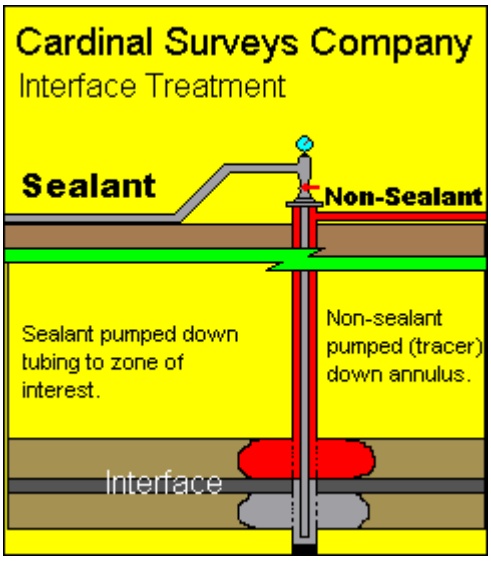
**The Controlled Interface Treatment.**




In order to selectively place fluid loss control agents or sealants (cement, polymer, etc.), sometimes it is necessary to use a well known and established method of hydraulically placing materials called the controlled interface treatment. The interface placement technique provides a method to direct the treatment solution into the selected interval(s) through simultaneous dual injection of sealing and non-sealing fluids into, respectively, the tubing and annulus. Determination of placement is performed in a real-time analysis utilizing a tagged fluid and a gamma-ray detector tool. During the initial analysis and possibly during the sealant placement, the pump rates (tubing and annulus) are regulated by readings from the gamma-ray detection tool.

In this method, fluids are pumped from two different directions, and the depth at which they meet is the interface depth. In order to quantify the interface depth, a radioactive tracer can be injected with one of the treatment fluids so that the presence of the tracer in only one fluid accurately defines the interface location. The tracing and recording of the interface is known as an interface log.

Applications are generally found in situations where other, more conventional means of isolation are impractical or impossible. Examples include open hole completions, wells with damaged casing, or wells with poor cement sheath isolation or other uncontrollable channeling problems such as vertical permeability or natural or hydraulically induced fractures. Wells experiencing sever water coning are also potential candidates for the controlled interface procedure. Some well problems are near well bore, and some are further out in the deep formation.

A gamma-ray detection tool is run down the well and suspended in the hole on an electric conductor cable inside of the tubing and is placed at the desired interface between the upper and lower points in the well. The annular fluid is tagged with a radioactive isotope that can be detected by the tool. The exact location of the interface can be adjusted by manipulating the rate at which the two dissimilar fluids are pumped. For example, if the interface location is too high, then the annular injection can be increased while the tubing injection is decreased in order to move the interface down the well.

Normal operations call for the sealing solution to be placed at a rate below fracture pressure into the zone desired to be sealed. The controller on these jobs is rate and not pressure. The only pressure consideration is pressure restrictions of the casing and fracture pressures.

To configure the well for the interface treatment, the tubing must be placed below the interface location, and left open ended. It is permissible to leave the packer on the end of the tubing string with the packer seals released. A pin-collar is recommended on the end of the tubing to prevent the logging tools from exiting the tubing.

Consideration should be made as to the treating chemical's differences in viscosity, density, etc., if it is necessary to begin the treatment without the logging tools in the well.

Spotting the annular fluid down close to the desired interface prior to performing the analysis is usually performed to save time since annular volumes are sometimes large based on the daily injection volume for the upper interval.

The gamma ray logging tools should be moved to locate the interface and track the developing stationary injectivities per each annular rate adjustment. Further, the tools may also be moved to analyze the initial movement when starting the analyses.

A temperature tool is sometimes required when the bottom hole injection temperature is needed for sealant reaction time calculations

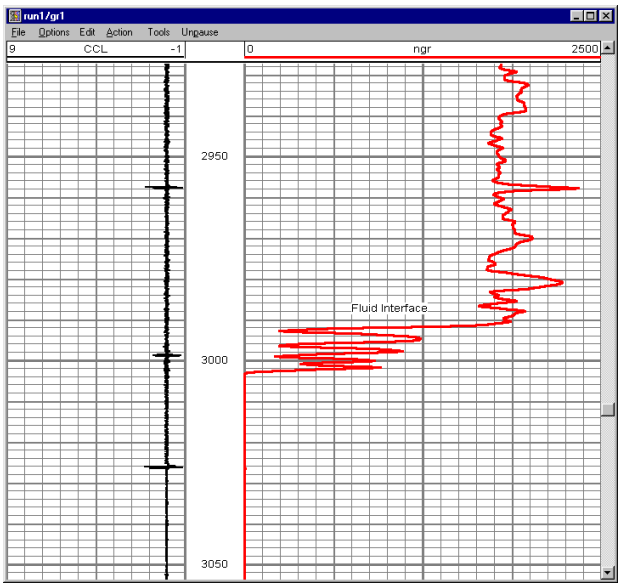
It is desirable to use high pressure tracer injection technology (Cardinal Surveys Company's Tagmaster) to prevent any unnecessary contamination of pumping equipment with radioactive materials.

**The Controlled Interface Treatment – General Operating Procedure.**

1. Configure well to allow pumping down tubing string and casing-tubing annulus. Set end of tubing near the bottom of the well, or well below the planned interface depth.
2. Rig up two pumps to inject fluid down the tubing and casing-tubing annulus, respectively. Install flow manifold to monitor rate and pressure to each injection point.
3. Connect Cardinal Surveys Company's Tagmaster unit to allow tracing of fluid which is injected down the casing-tubing annulus. Normally, a liquid based tracer of I-131 is preferred.
4. Rig up Cardinal Surveys Company logging unit with gamma ray detector, temperature and casing collar locator tools. Use full lubricator stack. Run correlation gamma ray and collar logs on zone of interest and make necessary depth corrections.
5. Begin injection of fluid down the casing-tubing annulus only. Begin radioactive tracer. Inject fluid at maximum allowable rate and pressure. Use gamma ray detector to monitor injected fluid as it moves down the casing-tubing annulus.

6. As the tracer leading edge nears the planned interface depth, begin injecting down the tubing while reducing injection down the casing-tubing annulus. Maintain total rate and pressures below maximum allowable levels, and adjust total rate to planned treatment rate.
7. Continue to monitor leading edge of tracer using gamma ray detector tool. Adjust individual injection rates while keeping total injection rate constant. Stabilize interface at desired interface depth.
8. Once interface has stabilized, begin pumping fluid control agent (polymer or cement slurry.) COH with logging tools if necessary. Continue to monitor interface depth if possible.

**Interface logging procedure:**




1. Gamma Ray detector is lowered below tracer leading edge, and a recording of gamma ray intensity is made versus depth. The tracer leading edge is indicative of the fluid interface once injection is established down both the casing-tubing annulus and down the tubing. Fluid containing the radioactive tracer will register a significantly higher reading when recorded.
2. Repeated recordings of gamma intensity versus depth are made. The interface depth is reported to pumping personnel after each recording. Pump rates are adjusted as required to position the interface at the desired depth.
3. Continued monitoring is desirable unless the fluid control agent is not compatible with the wireline equipment.