LOGIQ® Compensated Spectral Natural Gamma Ray (CSNG™) Tool

DETECT PRODUCIBLE ZONES AND INCREASE RESERVOIR UNDERSTANDING OF FORMATIONS

OVERVIEW

The Halliburton LOGIQ® CSNG™ tool measures the entire gamma ray spectrum, from 0 to 3,000 keV. The tool uses special borehole compensation techniques to provide the industry's most precise and accurate logs of potassium, uranium, and thorium concentrations. Measurement precision curves and tool diagnostics help validate logging data in the formation. A unique, patented low atomic number tool case enables gamma rays to be measured for accurate data retrieval in cased-hole and openhole environments.

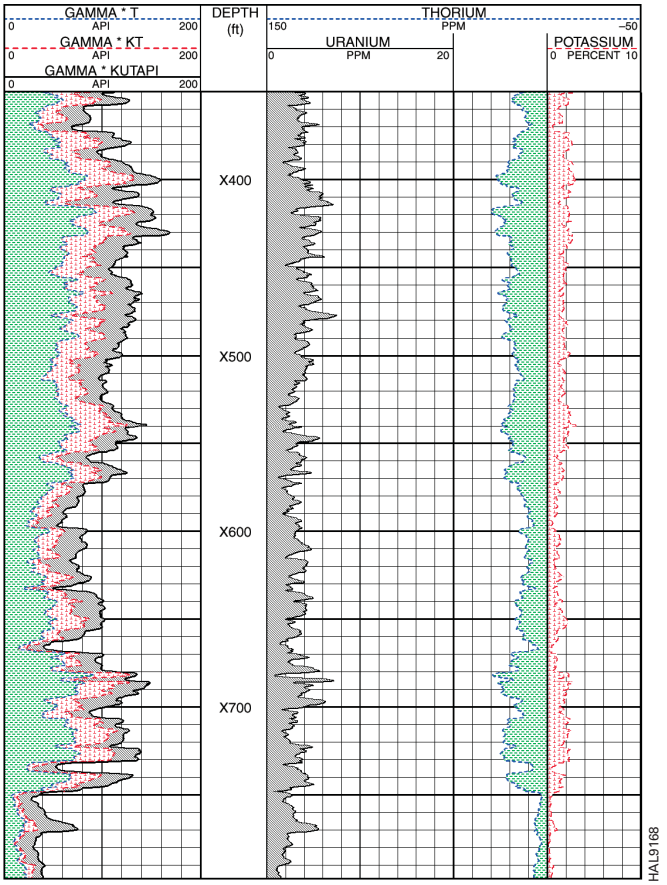
The CSNG tool's unique stabilizer system differentiates it from the competition by compensating for temperature-related drift in system gain, maintaining that gain to within 0.5%. Another unique feature of the CSNG tool is its ability to provide realtime outputs corrected for the borehole environment and converted to standard conditions (9-in. borehole, fresh water in borehole, no casing, and tool centered).

FEATURES

- Measures and records the energy of individual gamma rays
- Forms a spectrum of gamma energies indicating the number of gamma rays recorded at each energy level
- Divides overall spectrum into overlapping low and high spectra
- Photoelectric ratio produced by low-energy spectrum (0 to 350 keV) can be interpreted to help determine lithology in openhole wells or casing thickness in cased wells
- High-energy spectrum (0 to 3 MeV) facilitate determination of potassium, uranium, and thorium weight concentrations in formation

BENEFITS

- Aids detection of producible zones by more accurately distinguishing reservoir rock from those containing clays. Sandstones generally have low potassium and thorium concentrations compared to shales
- Increases reservoir understanding. Fractured or highly permeable reservoirs can be discovered when high uranium concentrations appear with low potassium and thorium concentrations. High uranium and thorium counts with low potassium counts indicate a clean reservoir containing accessory minerals



CSNG log with Gamma Ray contributions from Thorium, Potassium and Uranium.

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- Helps determine clay types, volumes, and cation exchange capacity using elemental concentration data and Clay and Matrix Analysis (CLAMS™) post-processing analysis
- Locating improved single-pass performance for radioactive tracers with the CSNG tool in Halliburton's TracerScan™ service to improve the evaluation of hydraulic fracturing, gravel packing, and frac packing operations

ASSOCIATED ANSWER PRODUCTS

- Direct output from the CSNG tool includes total gamma ray and elemental concentrations of potassium, uranium, and thorium
- Clay typing, volumes, and cation exchange capacity can be compared using Halliburton's Clay and Matrix Analysis software (CLAMS)

LOGIQ® Compensated Spectral Natural Gamma Ray (CSNG™) Tool Specifications

	Make Up Length		Diameter		Maximum Pressure*		Maximum Temperature		Weight	
	(ft)	(m)	(in)	(mm)	(psi)	(MPa)	(°F)	(°C)	(lb)	(kg)
Titanium Housing	14.9	4.5	3.625	92.1	14,000	96.5	350	176.7	271	122.9
Low Z Housing	12.9	3.9	3.625	92.1	8,000	55.2	275	135	260	117.9
DeepSuite™ Tool	8.2	2.5	4.44	112.8	35,000	241.3	350	177	206	93.5

* Please refer to the CSNG Pressure Rating chart below.