadrangle, and severity of hazard.

Seven broad regions of interest, based on past coal mining activities, were defined for the study. These were (1) King County (Black Diamond, Issaquah, Renton, and the Green River coal mining area), (2) Pierce County (Wilkeson, Carbonado, Fairfax, and Ashford), (3) Lewis County (Centralia, Chehalis, Toledo, Morton, and Packwood), (4) Cowlitz County (Kelso and Castle Rock), (5) Kittitas County (Roslyn, Cle Elum, and Manastash), (6) Skagit County (Hamilton and Cokedale), and (7) Whatcom County (Bellingham, Glen Echo, Van Zandt, Blue Canyon, and Glacier) (fig. 1). An average of 3 weeks was allotted for each of these broad study areas.

The study had three objectives: First, to inventory abandoned-coal-mine-related problems affecting the health, safety, and general welfare of the public at large. Second, to categorize these problems by severity, accessibility, and proximity to population. Finally, to recommend to OSM the priority in which these problems should be corrected (based on their detriment to the general public). To date DGER has identified 76 problem areas, with 6 weeks remaining for the study.

In addition, five areas within the seven broad regions were targeted for more detailed inventories. These areas were Roslyn-Cle Elum, Issaquah, Newcastle-Coal Creek, Renton, and Bellingham. Each of these areas was selected because of the intensity of previous coal mining activities, the lack of detailed descriptions of the problems as they currently exist, and the presence of extensive residential or recreational development. Each of these areas was selected by OSM in conjunction with DGER. The Office of Surface Mining (OSM) awarded contracts to consulting companies for the detailed inventories.

These contracted inventories proceed from office compilation of mine map data held by the Division of Geology and Earth Resources (Schasse and others, 1983) and all available historical data, to field location of hazardous mines, followed by surveying and title searches of properties requiring reclamation. If necessary, drilling may be done to verify the existence of underground workings as shown on mine maps or to probe for mine voids in areas lacking mine maps. Finally the contractors will make recommendations for reclamation and will rank the severity of problem areas in consultation with OSM.

The contractors retained by OSM are listed below:

(1) Roslyn-Cle Elum: George Maddox and Associates, Spokane, Washington. OSM budgeted $75,000 in fiscal year 1983 for the Roslyn area inventory (fig. 1) which is nearly completed. At least 26 mines were operated in this area (Schasse and others, 1983), and more than 80 mine openings and subsidence areas have been located; 12 have been targeted for reclamation, and OSM anticipates design and construction expenditures of approximately $150,000.

(2) Issaquah: Goodson and Associates, Denver, Colorado. OSM has budgeted $75,000 for the Issaquah area inventory which consists of lands east of state highway 900 and south of interstate highway 90. At least five mines have been operated in this area. Field work to date has shown that most of the surface expressions of mine openings and subsidence have been modified by urban development. Investigations are continuing.

(3) Newcastle-Coal Creek: Skelly and Loy, Lexington, Kentucky. Field investigations have not yet begun in the Newcastle-Coal Creek area but at least 19 mines have been operated in the area (Walsh, 1983) and extensive areas are still known to be open. OSM reclaimed entries to the old Newcastle mine in 1983.

(4) Renton: Morrison-Knudsen, Boise, Idaho. At least 18 mines have been operated in Renton (Livingston, 1971). Investigations to date have uncovered at least three areas of probable mine subsidence. OSM has already reclaimed one area of subsidence in Renton as an emergency problem. Field investigations are continuing as of this writing.

(5) Bellingham: Tetra Tech, Englewood, Colorado. Two large mines and several smaller ones have been operated in Bellingham. Subsidence is known to have occurred
and one entry is reported to be at least partially open. Field investigations have just begun and are expected to be completed soon.

