RGS EVALUATION TESTING REPORT

Compliance testing report

Item:

"RNG"

Reference regulation:

UK Gambling Commission – *Remote gambling and software Technical Standards*, February 2021

30/11/2022

ISO/IEC 17025 ACCREDITED TESTING N° 014 NAB- MALTA

QUINEL Ltd
M Space M3 – Zone 3, Central Business District – Triq L-Ghajn tan-Nofs – Birkirkara CBD 3060- Malta
info@quinel.com.mt

INTRODUCTION

The findings reported in this summary are the results of a broader set of documents and testing activities results archived in QUINEL Ltd's facilities. It is intended that the requester declares that:

- Any Hardware provided or described for analysis and testing is configured identically to hardware in commercial use
- Game software/ function provided for the testing and code review is declared by the customer to have the same behaviour to the software/code in commercial use
- Functionality made by the software in automatic test mode has a realistic behaviour

and that

- all the files and modules,
- the database schemas and all the specific programming resources,
- all the parameters contained into any databases and/or configuration file

that have been subject to the audit process guarantee the same behaviour of what is going to be published/deployed according to this audit results.

The Recipient, by accepting and using this Report, declares to be aware and accept unconditionally all the terms and conditions set forth. If the Applicant and / or the Recipient does not agree on the terms and conditions set forth, QUINEL Ltd reserves the right to cancel the certification provided with this Report, it follows therefore that the Recipient would have to immediately hand all copies of this Report to QUINEL Ltd and would not be able to use them.

Any copy of this compliance report must also include the page number and total number of pages.

A) Audit ID

J22112764_R001_RNG_REV.1

B) Reference regulation

UK Gambling Commission – *Remote gambling and software Technical Standards*, February 2021

C) Test methods

QISI001 – Software source inspection method
QIRT000 – RNG qualitative analysis
QIRT001 - Statistical analysis on scaled numbers in the range [0, 36]
QIRT002 - Statistical analysis on scaled numbers in the range [0, 51]
QIRT003 - Statistical analysis on float numbers in the range [0, 1)
QIRT004 - Statistical analysis on shuffled numbers
QIRT005 – DIEHARD battery of tests
QIRT006 – NIST battery of tests

D) Auditor / Test lab

QUINEL Ltd
M Space M3, Zone 3, Central Business District
Triq L-Ghajn tan-Nofs
Birkirkara CBD 3060 - Malta
info@quinel.com.mt

E) Audit subject / Scope

Description: Compliance of the following test items (games):

Test Item	*Item Name*	*Version*	*Interface*
R001	RNG	fortuna: 2.1 RandomProvider: 1.2 RandomProvider: 1.3 rng-management: 1.1	N.A

Receipt date:
17/11/2022 – first submission for testing against the regulation as per Section (B)

Inspection date:
21/11/2022 - 30/11/2022

F) Requester

Nolimit City Limited
63, Level 6 Tower Sixty3, Tower Road
SLM 1609 Sliema (Malta)
dragos@nolimitcity.com, per@nolimitcity.com

G) Owner/Producer of the system/software

Ref. to Section F)

H) Companies and organizations involved in the process

Producer(s): Ref. to Section G)

Requester: Ref. to Section F)

Licensee/Operator: N.A.

I) Individuals involved in the process

On the Requester side: Dragos Andreas Anton (Technical Compliance Analyst), Per Lindheimer (Product Owner)

On the Producer(s) / Integrator(s) side: same as for Requester

On the Licensee/Operator side: N.A.

J) Processes, rules and parameters of the games / Limitation of use

Refer to the Annex I for the full list of requirements satisfied.
Game / Test item type: **Random Number Generator**
Game / Test item use Jackpot: **N.A.**
Here follows the theoretical pay-out of the test item(s):

Test Item	*Test Item / Game name*	*Theor. RTP [%]*
R001	RNG	N.A.

K) Specifications of the gaming system

Type: software-based RNG
Programming language: Java 1.8

Description of the RNG:
The RNG is written entirely with Java and it is based on the Fortuna algorithm.
The RNG extends the Java standard *Random* library and overwrite the *next* method. Any scaling method, e.g., *nextInt* or *nextLong*, can be used from this implementation.

