# NILAND RESERVOIR MONITORING AND EVALUATION OPERATING PROGRAM

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Six wells will be utilized during operations to monitor reservoir parameters. Magmamax #1, Woolsey #1 and possibly later in the program Elmore #3 will be used for production. Magmainax #2 and #3 will be used for injection and Magmamax #4 and Elmore #3, initially, will be used for observation.

I. Activities to be carried out prior to actual start-up of thermal test loop.

A. All wells will have temperature and pressure surveys taken.

B. Magmamax #3 will be flowed into a Baker tank to obtain baseline chemistry associated with the reservoir being produced from Magmamax #3. This information will not be an accurate determination of actual reservoir conditions in Magmamax #3 because considerable injected fluid has been put into Magmamax #3 in the various small scale testing operations carried on in the past; however, a baseline of existing brine chemistry in the vicinity of the reservoir which is penetrated by Magmamax #3 will be desirable for monitoring future injection operations.

C. Magmamax #2 will be flowed into a Baker tank at the minimum rate possible to clean the well out and obtain an accurate sample of the produced waters to establish a baseline prior to injection operations on brine chemistry. The anticipated duration will be one to two hours depending on flow capabilities and the tank holding capacity. Since Magmamax 2 has not been previously used for injection purposes a good sample of actual reservoir conditions should occur rather rapidly.

D. Magmamax #1 will be produced through the by-pass to the brine pit until evidence is shown that the well is producing at a stabilized rate. It may be necessary *to* shut down the well and pump the brine pit to Magmamax #3 several times before stabilization occurs.

E. Woolsey #1 will be produced on the same basis as Magmamax #1 until stabilization has occurred.

II. Initial operations associated with the thermal test loop.

A. During the first three weeks Woolsey #1 and Magmamax #2 will be left in the shutin condition and production into the thermal test loop will occur from Magmamax #1 at full production capable from that well and injection will be made into Magmamax #3. During this period of time pressure monitoring will be done on a continuance basis as rapidly as the pressure monitoring device can be moved from well to well incorporating all six wells in the program. Pressure results will be logged and plotted daily to determine if any significant trends are established from this operation.

B. A second three-week period will be carried out with Magmamax 1 shutin and Woolsey #1 producing into the thermal test unit and Magmamax 3 continuing as the injection well. The same program as far as observations go would be carried out for this mode.

C. An analysis of the first six weeks of observation operations will be made to determine if both wells producing into the unit can be accommodated by injection into Magmamax #3. If this appears to be feasible then the continuing operating program would be to produce Woolsey #1 and Magmamax #1 into the thermal test loop and utilize Magmamax #3 for the total injection. During the initial six weeks of operation Schlumberger spinner surveys will be run in the injection well weekly and also if possible in the producing well. Analysis of the results of these surveys will determine the period for spinner surveys during the ongoing operation phase.

III. Ongoing operational phase.

A. Observations of downhole pressures will be made every four hours during the ongoing operational phase. Spinner surveys and pressure buildup determinations will be made periodically based on the results found during the initial operational phase.

B. Operational data will be transmitted to DeGolyer & MacNaughton weekly for analysis and interpretation and feedback from them will come forward with any suggestions as to additional operational requirements.

C. When operational changes such as flow rates or pressures occur the monitoring *of* downhole pressures will be maintained at the most rapid rate possible until stabilization has occurred, and then the monitoring will go back to the four-hour periodic interval.

IV. General considerations.

A. Much of the data accumulated relative to the brine chemistry and characteristics will be pertinent to both the SDGEE thermal test loop monitoring and the reservoir operations. Samples of the brine and steam in various locations of the thermal test loop would be taken periodically and analysis made to determine if there are any trends indicated in changes associated with the brine characteristics. Another feature which would be of prime importance is the monitoring of the quantities of noncondensable gases being produced throughout the duration of the testing operations. There is some evidence that the carbon dioxide may not be completely in solution with the brines in the reservoir and we may find a dropoff in carbon dioxide content after a certain amount of production. This will be monitored periodically to determine trends associated with carbon dioxide quantities being produced.

B. From experience associated with the previous small scale testing at Niland and other locations such as Heber, Mammoth and Brady Hot Springs, there has been evidence indicating that the silica deposition occurs more rapidly as temperature levels are lowered. In order to acquire detailed information in regard to this, it will be desirable to start the initial operations with as high a temperature discharge to the injection system as possible which can be accommodated by the thermal test loop. With the design of the thermal test loop it is anticipated that silica deposition will likely occur in the brine portion of the flash vessels or in the injection piping or even into the injection well or the injected formation. Therefore it will be desirable to start with as high an injection temperature as possible and operate continuously for several days at that temperature, and after inspection operate with progressively lower temperatures on a periodic basis to gain information relative to the characteristics of the silica deposition problem. Pressure drops in the injection pipeline system and the injection well itself will be monitored to establish trends which can be indications of deposition in various locations in the injection system.

C. Downhole pressure observations will be utilized to determine reservoir characteristics to establish potential barriers in the production zones of Magmamax 1 and Woolsey 1 and the injection zones associated with Magmamax #2 and Magmamax #3. This information will be continuously plotted with cumulated fluid production or injection as the abscissa and pressure as the ordinate. The information will be transmitted to DeGolyer & MacNaughton for analysis to establish reservoir characteristics. Magmamax #4 is completed above an identifiable shale in the reservoir and the injected fluid from Magmarnax 3 will be going into the reservoir below this shale. Continuing pressure monitoring of Magmamax 4 will provide insight into the vertical permeability of the reservoir. Observations in Magmamax #4 may be also influence by production from Magmamax 1 and Woolsey #1 since the production zones of those two wells is in the same horizon as the open area into the reservoir perforated in Magmamax #4. Pressure observations will also be monitored in Elmore #3 to provide insight relative to effects on the reservoir associated with the production and injection operations, if any, at that location, Pressure shutin test will be made periodically as directed by DeGolyer & MacNaughton.