



eGAMING COMPLIANCE SERVICES LIMITED

RANDOM NUMBER GENERATOR EVALUATION REPORT

FOR

RELAX GAMING LIMITED

REPORT REFERENCE NUMBER: e211763RLXMUL

REPORT ISSUE DATE: 08 APRIL 2021

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1. INTRODUCTION

Relax Gaming Limited requested eCOGRA to evaluate the randomness of their Random Number Generator product for an online gambling license application for products deployed in licensed jurisdiction. The Random Number Generator used for the gambling applications is software based.

2. COMPONENTS INSPECTED

CLIENT NAME:	Relax Gaming Limited
CLIENT ADDRESS:	99 Chains Business Centre George Borg Olivier Street St. Julian's STJ 1080 Malta
PRODUCT NAME:	Random Number Generator (RNG)
SUPPLIER:	Relax Gaming Limited
PRODUCT DESCRIPTION:	Pseudo-random RNG
PRODUCT VERSION:	RNG 2.0
RNG TYPE:	Software
JURISDICTION:	Alderney, Gibraltar, Isle of Man, Latvia, Estonia, Malta, Lithuania
TEST ENTITY FULL NAME:	eGaming Compliance Services Limited t/a eCOGRA
TEST ENTITY ADDRESS:	2 nd Floor Berkeley Square House, Berkeley Square, London, W1J 6BD, United Kingdom
TEST ENTITY ACCREDITATIONS HELD:	An Accredited Testing Laboratory No. 4656. ISO/IEC 17025:2017 (Great Britain, Denmark, Sweden and Switzerland), Issued by The United Kingdom Accreditation Service (Issue No: 019, Issue Date: 01 March 2021).
TESTING PERIOD	12 April 2019 - 29 April 2019
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REPORT ISSUE DATE:	08 April 2021
TEST ENGINEERS:	Sphamandla Langa, Sikhumbuso Mzobe, Pooveshan Gounden
SUPERVISION AND APPROVAL:	Gary Lupton-Smith
ASSESSMENT RESULT:	Compliant

3. RNG SOFTWARE DETAILS

The scope of the RNG evaluation and certification applies solely to the RNG files, RNG file versions and associated hashes provided in the tables below:

Random Number Generator

File Name	File Version	SHA1	MD5
Rng.jar	2.0	2AADB91A9B0CD1466ADA08472108 0423D7821C9E	5863170A231DB171413F2664B0D C2305

SCHEDULE 1. RNG TESTING

1. TESTS PERFORMED

The scope of the evaluation consisted of an assessment of the following components:

- Documentation review;
- Source code;
- Statistical and mathematical analysis;
- Seeding/re-seeding;
- RNG range; and
- RNG scaling.

The RNG evaluation was performed to ensure the following requirements were met:

- The data must be randomly generated;
- The data must be unpredictable; and
- The series cannot be reproduced.

The test suite used to perform the evaluation consisted of the following:

- Chi-Squared Tests;
- Wald-Wolfowitz (or Runs) Tests;
- Correlation and Serial Correlation;
- Expected probabilities for shuffle decks; and
- Diehard Test Suite.

2. TEST RESULTS

Recognised statistical and mathematical tests were performed to certify the RNG operated in compliance with the requirements stipulated in the regulations of highly regulated online gambling jurisdictions. This included tests for probability (to ensure the expected number of occurrences), randomness (so that one cannot predict the following occurrence with any degree of certainty) and uniformity (to determine that each possible outcome is equally likely over the long-term). The acceptance criteria for the statistical tests is a pass at a 95% confidence level.

1. OUTPUT BASED TESTING ON SCALED RANGES: 0-33, 0-36, 0-51, 0-66, 0-99, 0-500, 0-999
a. OUTPUT BASED TESTING ON SCALED RANGES RESULTS

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Test Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	0.4839	0.1976	0.0212	0.5107	0.2749	0.9722
2	3 000 000	0-36	36	0.8959	0.8427	0.1701	0.0203	0.3474	0.7166
3	3 000 000	0-51	51	0.6721	0.1670	0.9733	0.4696	0.9706	0.5735
4	3 000 000	0-66	66	0.6681	0.0810	0.6432	0.3991	0.1018	0.6389
5	3 000 000	0-99	99	0.0932	0.8358	0.6281	0.8430	0.4732	0.2756
6	3 000 000	0-500	500	0.0697	0.6111	0.7385	0.7073	0.1094	0.3102
7	3 000 000	0-999	999	0.3719	0.5153	0.4698	0.2499	0.6417	0.0765

b. SCALED DATA RANDOMNESS TEST SUCCESS (✓) OR FAILURE (x) SUMMARY

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Test Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	P-value
1	3 000 000	0-33	33	✓	✓	✓	✓	✓	✓
2	3 000 000	0-36	36	✓	✓	✓	✓	✓	✓
3	3 000 000	0-51	51	✓	✓	✓	✓	✓	✓
4	3 000 000	0-66	66	✓	✓	✓	✓	✓	✓
5	3 000 000	0-99	99	✓	✓	✓	✓	✓	✓
6	3 000 000	0-500	500	✓	✓	✓	✓	✓	✓
7	3 000 000	0-999	999	✓	✓	✓	✓	✓	✓