Security:
Fortuna algorithm is considered to be cryptographically strong.
See: https://www.schneier.com/academic/fortuna/

It is implemented a parallel background cycle which discards a random value from the Fortuna every *0* to *1000* milliseconds.

Refer to the Annex I for a full detailed list of requirements tested.
Refer to the Annex II for details related to RNG testing.

L) Security of the system

N.A.

M)Critical modules

Refer to section R)

N) Evaluation performed

The test evaluation, required by the Requester, was completed against the "UK Gambling Commission – *Remote gambling and software Technical Standards*, February 2021", to meet the requirements listed in the current "*Testing strategy for compliance with remote gambling and software technical standards*, February 2021".

Refer to the Annex I for a full detailed list of requirements tested.
Refer to the Annex II for details related to RNG testing.

O) Testing activities applied

Internal procedure followed:
Rif. "IOP 02-02 TEST METHODS".

P) Additional information

None

Q) Setup and application/system architecture

Refer to section K)

R) Product Tested

The tests were performed on the files listed below:

File name	*SHA1*	*Version*	*Critical*	*Test Item*
Rijndael.class	e36e48f393f0567ef48b9674f33f7c4787c365cb	2.1	Yes	R001
Fortuna.class	770ab27f22f92ef50a2be8487eb6922d95f61585	2.1	Yes	R001
Generator.class	dcca45b5572dd2a58e874cfc349acca4618592e9	2.1	Yes	R001
Dump.class	6fb8bab5c04fe557b538555c4228ee5ce83b052c	2.1	Yes	R001

File name	*SHA1*	*Version*	*Critical*	*Test Item*
ThreadTimeEntropySource.class	c9b74028eb833848903b21bb257004d6426e16ac	2.1	Yes	R001
MemoryPoolEntropySource.class	da22f35ddcd4f1f61a2230be9be125b44a318142	2.1	Yes	R001
FreeMemoryEntropySource.class	ee015dbc075d1a7ca1ec5183182242227d46c195	2.1	Yes	R001
BufferPoolEntropySource.class	ff7ed0a18ea8f099bccbdbaa0e436cb5129f4a15	2.1	Yes	R001
SchedulingEntropySource.class	a154a916a77e7d3018153cca1d1a344858feb386	2.1	Yes	R001
LoadAverageEntropySource.class	ef8f4e52d7ddc782aa7f3896a51a92778c4d5e54	2.1	Yes	R001
UptimeEntropySource.class	296ef2e47e36167bd07605d93e8e233ada59a214	2.1	Yes	R001
URandomEntropySource.class	2997a9ddab615739ee37b01f3ad8b495156c6317	2.1	Yes	R001
GarbageCollectorEntropySource.class	1a2138e7204bb79b48e12b736f35648c2ea4a24a	2.1	Yes	R001
Pool.class	dd9af082ebd7b5a8cec8c8e54ea850199aa3686c	2.1	Yes	R001
Util.class	638245cc0a9ce628d6a526de55e01d9e107d8028	2.1	Yes	R001
Counter.class	3ec7ccfddab3cb706aaaa871aad6cb049d1e63c7	2.1	Yes	R001
Encryption.class	ed0601596f5078925a86adb0830fbb6143003878	2.1	Yes	R001
EventAdder.class	414b95991d7f42316401f72c3b56940106cedc59	2.1	Yes	R001
Accumulator.class	59afa1aa2e0abb0bc728056f04dae9bb1d4effbc	2.1	Yes	R001
EventScheduler.class	f5efa7f3dc10b2c9ec4eb401ed992b9a9ae0dfac	2.1	Yes	R001
EntropySource.class	d3d8dfa2a895ab9027530025170f1f19963aaddc	2.1	Yes	R001
EventAdderImpl.class	714150e43d00f167be8a317f2d66bac15ff8724a	2.1	Yes	R001
PrefetchingSupplier.class	53a4ea99f7e489ab3c52cf9da0bef2ad9f355e18	2.1	Yes	R001
RandomDataBuffer.class	6e6a100d5cd8599820be17478c016df404c43bc9	2.1	Yes	R001
Fortuna$1.class	cbc33ac11ed7b90fd78d6ea49293dd65e4660098	2.1	Yes	R001
RandomProvider.class	1db38dcc032114f28dbce1b74d282602a67db7e5	1.2	Yes	R001
LoggingInvocationHandler.class	12282cc84f27d94e95cd9f08ecb3f2e6cbf52e50	1.3	Yes	R001
LoggingRandomProvider.class	41d976cef6a55b1a290d0dd726fa6b09461f8a68	1.3	Yes	R001
RandomCallLogger.class	03aa5a6f6aa8f57d060b397e4aaf82a9620a49e4	1.3	Yes	R001
RandomGeneratorWrapper.class	0c5ab2987ee8ea726d7067c05fd0a841b5ffe83d	1.3	Yes	R001
RNGHealthCheck$SegmentSupplier.class	c9b6a6e65332c93ba15d9bc8c0b0d315171aa71e	1.1	Yes	R001
RNGHealthCheck.class	052e3dd23756a7bbbf543acb311fd2023ff54b9d	1.1	Yes	R001
BackgroundCyclingRunnable.class	421b04aa190129fa08be58e68244f7d508a41923	1.1	Yes	R001