When completed, DGER will combine the information produced by contractors with our own data and produce an overall inventory that we estimate will include virtually all of the potential abandoned-mine-land-problem areas in the state. Reclamation priorities will be recommended to OSM and the report will be made available to the public as a DGER open-file-report. An appendix containing 2 inch by 2 inch photographic color slides of all the sites inventoried by DGER will be on file in the DGER library. The target date for completion of the report is October 1984. While we intend this report to be used principally for establishing reclamation needs and priorities, it is also expected to be used for planning in the affected communities. It may be useful for historical purposes as well.

REFERENCES CITED


Livingston, V. E., Jr., 1971, Geology and mineral resources of King County, Washington: Washington Division of Mines and Geology Bulletin 63, 200 p.


Walsh, T. J., 1983, Map of coal mine workings in part of King County, Washington: Washington Division of Geology and Earth Resources Open-File Report 83-17, 1 map, 4 p.

Partial Seam CRIP* Underground Coal Gasification
Field Test at Centralia Coal Mine

by

Henry W. Schasse**

A partial seam CRIP Underground Coal Gasification (UCG) field experiment was carried out at the Washington Irrigation and Development Company (WIDCO) coal mine near Centralia, Washington, in the fall of 1983. The test was performed near the earlier large block tests which were conducted during the early part of 1982 (Hill and Thorsness, 1982). The primary goals of the partial seam experiment were to test the CRIP concept and to further evaluate the test site for its potential for future development of UCG.

The process of underground (in-situ) coal gasification is a fairly simple concept. Two wells drilled into a coal seam some distance apart are connected by constructing a flow channel through the coal. The coal at the bottom of one of the wells is ignited and air or oxygen is pumped down this well from the surface to support the combustion. The gases produced by the burning coal escape through the flow channel and are removed through the other well. In a commercial-size system, many such well pairs would act simultaneously.

In practice, the process is complicated because as the burn proceeds the reacting volume is constantly changing geometry. In the early stages of the burn, the cavity is empty and totally within the coal. Later, roof collapse partially fills the cavity with rubble, which changes the flow patterns and the subsequent burn geometry.

The CRIP system is designed to keep the injection point on the bottom of the coal seam and to move it away from the collapse zone into fresh, solid coal. The principle of controlled retraction allows the operator to choose the optimum time and distance to move the injection point and consequently the burn zone to get optimum performance from the gasifier. The CRIP system is particularly well suited to thick coal seams where the cavity grows by coal collapse as well as combustion. A simplified design of the CRIP system is illustrated in figure 1.

The CRIP concept adds one more parameter (position of the injection point) to the other three control parameters in UCG (flow rate, injection gas composition, and operating pressure of the system). The CRIP maneuver is used when the product gas heating value declines to an unacceptable level. This characteristically occurs as a result of the growth of the burn cavity into the overburden and thus bringing inert material into contact with

* Controlled Retracting Injection Point System.
** Division of Geology and Earth Resources geologist.
overlying material

New injection point, after pipe is cut off

Previous injection point

To surface

Production well

Coal seam

Injection pipe

Cavity

Figure 1. – Basic design of the controlled retracting injection point (CRIP) system. As the cavity burns toward the left, the injection point is moved to the left also, step by step, by cutting off or perforating the injection pipe, which can be done remotely from the surface. Thus the injectant gas is always being fed to a zone of the coal seam where unburned coal remains to be gasified (after Hill and Shannon, 1981).

burning coal. When this occurs, the injection point is retracted upstream along a horizontal to near-horizontal well into a region of fresh coal where the new burn is initiated (Cena and others, 1984). The process is then repeated as needed until the entire useful length of the injection well is used up.

The Centralia CRIP test lasted for 30 days, during which time 2,000 tons of coal were affected. Steam and oxygen were used primarily as the injected reactants. A single inclined injection well was drilled 900 ft along the bottom of the upper 18 ft of the Big Dirty coal seam. This was done because it would allow significant interaction with the roof to occur within the 30-day limit placed on the experiment by budgetary constraints. This high-ash subbituminous coal seam dips 14 degrees from the horizontal in the test site area.

