UNCONTROLLED FLOW OF GAS FROM SHALLOW DEPTH DURING HOLE ENLARGMENT

Introduction:

An incident of uncontrolled flow of gas/oil/mud occurred in a well undergoing drilling operation.

It was planned to drill a 8 ½"pilot hole up to 150 meters to log the well in view of the shallow hydrocarbon find in the formation. Thereafter, enlarge the hole to 17½" size for lowering 13 3/8" surface casing.

Brief description:

The 8 ½" pilot holes was drilled up to 153 meters with mud of 1.15 gm/cc density. After circulation for hole cleaning, drill string was pulled and the well was handed for logging operations.

Logging operations took six hours and the well was in stable condition throughout the logging operations.No drop in mud level in the well/mud seepage loss/gas migration to the surface was noticed.

After completion of logging operations, enlargement of 8 ½" hole to 17 ½" was started. The hole was enlarged up to 100 meters. Reaming of enlarged portion was being carried out three times prior to next drill pipe single connection. During the process of hole enlargement up to 100 meters, mud weight was raised from 1.15 to 1.17 gm/cc.

After reaming Kelly length three times at 100 meters, mud pump were stopped to disconnect Kelly for next pipe connection. Self-flow of mud from annulus was noticed as the pumps stopped running. The flow increased suddenly and converted into uncontrolled flow of gas/ oil/mud and water.

The above mentioned uncontrolled flow of gas/oil/mud/water stopped suddenly after 14 hours, possibly due to open hole formation collapse.

Observations:

1. 8 ½" hole was drilled using maximum 1.15 gm/cc mud weight up to 153 meters. It was then logged for six hours. There was no well activity during this entire period. Apparently 1.15 gm/cc mud weight was sufficient to control the formation pressure & bore hole stability.

2. During interaction, it was informed by Shift in charge that very few drilled cuttings were coming out to the surface. Therefore, mud weight was raised from 1.15 to 1.17 to enhance cutting lifting capacity of mud ignoring the characteristics of the upper exposed weak formation.

3. The existence of a shallow oil/gas reservoir at a depth of 125 m as per recorded logs was informed to drilling department only after blow out took place.

4. Top hole drilling procedures, i.e. controlled rate of penetration, frequent pumping sweeps of pre hydrated bentonite/guar gum high viscous pills etc. for proper hole cleaning were not followed.

5. Shallow hydrocarbon reservoir was opened with only one barrier i.e. mud. There was no diverter for controlled diversion of shallow gas/oil.

6. The Shift In charge/Astt. Shift In charge did not have valid IWCF certificates.

Root cause of the incident:

Followings are the possible causes:

1. Poor information sharing between different departments for well construction, design, operational planning, execution, monitoring & review. Existence of shallow hydrocarbon gas bearing formation at bottom of the pilot hole, as per recorded logs, was not informed to drilling department prior to hole enlargement for taking necessary precautions.

2. The combined effect of raising mud weight from 1.15 to 1.17 gm/cc, suspended drilled cuttings in the annulus (due to insufficient lifting) and dissolving / sticking characteristics of clay resulted in increased effective mud weight (EMW) in the annulus. This led to induced fracture in the upper exposed weak formations. The induced fracture in upper weak formations resulted in drop in mud level when pumps were stopped. Well became underbalanced and inflow of influx started. This influx turned into an uncontrolled flow of gas / oil/ mud and water in the absence of Diverter / BOP.(It is also possible that mud loss could have been started during raising mud weight but crew could not detect due to continued circulation & loading of mud).

3. Top hole drilling procedures were not followed.

Recommendations:

1. There should be documented procedure to ensure coordination/sharing of information (at the right time) between the concerned departments, to minimize possibility of such mishaps.

2. Shallow gas bearing pockets should be drilled through with two barriers i.e. mud and Diverter for controlled diversion of trapped gas at shallow depth.

3. It is suggested to carry out a review/management of change meeting between concerned departments prior to mud weight increase/decrease.

4. Top hole drilling procedure should be followed.

5. Hazard identification and risk assessment analysis should be included in well plans.