S) Report revisions

N.A.

T) CERTIFICATION

Job ID: J22112764_R001_RNG_REV.1
Date: 30/11/2022

Requester: Nolimit City Limited
63, Level 6 Tower Sixty3, Tower Road
SLM 1609 Sliema (Malta)

Total Number of Pages: **14**

QUINEL Ltd certifies that the game / test item identified at section E)

R001: **RNG**

complies with the "UK Gambling Commission – *Remote gambling and software Technical Standards*, February 2021" reference standard based on the current "*Testing strategy for compliance with remote gambling and software technical standards*, February 2021".

Refer to the Annex I for the full list of requirements satisfied.
Refer to the Annex II for details related to RNG testing.

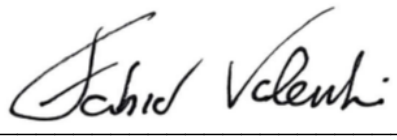
U) CONDITIONS

None.

V) CONCLUSIONS

QUINEL Ltd certifies that the item tested complies with the Technical Standards requested.

Date: 30/11/2022
Signed:



Fabio Valenti – Deputy Laboratory Manager
(QUINEL Ltd)

Isacco Ceci – CEO
(QUINEL Ltd)

ANNEX I – REQUIREMENTS SATISFIED

Definitions

Compensated games or events
Games or virtual events that adjust the likelihood of winning outcomes occurring based on previous payouts or intake. Sometimes referred to as adaptive behaviour or percentage compensation.
Easily accessible
This term generally means the facilities or information is either on the screen, or can be intuitively accessed via efficient navigation or other means
Game
A game of chance as defined in section 6(2) of the Act
Gambling
The Act defines gambling as: (a) gaming (within the meaning of sec.6) (b) betting (within the meaning of sec 9), and (c) participating in a lottery (within the meaning of sec. 14 and subject to sec 15)
Gaming session
A gaming session is the playing of any of the applicable activities (e.g. bingo or casino games) and commences when a player starts playing a game for real money. A gaming session ends when a player exits a game
High frequency lottery
A lottery in which any draw takes place less than one hour after a draw in a previous lottery promoted on behalf of the same non-commercial society or local authority or as part of the same multiple lottery scheme
Instant lottery
A lottery in which the draw takes place before any of the tickets in the lottery are offered for sale.
Lottery ticket
As described by section 253 of the Act and a reference in this document to a lottery ticket includes: • a lottery ticket which is sent by post following entry by means of remote communication • a message sent or displayed to a person electronically in a manner which enables him to (a) retain the message electronically or (b) print it.
Mapping
Is the process of selecting an outcome using the result from a Random Number Generator (RNG). For example, the result from a RNG is mapped to a reel strip symbol.
Peer-to-peer gambling
A type of gambling where customers gamble against each other rather than against the house. For example, equal chance gaming such as poker or peer-to-peer betting through betting exchanges.
Play-for-free
Also known as play-for-fun. Demonstration version of a real money game where the customer is not staking or winning any money or money's worth.
Progressive or progressive jackpot
An incremental prize that increases as a result of contributions from the monies staked within a game from pre-set base value.
Random Number Generator (RNG)
Refers to any item of hardware or software which is used to generate random numbers with the intended property of statistical randomness.
Restricted display device

