

## **Challenges of Well Completion & Testing in High Pressure High Temperature Environment-Case Study of ONGC**

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Search for new hydrocarbon resources has led to discovery of several High Pressure High Temperature (HPHT) fields in ONGC. Drilling, completion, testing and production in HPHT environment are technically complex operations with very high risk and exhibits major HSE issue and are further aggravated with the presence of H<sub>2</sub>S and CO<sub>2</sub>. The problem is more challenging in off-shore environments. This paper attempts to enumerate the problems & issues related to completion, testing, production and control of HPHT wells.

The challenges during drilling relates to containment of risk associated with HPHT, reduction of NPT, proper tools, mud system & cementation, casing and liner integrity etc. After drilling, next challenging task is good completion, successful testing and gathering all required information to assess and quantify hydrocarbon volumes, reservoir response and behavior as hydrocarbon is produced. The completion of HPHT wells is a further challenging task with reference to equipment selection, especially when significant pipe movement, compression loads and tubing stresses are expected. The effect of HPHT conditions on packers, elastomers, sliding sleeves, injection subs, mechanical & fluid friction and reliability of electronics plays an important role in gathering of downhole data, formation evaluation, completion & testing of such wells. Testing phase requires careful considerations of several key issues such as flow assurance, fluid contaminants- H<sub>2</sub>S, CO<sub>2</sub>, sand, hydrate, sealing requirements viz: equipment component sealing, well bore sealing, sealing of plugs, and stresses in tubular. In HPHT environment it is essential to evaluate effect of pressure-temperature-depth on reliability of safety valves, sliding sleeves, operation of slick line, lubricator packing, coil tubing, remote control, pressure, temperature and flow measurement tools during prolonged exposure. The well control issues include hydraulic calculations like Equivalent Circulating Density, kick tolerances like swabbed, drilled & pressured fault kicks, gas migration, gas diffusion, kill methods, surface flow parameters, mud gas separator, comparing kick behavior in brine water v/s oil based mud.

Handling HPHT fluid in surface equipment is also a major challenge with reference to corrosion, erosion, sand, wax and hydrate formation. Further it is also important to evaluate impact of these ingredients on measuring instruments. In addition, multiphase flow, flow assurance, stimulation, production chemistry, injection equipment, temperature limitations on chemicals and sand control are important production aspects in development of HPHT fields.

Global and Indian scenario dealing with the above issues along with technologies used is briefly covered in the paper. There are number of HPHT wells drilled in ONGC both onshore and offshore. These have been tested and some wells have produced. There are some cases where testing has not been successful. Completion, testing, operational issues and lesson learnt are briefly discussed.