The injection well was installed by directional drilling from the surface. Because of drilling problems encountered in its construction (the drill hole deviated from the coal seam into the underlying strata for part of its length), the five CRIP retractions planned originally were reduced to one.

Two production wells were constructed, one vertical and the other inclined. Gas was produced from the vertical production well for the first 12 days of the test while the inclined production well was used for the last 18 days of the test (see fig. 2).

Three distinct periods of gasification were observed during the test. During the initial period, a typical dry gas with a heating value of 248 Btu/scf (scf = standard cubic foot) was measured at the vertical production well. With the CRIP maneuver and switch to the inclined production well, a considerably higher gas quality (296 Btu/scf) was measured. The final period began with a large underground roof fall causing the typical dry gas heating value to drop to 220 Btu/scf.

The tests were conducted jointly by Lawrence Livermore National Laboratory and WIDCO. Sandia National Laboratory and Radian Corporation were involved in certain aspects of data collection. Sponsors of the test included the U.S. Department of Energy (with a support level of $30 million), the Gas Research Institute ($1 million), WIDCO ($200,000), and the Electrical Power Research Institute ($50,000). Meridian Land and Mineral Co., owner of the mineral rights to the coal seam, donated the coal resources utilized for the test.

Major conclusions drawn by Lawrence Livermore scientists (Cena and others, 1984) as a result of the CRIP field test were as follows:

The Big Dirty coal seam is satisfactory for in-situ UCG.

The burn cavity growth was consistent with that determined in the earlier large block tests.
The inclined production well worked satisfactorily. Although pressure drops were higher with the inclined production well, they were, however, localized to the area near the injection point. There were no long-term changes in pressure drop and flow performance.

The CRIP system worked well and provided a valuable control mechanism. Two distinct levels of gas quality were observed: (1) a relatively high-level after the CRIP maneuver; (2) lower levels during the first cavity burn and after the large-scale roof collapse.

Changes in steam/oxygen ratio, pressure, or flow rate did not have any lasting major effect on gas quality.

Particulate production was occasionally heavy, but was low during steady operation. The largest amounts of particulate produced were associated with periods of increasing flow rates.

The underground system was very forgiving and will apparently tolerate frequent upsets. Several power losses and boiler problems occurred during the operation of the test without any apparent long-term negative effects.

Plans are now underway for a 90-day commercial-scale test. Test plan objectives and cost estimates are currently being made and sponsors for the test are being solicited. The 90-day test will involve two simultaneous UCG modules growing together. This test will be used in making an economic analysis of such factors as the end use of product gases and optimum spacing of wells. Roger Paul, Manager of Business Development at WIDCO, believes that a commercial UCG operation is possible by the early 1990's.

For further and more detailed information on the partial seam CRIP test at Centralia, the reader is referred to the report by Cena and others (1984).

REFERENCES CITED


FORMER WASHINGTON STATE GEOLOGIST DIES

Vaughn Edward (Ted) Livingston, State Geologist and supervisor of the Division of Geology and Earth Resources from November 1971 until January 1982, died on July 9, 1984, following an extended illness.

Ted was born on February 6, 1928, in Hayward, California. Part of his early years were spent in the Entiat Valley of north-central Washington. He attended Brigham Young University and received a bachelor of science degree in geology in 1954, followed by a master of science degree, also in geology, from the same university in 1955. He began his service with the old Division of Mines and Geology in the State Department of Conservation (later to become the Division of Geology and Earth Resources in the Department of Natural Resources) as a geologist I in June 1956. He was promoted to geologist III in July 1959, and to geologist IV and Assistant State Geologist in May 1963. Following his service as State Geologist, Ted worked briefly for the Lands Division of the Department of Natural Resources before his retirement in May 1982.

During Ted's tenure as State Geologist, the geologic staff more than doubled, with the addition of an Environmental Geology section and broadened work on geothermal and coal resources. He was an active member of the Association of American State Geologists and the American Association of Petroleum Geologists. Throughout his state career, he took great interest in exploration for oil and gas in Washington, serving for many years as leader of the Division's regulatory program in oil and gas, either as Oil and Gas Supervisor or Deputy Oil and Gas Supervisor.