A device such as a mobile phone which has limited space on which to display information, when used to access gambling facilities that the operator intends a customer to use by means of such a device. We expect that a player using a restricted display device would still have the ability to use all required responsible gambling tools, such as financial limits or self-exclusion. We would not consider it acceptable to require a player to login via, for example, the desktop website version of the gambling facilities in order to access responsible gambling tools. Such an approach would create unreasonable barriers and may deter or prevent mobile users from utilising the available tools.
Scaling
Scaling is the process used to convert the output from a RNG into the format required to produce a result for a particular gambling product. To illustrate, an RNG may produce a result of between 1 and 100,000 but these possible outcomes need to be scaled to the potential game outcomes of, for example, between 1 – 52 (i.e. to correspond to a standard pack of cards).
Seeding
Refers to the process used to determine the initial state of the RNG.
Slots
Casino games of a reel-based type (includes games that have non-traditional reels).
Subscription lottery
A series of lotteries (other than instant lotteries) promoted on behalf of the same non-commercial society or local authority in respect of which participants pay for participation in one or more future lotteries by regular subscription over a fixed or indefinite period.
Telephone gambling
Gambling which takes place via a telephone, without the use of visual displays, by interaction with a customer service agent or an automated system, such as intelligent voice recognition systems or touch tone.
Third Party Software
Refers to software that is separately available from the core software product and is designed to add optional features. It includes additional software, supplied, or used, by the gambling operator, or player, which wasn't part of the basic package.
Virtual
As described by s353(3) of the Act. Virtual event and virtual game are to be construed accordingly.

Unless differently specified, the results are related to all the test items.

Requirements			Result
RTS	**Aim**	**Req.**	**PASS / FAIL / N.A.**
RTS 1	To provide customers with easily accessible information about their current balances and facilities that enable them to review previous gambling and account transactions.	**A**	N.A.
		B	N.A.
		C	N.A.
RTS 2	To enable the customer to understand the value and content of their transactions.	**A**	N.A.
		B	N.A.
		C	N.A.
		D	N.A.
		E	N.A.
RTS 3	To enable customers to make informed decisions about whether to gamble based on their chances of winning, the way the game, lottery or event works, the prizes or payouts on offer and the current state of multi-state games or events.	**A**	N.A.
		B	N.A.
		C	N.A.
		D	N.A.
RTS 4	To reduce the risk that customers are unfairly disadvantaged by technical factors that may affect speed of response, and to ensure customers are made aware of the risk	**A**	N.A.
		B	N.A.
RTS 5	To ensure that the gambling system implements the operator's rules, game rules and betting rules as they are described to the customer.	**A**	N.A.
RTS 6	To minimise the risk that customers are misled about the likelihood of winning due to the behaviour of play-for-free games	**A**	N.A.
RTS 7	To ensure that games and other virtual events operate fairly.	**A**	PASS
		B	N.A.
		C	N.A.
		D	N.A.
		E	N.A.
RTS 8	To ensure that the customer is still in control of the gambling where auto-play functionality is provided and to minimise the risk that the functionality disadvantages a customer or that auto-play or other strategy advice is misleading.	**A**	N.A.
		B	N.A.
		C	N.A.
RTS 9	To ensure that progressive jackpot systems operate fairly	**A**	N.A.
		B	N.A.
RTS 10	To ensure that customers are treated fairly in the event of interrupted play or betting and that they are aware of how they will be treated if interruptions occur	**A**	N.A.
		B	N.A.
		C	N.A.
RTS 11	To reduce the risk that cheating or collusion by players unfairly disadvantages another player and to inform customers about the risks posed	**A**	N.A.
		B	N.A.

