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Tulsa, Oklahoma
June 22, 1955

Engineering Report
Huerfanito Unit
San Juan County
New Mexico

The following engineering data is submitted in support of Skelly Oil Company's contention that there is no existing evidence that would definitely prove that the Pictured Cliffs gas wells in the South end of the Huerfanito Unit Area are producing from a separate reservoir from the wells in the North end of the Unit Area. Mr. J. Glenn Turner, operator of the Huerfanito Unit, has submitted an engineering report prepared by Mr. Albert R. Greer to support his contention that there are two separate reservoirs within the Huerfanito Unit. This report will be used for reference in this presentation.

The object of Mr. Greer's report was to determine and set forth criteria to be used in delineating the areas in the vicinity of the Huerfanito Unit and the Ballard Pictured Cliffs Pool. In particular, it was his intention to present evidence that the wells in the northern part of the Huerfanito Unit are producing from a reservoir which is separate from that in which the northern part of the Unit produces. His argument was presented both from a geological and an engineering standpoint. My reference will be restricted to the engineering aspect of this report which concerns specifically the importance placed on the difference in initial shut-in pressures between wells in the north end of the Unit as opposed to the wells in the south end.

In Article III, page 3, of this engineering report, Mr. Greer states that the fact that Pictured Cliffs wells are producing from different reservoirs is evidenced by the difference in initial shut-in pressures of the wells. We find no basis for this statement. A thorough study of the initial shut-in pressures on wells throughout this general area has shown that there are numerous cases where the differences in initial shut-in pressures of offset wells in one field are greater than the difference in initial shut-in pressures of wells in entirely different pools. Examples of such differences are shown below:

Huerfanito Unit Area

Location	Initial Shut-in Pressure, Psig	Time Shut-in, Days	Date S.I.
South End			
NW/4 Sec. 11-26N-9W	626	13	12-13-54
SE/4 Sec. 12-26N-9W	666	15	1-11-55
	Difference 40 Psig		
North End			
SW/4 Sec. 14-27N-9W	710	3	2-13-53
SE/4 Sec. 24-27N-9W	599	3	6-20-52
	Difference 111 Psig		

Ballard Pictured Cliffs Field

Location	Initial Shut-in Pressure, Psig	Time Shut-in, Days	Date S.I.
NW/4 Sec. 34-26N-8W	651	25	1-12-55
SE/4 Sec. 33-26N-8W	544	35	4-11-55
	Difference 107 Psig		

Fulcher-Kutz Pictured Cliffs Field

NW/4 Sec. 24-27N-10W	631	?	6-21-51
NE/4 Sec. 24-27N-10W	504	?	5-21-51
	Difference 127 Psig		

In the above tabulation it is seen that there is a difference of 107 psig in the initial S.I.P. taken on wells in the Ballard Pictured Cliffs Field, which is more than twice as much as the difference in initial shut-in pressures on wells in the Huerfanito Unit Area. Additional evidence showing the uselessness of initial shut-in pressures in determining reservoir limits is shown on Skelly's Exhibit No. 1, where certain pressure for comparison purposes have been circled reflecting differences as great as 400 psig on wells producing from the same field.

On page 5 of the engineering report, Mr. Greer states the virgin pressure of the Ballard Pictured Cliffs Field to be 669 psig, which was measured on Benson and Montin #1 McManus. He further states that this well had been shut-in a total of 284 days and apparently had built-up to its maximum pressure. Mr. Greer then proceeded to compare the pressure obtained on this well, as explained by him to be the equalized pressure over the entire Ballard Pictured Cliffs Field, with the initial shut-in pressure of 719 psig on a well in the northern part of the Huerfanito Unit, a distance of approximately seven miles. We are of the opinion that it is inconceivable from a scientific standpoint that a definite conclusion as to reservoir separation in a reservoir with physical characteristics such as are found in the Pictured Cliffs formation in this area could be made on the basis of the difference of only 50 psig in the initial shut-in pressure on wells seven miles apart.

It is interesting to note that the key wells located in the area offsetting the southern part of the Huerfanito Unit exhibited relatively high pressures after having been shut-in not more than 14 days. Referring to Mr. Greer's Exhibit "G", the J. Glenn Turner Ballard Well #4-12 had an initial shut-in pressure of 666 psig in 14 days, the Stanolind Huerfano #28 had an initial S.I.P. of 653 psig in 7 days, and the J. Glenn Turner Ballard Well #4-15 had an initial shut-in pressure of 662 psig in 10 days. Referring to Mr. Greer's Exhibit "B" page 2, it is found that there are a number of instances where the shut-in pressure on wells in the Ballard P. C. Field had not begun to stabilize until after they had been shut-in at least 60 days. Therefore, we are of the opinion that if these three key wells immediately offsetting the Huerfanito Unit had not been placed on production, the equalized shut-in pressure would have closely approached the equalized shut-in pressures on wells in the north end of the Huerfanito Unit.

