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Reactivation of Gas Well With Lower Master Valve Problem Using Hottapping Method

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Abstract
Lower master valve is the most crucial part of a christmas tree in a producing well. This valve is directly connected to the well, which means it has direct contact with pressured fluid from reservoir. Therefore, excellent condition for lower master valve is a must.

M-03 is a gas well in M structure Pertamina that had failure in its lower master valve. This well was forced to stop producing due to problem in lower master valve. The disk in the lower master valve was stuck in closed position so that the well couldn't produce. The problem escalated once the valve's condition deteriorated. It started leaking gas that made a hazard to the surroundings. For safety reason, an action needed to be taken, however there was no path to kill the well. An alternative solution was needed to solve the problem.

In order to stop gas leak and recover production, hottapping method to make a hole in the lower master valve's disk was performed. First scaffolding is needed for safety during operation. For this, hoist rotary table was used. Another master valve was added to be the new lower master valve, ignoring the broken original lower master valve. Hottapping assembly was installed above this valve, the rest of the christmas tree was taken down. The drill inside hottapping assembly was moved by air compressor. Once the operation finished, a path for production in the stuck disk was made, christmas tree was reinstalled with one added master valve, flow line was modified, and well was producing again safely (no more gas leak). This solution regained production from well M-03 of 1.5 MMSCFD gas as well as stopping HSSE hazard (gas leak) from the well.

Having this method as a solution provide safety nets if the same problem ever happened at other wells in Pertamina. HSSE problem is something that could not be taken lightly in oil and gas industry. This project served that purpose as well as put the well back into production, which ultimately affected company's sales revenue.

Introduction
The loss of well integrity can result in major accidents and presents a severe risk to the environment (Raj 2014). No matter how old a well is, well integrity still needs to be maintained. M Structure in Pertamina was a gas structure with 30 MMSCFD gas and 350 bopd condensate production. This structure had 17 wells with 13 producing wells. Well M-03 is one of those 13 producing wells in M Structure. This well was shut in for quite a long time with last production of 3 MMSCFD and 20 bbls/day condensate. This well had a broken lower master valve that could not be opened. Beside of suspended production due to this problem, safety aspect needed to be considered. With average tubing pressure of 970 psi, this well needed to be put back on production to prevent any outside disturbance that can put safety at risk. Figure 1 shows the condition of suspended well M-03.

Figure 1 Well M-03 Condition

Well integrity is "the qualification that testifies to the well's sound capability to perform its function to contain and control the flow of fluids within the predetermined barriers throughout its designed life" (Sultan 2009). Since lower master valve in well M-03 could not perform its function, it means that M-03 had well integrity problem. Therefore well intervention was needed.

Data and Method
The condition of Well M-03 was active reservoir with perforated interval and complete production string. Estimated tubing string from this well was quite high (> 900) psi. There were two options that could be taken to solve this problem: kill or reactivate the well. In order to perform either options, connection from surface to reservoir was needed. Killing the well straight away could not be performed because no pathway from string due to stuck disk in the lower master valve. Killing from the well's annulus was also negative due to the presence of packer in the production string. Therefore, creating pathway safely through the stuck disk in existing lower master valve was chosen as solution.

The next consideration was either to kill or reactivate the well. Killing the well would mean giving disturbance to an active natural flow reservoir, something that should be avoided without emergency reasons. Bearing that in mind, after creating pathway in the problematic lower master valve, a new x-mas tree would be installed to safely reactivate the well.

The stuck disk in the lower master valve would be drilled to create a hole with sufficient size that considered inside diameter of the valve (3-1/8"). In order to perform this job safey, job safety analysis was laid out and some mitigations would be taken as precautions:

- With a quite high average tubing pressure of 970 psi and an active gas reservoir below, drilling the disk

should be performed with proper equipments that can handle high pressure and a good condition. Based on the requirements, drilling machine D-904 that can handle up to 2,200 psi at 100^0 F was selected. The pressure capacity that was alsmost twice the average tubing pressure in M Structrure was selected to accommodate the actual range of tubing pressure in M Structure, which was 900 – 1500 psi. Traveling bar of the machine was 28" in length, with a twist drill was 8.5" long and 1" diameter.

- Before performing the job, an isolation valve was installed above the stuck master valve so that when the job was finished, travelling bar of the drilling machine could be safely extracted, the well could be temporarily shut in to release remaining pressure and gas above the isolation valve, and the rest of new x-mas tree could safely be installed.
- The job would be performed at height more than 2 meters, so scaffolding was needed. The scaffolding should be firm and stable enough to perform the job. Furthermore, clearance from the stuck valve to the surface of the scaffolding must be enough to accommodate drilling machine. The scaffolding should also be not too high so that the drilling machine could be operated safely and comfortably on the scaffolding. Rig/hoist rotary table met all of these requirements and would be used as the scaffolding during the job.
- Since the strength of valve disk material should be strong enough to handle up to 1500 psi pressure, drilling job should be taken quite some time and could not be performed solely on human strength. An air compressor would be utilized as a prime mover for the drilling machine.
- Fluid inside the drilling machine and master valve was needed for cooling and lubrication. Lubricant would be used as the fluid.
- All the equipments that would be directly in contact to pressure from the reservoir should passed pressure test on maximum estimated pressure when drilling job finished.
- All the safety documents should be provided and discussed before executing the job, and revisited in pre job safety meeting on site.