2. OUTPUT BASED TESTING ON SHUFFLED DECKS

a. OUTPUT BASED TESTING ON SHUFFLED DECKS RESULTS

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Tests Number	Sample size	Test Range	DoF	Sample 1 P-value	Sample 2 P-value	Sample 3 P-value	Sample 1 P-value	Sample 2 P-value	Sample 3 P-value
1	3 000 000	5 Card Hands	8	0.5562	0.5593	0.3851	0.7198	0.3681	0.4508
2	3 000 000	7 Card Hands	9	0.7535	0.4415	0.5558	0.5179	0.4711	0.5012
3	3 000 000	5-7 Card Multiples Combinations	17	0.6568	0.4648	0.7782	0.6491	0.3506	0.4249
4	3 000 000	5-7 Card Suit Combinations	29	0.3828	0.7394	0.5097	0.5365	0.7252	0.2516

b. SHUFFLED DECKS RANDOMNESS TEST SUCCESS (✓) OR FAILURE (x) SUMMARY

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Tests Number	Sample size	Test Range	DoF	Sample 1 P-value	Sample 2 P-value	Sample 3 P-value	Sample 1 P-value	Sample 2 P-value	Sample 3 P-value
1	3 000 000	5 Card Hands	8	✓	✓	✓	✓	✓	✓
2	3 000 000	7 Card Hands	9	✓	✓	✓	✓	✓	✓
3	3 000 000	5-7 Card Multiples Combinations	17	✓	✓	✓	✓	✓	✓
4	3 000 000	5-7 Card Suit Combinations	29	✓	✓	✓	✓	✓	✓

3. DIEHARD TESTS

a. DIEHARD TEST RESULTS

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	0.0792	0.0653	0.0685	0.3090	0.0099	0.2339
OVERLAPPING 5-PERMUTATION TEST	48 000 000	0.8842	0.4242	0.7387	0.3039	0.0403	0.2606
THE BITSTREAM TEST	48 000 000	0.0868	0.0266	0.0367	0.2700	0.2314	0.0109
COUNT-THE-1's TEST bytes	48 000 000	0.0074	0.0222	0.0307	0.0207	0.0174	0.0829
MINIMUM DISTANCE TEST	48 000 000	0.0874	0.6590	0.8810	0.3633	0.8035	0.9128
SQUEEZE TEST	48 000 000	0.5184	0.3457	0.7770	0.4170	0.5661	0.2755
RUNS TEST	48 000 000	0.0743	0.1361	0.3872	0.0134	0.0399	0.0763
CRAPS TEST	48 000 000	0.2070	0.0315	0.8903	0.4106	0.5579	0.7820

b. DIEHARD TESTS SUCCESS (✓) OR FAILURE (✗) SUMMARY

DIEHARD TEST		CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
Test Name	Sample Size	Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
BIRTHDAY SPACINGS TEST	48 000 000	✓	✓	✓	✓	✓	✓
OVERLAPPING 5-PERMUTATION TEST	48 000 000	✓	✓	✓	✓	✓	✓
THE BITSTREAM TEST	48 000 000	✓	✓	✓	✓	✓	✓
COUNT-THE-1's TEST bytes	48 000 000	✓	✓	✓	✓	✓	✓
MINIMUM DISTANCE TEST	48 000 000	✓	✓	✓	✓	✓	✓
SQUEEZE TEST	48 000 000	✓	✓	✓	✓	✓	✓
RUNS TEST	48 000 000	✓	✓	✓	✓	✓	✓
CRAPS TEST	48 000 000	✓	✓	✓	✓	✓	✓

4. SERIAL CORRELATION TESTS

a. SERIAL CORRELATION TEST RESULTS:

