Well Planning

- **The most demanding aspect of drilling engineering**
- **Requires the integration of engineering principles, corporate or personal philosophy, and experience factors**
- **Vary within drilling industry**
- **Skilled well planners have three common traits**
  - **Experienced drilling personnel**
  - **Utilize available engineering tools**
  - **Research and review every aspect of the plan to isolate and remove potential problems areas**

Well Planning Objectives

- **Well planning objectives are:**
  - **Safe**
  - **Minimum cost**
  - **Usable**

Safety

- **The highest priority in well planning**
- **Personnel consideration must be placed above all other planning aspects**
- **Sometimes the plan must be altered when unforeseen drilling problems endanger the crew**
- **Second priority involves the safety of the well**
- **The plan must minimize the risk of blow out or other problems**
- **Extra cost of well planning can prevent serous problems**

Example

- **A turnkey contractor assigned to drill a 9000-ft well**
- **The well was in a high activity area**
- **52 wells had been drilled in the area**
- **The drilling superintendent called a bit company and obtained record on two wells**
- **In the section where the prospect well was to be drilled**
- **The wells shoed that the formation pressure would be normal to a depth o 9800 ft**
- **Therefore, the pressure problems were not anticipated.**
- **The contractor elected to set 10-3/4 in casing at 1800 ft and drill with 9.5 ppg mud to 9000 ft with 9-7/8 in bit**
- **Drilling was uneventful until a depth 8750 ft**

- **At that point a sever kick was taken and an underground blowout occurred that soon erupted into a surface blowout**
- **The rig was destroyed and natural resources were lost until the well was killed three weeks later.**

- **A drilling consultant retained by a major European insurance company conducted a study that yielded the following**
- **All the wells appeared to be normal pressured until 9800 ft**
- **4 well of the 52 well has blow out n the past five years, it appeared that the blowout came from the same zone**
- **A total of 16 of the remaining 48 wells had taken kick or severe gas cutting from the same zone**
- **All problems appeared to occur from 12,400-ft abnormal pressure**

Conclusion

- **The drilling company did not search thoroughly the surrounding wells**
- **The final settlement by the insurance company was over $16 million.**
- **The incident probably would not have occurred if the contractor has spent $800 to obtain proper drilling data.**

Minimum Cost

- **Minimize the cost without jeopardizing the safety aspects**
- **Well planning effort reduce the costs**
- **A proverb says ”It is not noble to build “Steel monuments” in the name of safety if additional expense is not required”**
- **Monies should be spent as necessary to develop a safe system**

Usable Holes

- **The final well configurations should be usable**
- **The hole diameter is sufficiently large for adequate completion**
- **Do not damage the pay zone**
- **Take care about depth and abnormal formation pressures**

Classification of The Wells

- **Wildcats**
- **Exploratory**

- **Step-out**
- **Infills**
- **Reentries**
- **Wildcats require more planning than the other types**
- **Infills and reentries require minimum planning in most cases**

Well Type Characteristics

Well Type	Characteristics
Wildcat	**Not known (or little) geological foundation for site selection**
Exploratory	**Site selection based on seismic data, satellite survey, etc.** **No known drilling data in the area**
Step-out	**Delineates the reservoir's boundary** **Drilled after the exploratory discovery(s)** **Based on seismic data**
Infill	**Drills the known productive portions of the reservoir** **Site selection based on patterns, drainage radius, etc.**
Reentry	**Existing well reentered to deepen, sidetrack, rework, or recomplete** **Various amounts of planning required, depending on purpose of reentry**

Formation Pressures

- **Affect the well planning**
- **May be normal, abnormal (high) or subnormal (low)**

Normal Pressure

- **Does not create planning problems**
- **Mud weight ranges from 8.5 to 9.5 ppg**
- **Kick and blowout prevention problems should be minimized but not eliminated**
- **Casing requirements can be stringent even in normal pressure wells deeper than 20,000 ft due to tension/collapse design constraints**

Subnormal Pressure

- **May require setting additional casing to cover weak formation**
- **May result from geological or tectonic factors or depletion in producing intervals**
- **May be serious if other abnormal formation encountered**

Abnormal Pressure

- **Affect well planning in many areas**
- **Casing and tubing design**
- **Mud weight and type selection**
- **Casing setting depth selection**
- **Cement planning**

The following problems must be considered

- **Kick and blowout**
- **Differential pressure pipe sticking**
- **Lost circulation resulting from high weights**
- **Heaving shale**
- **Well costs increase significantly with geopressure**

Planning Cost

- **Cost to plan a well is significant in comparison to the actual well cost**
- **In most cases, less than $1000 is spent in planning a $ 1 millon well**
- **It presents 1% of the well cost**

Overview of the Planning Process

Prospect development
Data collection
Pore pressure analysis
Fracture gradient prediction
Pipe setting depth selection
Hole geometry selection
Completion planning
Mud plan
Bit program
Casing design
Tubing design
Drill string design
Rig size and selection
Drill time projection
Cost estimation