Vibration Technology Utilizes Resonant Frequency and Mechanical Impedance

PROJECT PROFILE
ENERGY TRANSFER

VT UNIT SIZE
All Vibrators

VIBRATION TIME
Few minutes to a couple of days

WELL DEPTH
Max Depth to Date 21,000'.

WORK STRING
Coil Tubing to Casing strings

STRING WEIGHT
500,000 # lb. Max

HOW DOES VIBRATION TECHNOLOGY ENSURE ADEQUATE ENERGY TRANSFER TO THE STUCK POINT?

SITUATION:

How does Vibration Technology ensure adequate energy transfer to the stuck point?

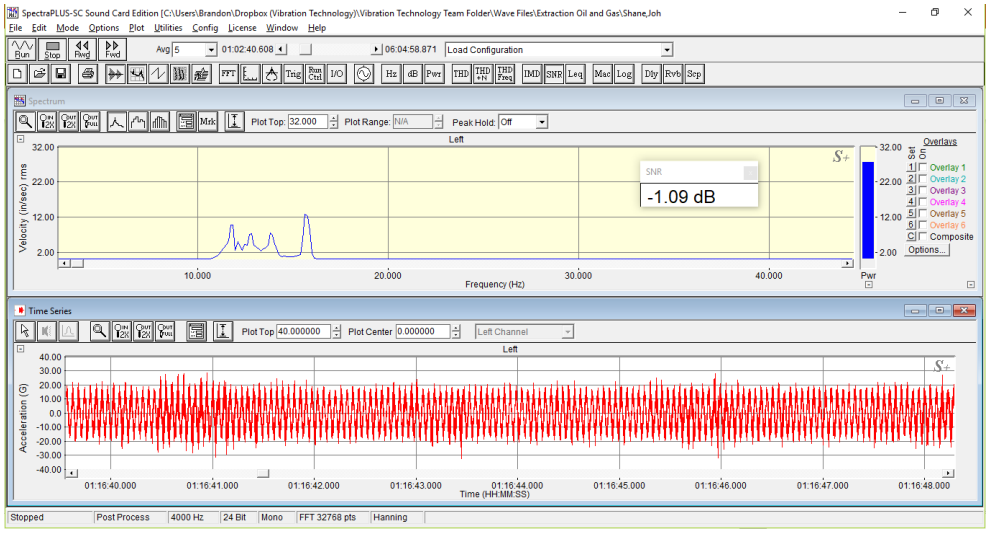
SOLUTION:

Being thousands of feet away from the stuck point requires measurement techniques that indicate whether the energy you impart at the surface actually gets transmitted to the stuck point. Mechanical Impedance, defined as the ratio of Force divided by Velocity, allows us to do that in real time while the vibration sequence is taking place.

These measurements are done using an accelerometer and spectral analysis software. We only need to measure one of the parameters, like Velocity, in order to know whether the Impedance is at a maximum or a minimum. This can only be accomplished by vibrating the work sting at one of its Resonant Frequencies. A spectrum analyzer clearly allows us to do that, as can be seen in the subsequent images.

RESULTS:

Below are captured spectrum examples which plot the velocity vs frequency, as well as acceleration vs time. The bottom plot on each image is a time domain picture of the waveform while the top plot is the calculated frequency spectrum of that time domain waveform.



VIBRATION TECHNOLOGY
Innovative Technology for Removing Stuck Tubulars

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During the initial phases of vibration, as shown above, the operator is trying to find and lock into a Resonant Frequency pattern. This figure shows the sweeping motion of the vibrator before lock-in. The strength of the signal relative to the noise in the system is at a minimum, as indicated by the very low signal-to-noise ratio (SNR). Note also the low quality of the time domain waveform since it has noise superimposed on the sine wave output of the vibrator.

Once the operator has locked into a Resonant Frequency pattern, as shown below, the SNR increases indicating that the sine wave output of the vibrator is well above the surrounding noise thereby allowing easy transfer of the vibration energy to the stuck point. Also, the purity of the vibrator's output sine wave is clearly evident in both plots.

By comparison, jars output random noise and thereby have no pure sine waves to travel any appreciable distances. That is why jars have to be located extremely close to the stuck point, otherwise their energy output gets dissipated very quickly.