

Neptune Sonar Report

SEL testing

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RMS Source level measurements of Ace Aquatec's Acoustic Startle Reponse (A.S.R) systems

The Peak source levels of the ASR systems at maximum volume over ten milliseconds has been known for some time, but recently the average power over a scram has become an important parameter for the Scottish regulators.

The main 3 systems have been directly measured by firing a scram and listening with a D/70 Hydrophone, s/n 34376 attached to a Keysight MXA N9020B Vector signal analyser. The average of 5 pulses was taken, looking at the first 2s of the pulse and measuring the rms amplitude. This ensures that the amplitude modulation is taken into account and allows the SEL (Sound exposure level) to be calculated.

$SEL = SPL + 10 \log(t)$ where t is time in seconds (length of a scram, currently approx. 2 to 3 seconds)

Experimental Setup

The RT1 pod was deployed, hanging from its rope in the orientation it would be when deployed on a fish farm (ring in horizontal plane). The transducer is omnidirectional in this plane with a normal variation of +/- 1dB around the circumference.

It was deployed from the second station on the raft at Neptune Sonar. The raft is entirely floating so there are no obstructions below 0.5m under the water surface and the lake is essentially a free-field for propagation purposes.

The Hydrophone was connected directly to channel 2 of the VSA and the triggering set up to trigger off the acoustic signal.

Parameter	Value
Depth of device under test	4 m
Depth of hydrophone	4 m
Distance between hydrophone and device under test	3.0 m +/- 0.1m
Length of acquisition	2.0 s
Number of scrams in the average	5
Trigger level	-20mV
Hydrophone Serial No:	34376
Hydrophone Sensitivity (1-5kHz)	-200 dB re 1V/uPa
Hydrophone Sensitivity (10 to 20kHz)	-202 dB re 1V/uPa
Background noise level	< 100dB re 1uPa

	Lower	Mid	Upper	Full
FS1	800 – 1200 Hz	1000 – 2000 Hz	1000 – 5000 Hz	800 – 5000 Hz
RT1	800 - 1200 Hz	1000 – 2000 Hz	1000 – 5000 Hz	800 – 5000 Hz
US3	8000 – 11000 Hz	10000 – 15000 Hz	10000 – 20000 Hz	8000 – 20000 Hz

Table 1 – Frequency range settings for the 3 systems
(blue is aquaculture settings, black is offshore MMD)

Results

System	Length of scram (Tone 1) (s)
FS1	2.8
RT1	2.8
US3	2.6

Table 2 – Measured scram length

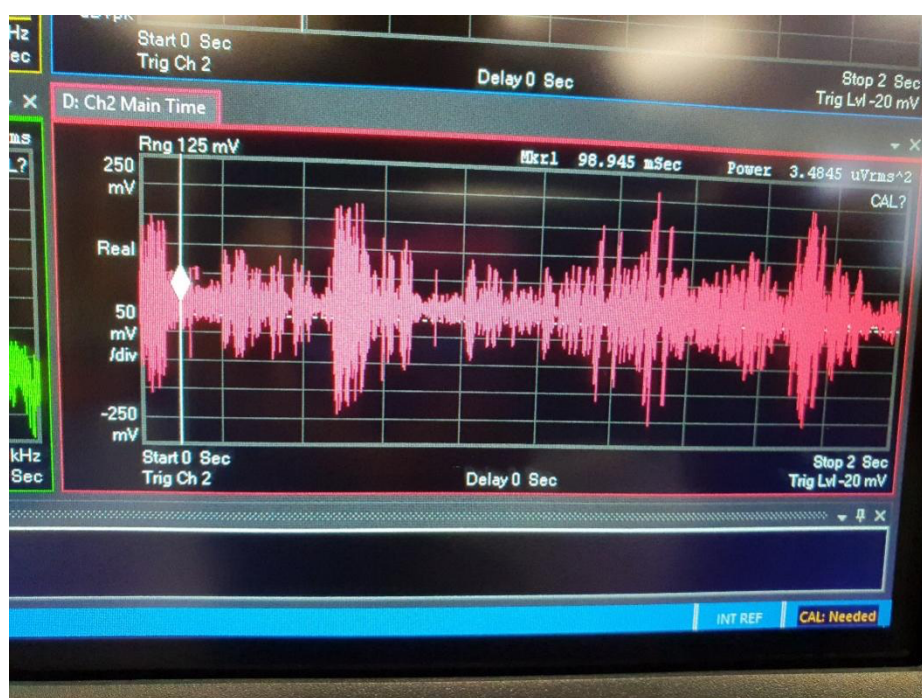


Figure 1 Time domain trace of FS1 hydrophone waveform showing amplitude modulation

Volume Setting	Rms source level Lower Band dB re 1uPa @1m	Rms source level Mid Band dB re 1uPa @1m	Rms source level Upper Band dB re 1uPa @1m	Rms source level Full Band dB re 1uPa @1m
1	151.8	157.8	150.4	157.1
2	163.0	165.1	161.8	163.2
3	167.3	168.8	167.9	167.4
4	169.9	171.5	169.4	169.3
5	171.8	172.5	170.9	170.8
6	173.6	174.0	173.6	172.5
7	174.2	176.2	173.7	174.7
8	175.3	177.6	174.9	175.6
9	175.8	178.7	176.6	176.4

Table 3 – Amplitude of the Flex System (FS1)
(blue is aquaculture settings, black is offshore MMD)

Volume Setting	Rms source level Lower Band dB re 1uPa @1m	Rms source level Mid Band dB re 1uPa @1m	Rms source level Upper Band dB re 1uPa @1m	Rms source level Full Band dB re 1uPa @1m
1	149.5	157.8	160.2	159.9
2	156.0	165.1	167.5	167.8
3	158.5	169.8	171.2	170.9
4	162.6	172.5	173.7	173.5
5	163.7	173.5	175.1	175.9
6	165.8	176.2	177.3	176.5
7	168.0	177.2	178.9	178.2
8	168.4	177.8	179.2	180.5
9	170.1	179.6	181.0	181.2

Table 4 – Amplitude of the FFR System (RT1)
(blue is aquaculture settings, black is offshore MMD)

Volume Setting	Rms source level Lower Band dB re 1uPa @1m	Rms source level Mid Band dB re 1uPa @1m	Rms source level Upper Band dB re 1uPa @1m	Rms source level Full Band dB re 1uPa @1m
1	161.9	168.9	169.8	169.6
2	167.4	173.3	174.5	175.5
3	171.3	177.0	178.8	177.5
4	173.5	179.0	180.3	180.7
5	174.8	181.3	183.1	181.9
6	176.9	183.0	184.2	184.8
7	178.4	184.6	185.0	185.6
8	179.6	185.9	186.7	185.7
9	180.6	186.8	188.2	187.7

Table 5 – Amplitude of the US3 System (US3)
(blue is aquaculture settings, black is offshore MMD)