	DECK 1					DECK 1				
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 1	Col 2	Col 3	Col 4	Col 5
LAG 1	0.3587	0.6787	0.8095	0.1608	0.9886	0.1512	0.0890	0.5208	0.7962	0.5002
LAG 2	0.6397	0.6870	0.4619	0.3505	0.8193	0.0503	0.1645	0.2943	0.8603	0.7300
LAG 3	0.4878	0.8597	0.6708	0.2585	0.8117	0.0840	0.1334	0.4403	0.8582	0.8389
LAG 4	0.4673	0.9207	0.4508	0.3228	0.7917	0.0486	0.2163	0.5665	0.9234	0.9060
LAG 5	0.5667	0.9656	0.5407	0.4153	0.8749	0.0880	0.2981	0.6905	0.9253	0.8367
LAG 6	0.4238	0.6584	0.5841	0.0327	0.8653	0.1224	0.2738	0.7819	0.9562	0.9030
LAG 7	0.5119	0.7396	0.6944	0.0534	0.8698	0.1855	0.3667	0.7282	0.9805	0.7067
LAG 8	0.6008	0.7975	0.5627	0.0424	0.8831	0.2589	0.3810	0.7950	0.9812	0.7801
LAG 9	0.4197	0.6361	0.5927	0.0642	0.4727	0.2983	0.2207	0.4695	0.9908	0.8511
LAG 10	0.2064	0.7228	0.6532	0.0959	0.2986	0.3492	0.2880	0.5599	0.9854	0.9022

b. SERIAL CORRELATION TEST SUCCESS (✓) OR FAILURE (×) SUMMARY

	DECK 1					DECK 2				
	Col 1	Col 2	Col 3	Col 4	Col 5	Col 1	Col 2	Col 3	Col 4	Col 5
LAG 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

5. CORRELATION TESTS

a. CORRELATION TEST RESULTS: Sample 1

	CLIENT GENERATED DATA							eCOGRA GENERATED DATA						
Range	0-33	0-36	0-51	0-66	0-99	0-500	0-999	0-33	0-36	0-51	0-66	0-99	0-500	0-999
LAG 1	0.5179	0.0034	0.1664	0.4556	0.7619	0.6983	0.3102	0.1258	0.1372	0.2529	0.8222	0.0503	0.2792	0.1749
LAG 2	0.8055	0.0106	0.3639	0.4978	0.0891	0.9038	0.3204	0.2303	0.0363	0.1938	0.9391	0.1435	0.1201	0.2610
LAG 3	0.9187	0.0148	0.5635	0.6340	0.1833	0.9104	0.4213	0.2455	0.0182	0.1899	0.9659	0.2741	0.2340	0.0664
LAG 4	0.9680	0.0037	0.5690	0.7120	0.2605	0.5067	0.5895	0.1893	0.0326	0.2978	0.9597	0.2258	0.3710	0.1026
LAG 5	0.8929	0.0057	0.4797	0.7578	0.2525	0.4688	0.5975	0.1889	0.0454	0.1274	0.8923	0.1238	0.3068	0.1316
LAG 6	0.6941	0.0116	0.5270	0.8140	0.1018	0.4766	0.1303	0.2722	0.0456	0.1460	0.9270	0.1471	0.2850	0.1634
LAG 7	0.6344	0.0210	0.5804	0.6901	0.1337	0.4393	0.1144	0.3687	0.0749	0.1979	0.6203	0.2003	0.2212	0.1553
LAG 8	0.5694	0.0332	0.6769	0.7526	0.1826	0.4590	0.1168	0.3944	0.0219	0.1802	0.4016	0.2613	0.2662	0.1964
LAG 9	0.4951	0.0531	0.7660	0.7838	0.2410	0.1702	0.0988	0.4682	0.0076	0.2445	0.4522	0.1909	0.3198	0.2203
LAG 10	0.5230	0.0662	0.4788	0.8399	0.2309	0.2289	0.0843	0.4825	0.0122	0.2980	0.4760	0.2582	0.4056	0.2667

b. CORRELATION TEST SUCCESS (✓) OR FAILURE (✗) SUMMARY

	CLIENT GENERATED DATA							eCOGRA GENERATED DATA						
Range	0-33	0-36	0-51	0-66	0-99	0-500	0-999	0-33	0-36	0-51	0-66	0-99	0-500	0-999
LAG 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LAG 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

4. CONCLUSION

Our test results for the RNG produced statistically acceptable random numbers that were free of any significant statistical bias or predictability. The results obtained from eCOGRA's testing confirm the random number generator operates in compliance with the applicable requirements of the regulations of highly regulated online gambling jurisdictions.

Project Approval:

A handwritten signature in black ink, appearing to read "Gary Lupton-Smith", written over a horizontal line.

Gary Lupton-Smith,
Technical Services Manager