Ted's academic training and major interests as a professional geologist were in "soft-rock" geology — more specifically, paleontology and stratigraphy. Early contributions include a bulletin on the geology and mineral resources of the Kelso-Cathlamet area, much reconnaissance geologic mapping and compilation in southwestern Washington for the 1961 state geologic map, and the first "dry hole" map of the state ("Oil and Gas Exploration in Washington, 1900-1957"). Ted was also very much interested in educating lay persons about Washington's geology and resources. Publications on fossils in Washington, and geologic history and rocks and minerals of Washington were expressions of this interest.

As Assistant State Geologist, Ted was responsible for the day-to-day direction of the geologic staff and also for the direction of the Division's publication staff. In the area of publications, Ted became a reliable and frequently used source of practical knowledge on the preparation and printing of geologic maps and reports. He may be remembered by some as a pretty tough customer when it came to the correct use of stratigraphic names in geologic maps and reports.

As State Geologist, Ted still loved to get into the field when he could. Most often this was in the form of a 1-day visit to one of the staff geologist's field area. A sure-fire way to send him away happy was to show him your knottiest stratigraphic correlation problem; or better yet, take him to a fossil locality that he hadn't visited before.

Ted was long on patience, slow to anger, and will be remembered by many of us at the Division not only as our former boss, but also as a friend. Ted is survived by his wife, Nancy, and by four grown children — Leann, Jay, Robert, and David.

DIVISION OF GEOLOGY AND EARTH RESOURCES RELEASES OPEN-FILE REPORTS

The following open-file reports may be purchased from the Department of Natural Resources, Division of Geology and Earth Resources, Olympia, WA 98504; they are also available for inspection in our Division library.

Please send $1 to cover our Handling and Distribution charge for your total publication order.


Walsh, T. J., 1983, Map of coal mine workings in part of King County, Washington: Washington Division of Geology and Earth Resources Open-File Report 83-17, 4 p., 1 plate, scale 1:24,000. Price $1.00.

NEW 1:250,000-SCALE GRAVITY MAPS RELEASED

A new set of gravity maps for Washington has been released by the U.S. Geological Survey (USGS). Compiled from 29,733 gravity stations, the maps cover all of Wash
ington and adjacent Oregon, Idaho, and offshore areas at a scale of 1:250,000. The maps consist of contoured free-air anomalies for offshore areas, and complete Bouguer anomalies (reduction density = 2.67 g/cm³) for onshore. The contour interval is 2 mga ls. Gravity station locations are also plotted.

Each of the maps is designed to overlay a standard USGS 1° by 2° topographic quadrangle. Longitude and latitude tick marks are provided at 15-minute intervals to ensure a good fit. Paper stretching or shrinkage of both base map or overlay can cause a slight distortion that should not present problems in routine use. There are 18 individual maps in the set.

The maps greatly improve the published gravity coverage of Washington and should prove useful in many geological applications. A set of the maps plotted on transparent acetate is available for use at the Division of Geology and Earth Resource's library in Lacey. The title of the map and the address where it can be purchased are listed below:


U.S. Geological Survey
Branch of Distribution
Open-File Services Section
Federal Center, Box 25425
Denver, CO 80225
(303) 236-7476

THESES ADDED TO DIVISION OF GEOLOGY AND EARTH RESOURCES LIBRARY

The following theses were recently added to our division library where they are now available for reference work:


U.S. GEOLOGICAL SURVEY OPEN-FILE REPORTS RECENTLY ADDED TO OUR DIVISION LIBRARY

The following U.S. Geological Survey Open-File Reports are now available for inspection in our Division of Geology and Earth Resources library. If you wish to purchase any of these reports, please write or call:

Open-File Services Section
Branch of Distribution
U.S. Geological Survey
Box 25425, Federal Center
Denver, CO 80225
(303) 236-7476

Prepayment is required. Open-file reports are announced, with price, in the monthly list, “New Publications of the Geological Survey.” A free subscription to the list may be obtained on application to: Mailing List Unit, U.S. Geological Survey, 329 National Center, Reston, VA 22092.


