



**eGAMING COMPLIANCE SERVICES LIMITED**

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**RANDOM NUMBER GENERATOR EVALUATION REPORT**

**FOR**

**RELAX GAMING LIMITED**

**CONFIDENTIAL**

**REPORT REFERENCE NUMBER: e211761RLXGBR**

**REPORT ISSUE DATE: 08 APRIL 2021**

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## TABLE OF CONTENTS

SECTION 1. GENERAL INFORMATION .....	4
SECTION 2. INTRODUCTION.....	5
SECTION 3. SOFTWARE DETAILS .....	6
SECTION 4. REVIEW FINDINGS .....	7
SCHEDULE 1. RNG TESTING.....	11
1. TESTS PERFORMED.....	11
2. TEST RESULTS .....	11
3. CONCLUSION .....	17

## SECTION 1. GENERAL INFORMATION

<b>CLIENT NAME:</b>	Relax Gaming Limited
<b>CLIENT ADDRESS:</b>	99 Chains Business Centre George Borg Olivier Street St. Julian's STJ 1080 Malta
<b>PRODUCT NAME:</b>	Random Number Generator (RNG)
<b>SUPPLIER:</b>	Relax Gaming Limited
<b>PRODUCT DESCRIPTION:</b>	Pseudo-random RNG
<b>PRODUCT VERSION:</b>	RNG 2.0
<b>RNG TYPE:</b>	Software
<b>JURISDICTION:</b>	Great Britain
<b>SCOPE OF TESTING:</b>	Remote Gambling and Software Technical Standards ("RTS") – February 2021, Level 1 testing against RTS 7A and 7B
<b>TESTING LABORATORY:</b>	eGaming Compliance Services Limited, trading as 'eCOGRA' 2/F Berkeley Square House, Berkeley Square, London, W1J 6 BD, United Kingdom
<b>TESTING LABORATORY ACCREDITATION:</b>	A UKAS accredited testing laboratory No. 4656 ISO/IEC 17025:2017, issued by the United Kingdom Accreditation Service (Issue No: 019, Issue Date: 01 March 2021).
<b>TEST ENGINEERS:</b>	Sphamandla Langa, Sikhumbuso Mzobe, Pooveshan Gounden
<b>TEST SUPERVISOR:</b>	Gary Lupton-Smith
<b>TESTING PERIOD:</b>	12 April 2019 - 29 April 2019
<b>CERTIFICATE DATE:</b>	08 April 2021
<b>CERTIFICATE NUMBER:</b>	e211761RLXGBR
<b>RESULT OF TESTING:</b>	Compliant (Refer to Test Results under Schedule 1)

I hereby certify that the abovementioned RNG complies with the requirements of RTS 7A and RTS 7B of the UKGC's Remote Gambling and Software Technical Standards – February 2021, as described in Section 4 of this report.

Gary Lupton-Smith



Technical Services Manager, eCOGRA

## SECTION 2. INTRODUCTION

eCOGRA has been appointed by Relax Gaming Limited to evaluate and certify the Random Number Generator product against compliance with the relevant Remote gambling and software technical standards – February 2021, and to highlight any exceptions identified during testing.

- RNG 2.0

This certification report highlights our key findings as a result of the evaluation conducted during the period 12 April to 29 April 2019.

Please note that no changes were made to the product or critical files. Numerous additional tests were however conducted and therefore this RNG certificate supersedes the certification for the RNG previously issued:

- Previous Certificate Number: 51243RGNUKC

### SECTION 3. 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:

#### RNG Components

File Name	Version Number	MD5
Rng.jar	2.0	5863170A231DB171413F2664B0DC2305

#### SECTION 4. REVIEW FINDINGS

The key findings of our evaluation of the RNG for compliance with the relevant sections of the Remote Gambling and Software Technical Standards – February 2021, are as follows:

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
<b>RTS 7 – Generation of random outcomes</b> <i>(Aim: To ensure that games and other virtual events operate fairly)</i>				
<b>RTS requirement 7A</b> Random number generation and game results must be ‘acceptably random’. Acceptably random here means that it is possible to demonstrate to a high degree of confidence that the output of the RNG, game, lottery and virtual event outcomes are random, through, for example, statistical analysis using generally accepted tests and	<b>RTS implementation guidance 7A</b> a. RNG’s should be capable of demonstrating the following qualities: i. the output from the RNG is uniformly distributed over the entire output range and game, lottery, or virtual event outcomes are distributed in accordance with the expected/theoretical probabilities ii. the output of the RNG, game, lottery, and virtual event outcomes should be unpredictable, for example, for a software RNG it should be computationally infeasible to predict what the next number will be	Refer to “1. Tests Performed” under “Schedule 1 – RNG Testing” below.	Compliant	

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
<p>methods of analysis. Adaptive behaviour (i.e. a compensated game) is not permitted.</p> <p>Where lotteries use the outcome of other events external to the lottery, to determine the result of the lottery (for example, using numbers from the National Lottery) the outcome must be unpredictable and externally verifiable.</p>	<p>without complete knowledge of the algorithm and seed value</p> <p>iii. random number generation does not reproduce the same output stream (cycle), and that two instances of a RNG do not produce the same stream as each other (synchronise)</p> <p>iv. any forms of seeding and re-seeding used do not introduce predictability</p> <p>v. any scaling applied to the output of the random number generator maintains the qualities above.</p> <p>c. For games or virtual events that use the laws of physics to generate the outcome of the game (mechanical RNGs), the mechanical RNG used should be capable of meeting the requirements in a. where applicable and in addition:</p> <p>i. the mechanical pieces should be constructed of materials to prevent decomposition of any component over time (e.g. a ball shall not disintegrate)</p>			

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
	ii. the properties of physical items used to choose the selection should not be altered iii. players should not have the ability to interact with, come into physical contact with, or manipulate the mechanics of the game. d. Restricting adaptive behaviour prohibits automatic or manual interventions that change the probabilities of game outcomes occurring during play. Restricting adaptive behaviour is not intended to prevent games from offering bonus or special features that implement a different set of rules, if they are based on the occurrence of random events.			
<b>RTS requirement 7B</b> As far as is reasonably possible, games and events must be implemented fairly and in accordance with the rules and prevailing payouts, where	<b>RTS implementation guidance 7B</b> a. Games should implement the rules as described in the rules available to the customer before play commenced. b. The mapping of the random inputs to game outcomes should be in accordance	Refer to individual game certification.	Compliant (as stipulated in individual game certifications)	

RTS Requirement	RTS Implementation Guidance	Testing Applied	Assessment	Comments
applicable, as they are described to the customer.	with prevailing probabilities, pay tables, etc. c. When random numbers, scaled or otherwise, are received, e.g. following a game requesting a sequence of random numbers, they are to be used in the order in which they are received. For example, they may not be discarded due to adaptive behaviour. d. Numbers or sequences of numbers are not to be discarded, unless they fall outside the expected range of numbers required by the virtual event – such an occurrence should result in an error being logged and investigated.			

## **SCHEDULE 1. RNG TESTING**

### **1. TESTS PERFORMED**

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

- Documentation;
- 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**

Numerous recognised statistical and mathematical tests were performed to certify the RNG operated in compliance with RTS 7A and RTS 7B of the Remote Gambling and Software Technical Standards – February 2021, including tests for probability (to ensure the expected 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 should pass the tests 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		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	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 (×) SUMMARY**

OUTPUT BASED TESTING				CLIENT GENERATED DATA			eCOGRA GENERATED DATA		
				Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3
Tests Number	Sample size	Test Range	DoF	P-value	P-value	P-value	P-value	P-value	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**

Range	CLIENT GENERATED DATA							eCOGRA GENERATED DATA						
	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**

Range	CLIENT GENERATED DATA							eCOGRA GENERATED DATA						
	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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

### **3. CONCLUSION**

Our test results together with the individual Level 3 game testing certifications produced statistically acceptable outcomes that were free of any significant statistical bias or predictability. Based on the testing conducted, the RNG is compliant with the requirements of RTS 7A and RTS 7B of the UKGC's Remote gambling and software technical standards – February 2021.