Theoretically, shut-in pressures on wells which have been shut-in sufficiently

long to allow complete reservoir pressure equalization would be equal, if such wells were producing from the same reservoir and also if all wells producing from said reservoir were shut-in. However, none of these optimum conditions exist in this area so we believe the application of initial shut-in pressures for determining reservoir delineation result in erroneous conclusions. There are certain factors commonly known by engineers, some of which were apparently overlooked by Mr. Greer, which have some influence on the accuracy of shut-in pressure data, and the study thereof. These factors are as follows:

1. Completion dates of key wells used as examples.
2. Gas production from reservoir in which such well is completed, prior to and during time well is shut-in.
3. Length of time well shut-in.
4. Volume of gas blown to air during completion.
5. Method of completion, whether shot or sand-oil fractured.
6. Elevation of wells under comparison. (Refer to Skelly Exhibit #2)

The Skelly Oil Company believes that the magnitude of factors adversely affecting the accuracy of initial shut-in pressures by far exceed the magnitude of some of those same factors that adversely affect the accuracy of seven-day shut-in pressures. Therefore it is our contention that if the United States Geological Survey find it necessary to solve the problem by use of pressure data, seven day shut-in pressures rather than initial shut-in pressures should be used.

Skelly Oil Company has included in the Engineering Report three exhibits for reference. Exhibit No. 1 - a map showing initial shut-in pressures on wells in the area surrounding the Huerfanito Unit. Exhibit No. 2 - well data tabulation on all Pictured Cliffs wells located in Townships 26N-27N-Range 9 West, San Juan County; Exhibit No. 3 - pressure map showing seven day shut-in pressures last taken on wells in area under discussion.

We have taken certain wells producing from the Pictured Cliffs formation within the boundaries of the Huerfanito Unit Area and wells offsetting this Unit Area, all of which are located in Townships 26N and 27N-Range 9 West, San Juan County, New Mexico, and listed on Skelly's Exhibit #2. This exhibit presents pertinent data on the wells in this immediate area to be used by Skelly for our proof of the continuity of and the interconnection of the Pictured Cliffs formation, as it underlies the Huerfanito Unit. You will note that some of the wells are outside the boundaries of the Huerfanito Unit; however, we believe all of them are producing from the same reservoir and therefore have considered it necessary that they be included in this study.

You will see in Skelly's Exhibit No. 2 that the wells have been divided into two groups, Group "A", composed of six wells, and Group "B", composed of thirty wells. These wells were chosen and grouped in this manner so as to provide a means of comparing the characteristics of portions of the Pictured Cliffs reservoir underlying each area on which these wells are located. We believe the comparison of these two

particular areas, relative to the determination of the interconnection of this Pictured Cliffs formation underlying said areas, is all that is necessary insofar as an engineering interpretation is concerned.

You are referred to Skelly's Exhibit No. 2 which shows that the arithmetical average of the seven day pressures on wells in Area "A" was calculated to be 558 psi, only 21 psi greater than the average of 537 psig pressure on the wells in Area "B". It is also interesting to note that the wells in Area "B" were shut-in for pressure tests more than four months later than the wells in Area "A". During this four month period a total of approximately 600,000 Mcf of gas was produced from Area "B", as compared to approximately 43,800 Mcf of gas produced from Area "A". Although we believe the absolute effect of the time and production factors is undeterminable in this case, nevertheless we think they should be given serious consideration when comparing shut-in pressure data. We might also add that, although Mr. Greer chose to neglect an elevation correction in his pressure studies, Skelly Exhibit No. 2 shows a difference of 300 in the elevation of wells in Areas "A" and "B" which would amount to a correction of around 5 psig. If all of these factors are considered, it is obvious that the 21 psig difference in seven day shut-in pressures would be reduced considerably.

In view of the above findings it is my considered opinion that if an engineering interpretation is deemed necessary to determine whether or not the wells in the Huerfanito Unit are producing from the same reservoir, pressure data as obtained from seven day shut-in pressures is the most reliable method available, and should be carefully considered in deciding this matter.

Barton W. Ratliff

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Barton W. Ratliff
Petroleum Engineer

Exhibit

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