The following U.S. Geological Survey reports have recently been acquired by the Division of Geology and Earth Resources and are now available for reference work in the library:


A PROGRESS REPORT ON THE GRADUATE STUDENT MAPPING PROJECT, STATE GEOLOGIC MAP PROGRAM

As previously reported in our Geologic Newsletter (January 1984), the Division of Geology and Earth Resources has begun a project to support graduate student thesis mapping. This project will provide geologic source maps for use in our compilation and revision of the state geologic map, form closer working relationships with the graduate students and faculties of the Pacific Northwest universities, and provide motivation and monetary support for graduate student geologic thesis mapping.

We distributed a "Request for Proposal" in October 1983, which called for submission of proposals by January 13, 1984. We received only three proposals. The low response seemed to be due to the holiday season and the fact that many students were not prepared to select a thesis area that early in the academic year. Therefore, we reissued the "Request for Proposal" with a cutoff date of April 30, 1984. This time, 13 proposals were received.

Of the 16 proposals submitted under both announcements, 14 were selected for support. Twelve of these are master's thesis projects, one is an extension of a master's thesis (Jeffrey Jones), and one is being conducted by a professor (Robert Miller). Together, these projects will provide about 550 square miles of new geologic mapping for a total contracted price of just over $26,000.

The following table lists the name and university of each investigator, the state geologic map quadrant where the project is located, the date by which the project will be finished, and the project's title.

<table>
<thead>
<tr>
<th>Investigator</th>
<th>University</th>
<th>State Map quad.</th>
<th>Completion date</th>
<th>Title</th>
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<tr>
<td>Brad Carkin</td>
<td>Western Wash. Univ.</td>
<td>Southwest</td>
<td>1-1-85</td>
<td>Chemistry, stratigraphy, and paleomagnetism of the Fifes Peak Formation in the Cliffdell area, Kittitas and Yakima Counties, Washington.</td>
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<td>Investigator</td>
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<td>Randy Hagen</td>
<td>University of Oregon</td>
<td>Southwest</td>
<td>3-30-85</td>
<td>Geologic map of the northern part of the Morton 15-minute quadrangle, Lewis County, Washington.</td>
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<td>Jeffrey Jones</td>
<td>Western Wash. University</td>
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<td>12-31-84</td>
<td>Geology of the western portion of the Canyon Creek-Church Mountain area, Whatcom County, Washington.</td>
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<td>John Link</td>
<td>Washington State Univ.</td>
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<td>12-31-84</td>
<td>Copper and gold mineralization in the McCoy Creek district, Skamania County, Washington</td>
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<tr>
<td>Krista McGowan</td>
<td>Portland State Univ.</td>
<td>Southwest</td>
<td>12-31-84</td>
<td>Regional geologic setting of the Wind River gold prospect, Skamania County, Washington</td>
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<tr>
<td>Robert Miller</td>
<td>Clark College</td>
<td>Southwest</td>
<td>12-31-84</td>
<td>Geologic map of the pre-Cenozoic rocks in the Bumping Lake-Rimrock Lake-Tieton River area, southern Cascades, Washington.</td>
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<tr>
<td>Kristin Orr</td>
<td>University of Washington</td>
<td>Northeast</td>
<td>3-31-85</td>
<td>Structural features along the margins of Kettle and Okanogan domes, northeastern Washington.</td>
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<td>Gregory Reller</td>
<td>Western Wash. University</td>
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<td>6-20-85</td>
<td>Geology of the Deer Peak area, Skagit County, Washington</td>
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<td>Patricia White</td>
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<td>Geology of the Island Mountain area, Okanogan County, Washington</td>
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<td>Glenn Wiedenhoefl</td>
<td>Washington State Univ.</td>
<td>Northeast</td>
<td>12-31-84</td>
<td>Structural geology of the southern Metaline district, Pend Oreille County, Washington</td>
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## RECENT PERMITS FOR OIL AND GAS DRILLING