In summary, job procedure of drilling the stuck disk valve were as follow:

- Clean and dry the stuck disk valve.
- Nipple up isolation valve on top of the stuck valve.
- Setting scaffolding (rotary/hoist table) surrounding Well M-03 wellhead
- Prepare drilling machine, connect twist drill to the machine.
- Nipple up drilling machine on top of the isolation valve.
- Pressure test drilling machine and isolation valve.
- Connect air compressor and execute the job.
- When the drilling finished, extract travelling bar back into the drilling machine, close isolation valve, bleed off pressure from needle valve on the drilling machine.
- Nipple up new x-mas tree (isolation valve as new lower master valve).
- Connect line to Emergency Shut Down Valve (ESDV), put the well back on production.

Figure 2 shows the description of D-904 drilling machine. As shown in Figure 2, since the stuck master valve was a flange type master valve, threaded valve adapter was not used. Also instead of hole saw, twisted drill was utilized. Figure 3 to 11 show job execution along with the explanation.

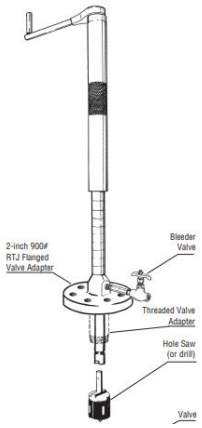

Figure 2 D-904 TD Williamson Drilling Machine

Figure 3 Stuck disk of the problematic lower master valve

Before the job, the above part of the master valve was cleaned and dried so that no debris on the soon to be drilled valve's disk.

Figure 4 Installation of Isolation Valve on Top of the Stuck Valve

Figure 5 Setting Scaffolding (Rotary Table)

Figure 6 Setting D-904 Drilling Machine, Complete with Twist Drill

Figure 7 Installing Drilling Machine on Top of the Isolation Valve

Figure 8 Pressure Test Drilling Machine and Isolation Valve

Figure 9 Execution of Drilling the Stuck Disk

Figure 10 Well M-03 was Back on Production after Drilling the Stuck Valve

After the well was put back into production, well test and monitoring was performed to evaluate the newly back on production Well M-03.

Result and Discussion

Well test and monitoring was performed after Well M-03 was back on production. Figure 11 shows production performance before and after the job.

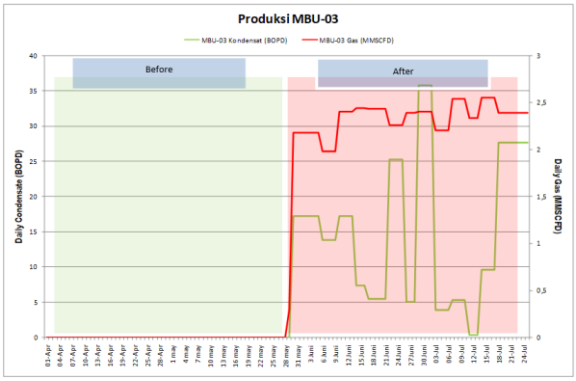

Figure 11 Well M-03 Production Performance Before and After the Job

It can be seen that average production of Well M-03 was 2.34 MMSCFD and 14.91 bopd.

Gas handling in Gas Compressing Station in M structure has maximum allowable gas temperature to be allowed entry, which was 130^0 F. Average temperature of Well M-03 was 120^0 F, hence the restriction did not apply for its gas.

Therefore, putting Well M-03 successfully added the whole structure gas production from 29.98 to 31.34 MMSCFD. Figure 12 shows M Structure gas production before and after putting Well M-03 back on production.

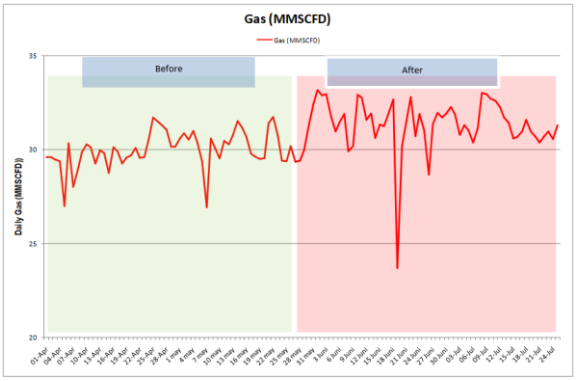

Figure 12 M Structure Production Performance Before and After Reactivating of Well M-03

Figure 11 and 12 show that this project was successfully carried out safely. Aside from economical aspect of added gas production, safety aspect in term of well integrity was also successfully regained. Furthermore no disturbance to the active gas reservoir, so this method was also a success in reservoir management aspect.

Conclusions

Reactivation of Well M-03 by performing drilling stuck disk of lower master valve was a success in economics, safety, and also technical aspect in oil and gas industry. It would be wise to prevent the same thing from happening in the future by performing good housekeeping and equipment maintenance for each producing well. However, if the same were unavoidable, this method would be the solution.

References

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