Requirements			Result
RTS	**Aim**	**Req.**	**PASS / FAIL / N.A.**
RTS 12	To provide customers with facilities that may assist them in sticking to their personal budgets for gambling with the operator. Customers must be also be given the option to set financial limits at an account level.	**A**	N.A.
		B	N.A.
RTS 13	To provide customers with facilities to assist them to keep track of the time they spend gambling.	**A**	N.A.
		B	N.A.
		C	N.A.
RTS 14	To ensure that products are designed responsibly and to minimise the likelihood that they exploit or encourage problem gambling behaviour.	**A**	N.A.
		B	N.A.
		C	N.A.
		D	N.A.
		E	N.A.
		F	N.A.
RTS 15	To make the customer aware that they may not have the latest information available when betting on live events, and that they may be at a disadvantage to operators or other customers who have more up-to-date information	**A**	N.A.
RTS 16	To make customers in peer-to-peer gambling aware that they may be gambling against a software program (designed to automatically participate in gambling within certain parameters, sometimes referred to as a bot), or a human aided by third party software.	**A**	N.A.
		B	N.A.
		C	N.A.
RTS 17	To ensure that live dealer operations are fair	**A**	N.A.

ANNEX II – RNG TEST DETAILS

A) Security

RNG output is used immediately and not stored in memory. Fortuna instances are shared among all games. It is implemented a parallel background cycle which discards a random value from the Fortuna every *0* to *1000* milliseconds.

B) Testing results for raw output of RNG

Confidence level: 95% and 99%

1) Data sets of 3.500.000 outcomes each of raw 32-bit integers

DIEHARD battery of tests

Overall results: POSITIVE

Test results:

BIRTHDAY SPACINGS TEST:	PASS
OVERLAPPING 5-PERMUTATION TEST:	PASS
BINARY RANK TEST for 31x31M:	PASS
BINARY RANK TEST for 32x32M:	PASS
BINARY RANK TEST for 6x8M:	PASS
BITSTREAM TEST:	PASS
OPSO, OQSO and DNA TESTS:	PASS
COUNT-THE-1's TEST (stream):	PASS
COUNT-THE-1's TEST (specific):	PASS
PARKING LOT TEST:	PASS
MINIMUM DISTANCE TEST:	PASS
3DSPHERES TEST:	PASS
SQEEZE TEST:	PASS
OVERLAPPING SUMS TEST:	PASS
RUNS TEST:	PASS
CRAPS TEST:	PASS

NIST battery of tests:

Overall results: POSITIVE

Test results:

FREQUENCY:	PASS
BLOCK FREQUENCY:	PASS
CUMULATIVE SUM:	PASS
RUNS:	PASS
LONGEST RUN:	PASS
RANK:	PASS
FFT:	PASS

NONOVERLAPPING TEMPLATE:	PASS
OVERLAPPING TEMPLATE:	PASS
UNIVERSAL:	PASS
APPROXIMATE ENTROPY:	PASS
RANDOM EXCURSIONS:	PASS
RANDOM EXCURSIONS VARIANT:	PASS
SERIAL:	PASS
LINEAR COMPLEXITY:	PASS

C) Testing results for scaled data

Confidence level: 95% and 99%

1) Data sets of 300.000 integer outcomes each in the range [0,36] (included)
2) Data sets of 300.000 integer outcomes each in the range [0,51] (included)

Overall results: POSITIVE

Test results:

RUNS TESTS:	PASS
FREQUENCY TESTS:	PASS
SERIAL CORRELATION TESTS:	PASS
COUPLES TESTS:	PASS

D) Testing results for float data

Confidence level: 95% and 99%

1) Data sets of 300.000 float outcomes each in the range [0,1] (included)

Overall results: POSITIVE

Test results:

GAP TESTS:	PASS
FREQUENCY TESTS:	PASS
SERIAL TESTS:	PASS
POKER TESTS:	PASS
ORDER TESTS:	PASS

E) Testing results for shuffled decks data

Confidence level: 95% and 99%

1) Data sets of 150.000 of shuffled decks with cards in the range [0,51] (included)

Overall results: POSITIVE

Test results:

FREQUENCY TESTS (for position):	PASS
FREQUENCY TESTS (for card value):	PASS
SERIAL CORRELATION TESTS:	PASS
DISTANCE TESTS:	PASS
RECIPROCAL POSITION TESTS:	PASS
SEQUENCE LENGTH TESTS:	PASS

END
OF
COMPLIANCE
REPORT