### Oil and Gas Exploratory Wells

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<th>Operator</th>
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<td>340</td>
<td>Grant</td>
<td>BN 1-0</td>
<td>965 ft FWL and 1,869 ft FSL</td>
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<td>5-22-81</td>
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<td>King</td>
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<td>5-18-83</td>
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<td>AMOCO Prod. Co.</td>
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<td>Amoc-</td>
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<td>Maughan et al No. 1-5</td>
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### Oil and Gas Stratigraphic Tests

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<td>AMOCO Prod. Co.</td>
<td>367</td>
<td>Pierce</td>
<td>WC-83-13</td>
<td>964 ft FWL and 1,015 ft FEL</td>
<td>3,260</td>
<td>12-28-83</td>
</tr>
<tr>
<td>AMOCO Prod. Co.**</td>
<td>369</td>
<td>King</td>
<td>WC-83-15</td>
<td>1,164 ft FWL and 704 ft FEL</td>
<td>310</td>
<td>12-28-83</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>371</td>
<td>King</td>
<td>WC-83-31</td>
<td>114 ft FWL and 1,194 ft FSL</td>
<td>1,125</td>
<td>2-2-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>372</td>
<td>King</td>
<td>WC-83-32</td>
<td>799 ft FWL and 2,001 ft FSL</td>
<td>620</td>
<td>2-2-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>373</td>
<td>Pierce</td>
<td>WC-83-26</td>
<td>40 ft FWL and 609 ft FSL</td>
<td>725</td>
<td>2-2-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>374</td>
<td>King</td>
<td>WC-83-17</td>
<td>847 ft FWL and 1,460 ft FSL</td>
<td>615</td>
<td>2-2-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>375</td>
<td>King</td>
<td>WC-83-16</td>
<td>2,254 ft FWL and 562 ft FSL</td>
<td>1,246</td>
<td>2-2-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>377</td>
<td>King</td>
<td>WC-83-20</td>
<td>695 ft FWL and 1,258 ft FSL</td>
<td>435</td>
<td>2-22-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>378</td>
<td>King</td>
<td>WC-83-21</td>
<td>616 ft FWL and 1,121 ft FSL</td>
<td>676</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>379</td>
<td>Pierce</td>
<td>WC-83-23</td>
<td>1,073 ft FWL and 1,130 ft FSL</td>
<td>820</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>381</td>
<td>Lewis</td>
<td>WC-83-24</td>
<td>2,244 ft FWL and 2,236 ft FSL</td>
<td>1,643</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>381</td>
<td>Lewis</td>
<td>WC-83-25</td>
<td>1,023 ft FWL and 752 ft FEL</td>
<td>1,549</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>382</td>
<td>Pierce</td>
<td>WC-83-28</td>
<td>2,335 ft FWL and 661 ft FEL</td>
<td>520</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.**</td>
<td>382</td>
<td>Pierce</td>
<td>WC-83-29</td>
<td>1,144 ft FWL and 1,183 ft FEL</td>
<td>1,695</td>
<td>4-13-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>384</td>
<td>Lewis</td>
<td>WC-83-33</td>
<td>1,107 ft FWL and 1,243 ft FEL</td>
<td>1,350</td>
<td>2-15-84</td>
</tr>
<tr>
<td>AMOCO Prod. Co.</td>
<td>385</td>
<td>Pierce</td>
<td>WC-83-34</td>
<td>700 ft FWL and 2,346 ft FEL</td>
<td>725</td>
<td>2-15-84</td>
</tr>
</tbody>
</table>

* Land description indicates that the location is 965 ft from the west line and 1,869 ft from the north line of sec. 8, township 15 north, range 25 east, Wilkeson meridian.

** Plugged and abandoned.