GLI®

World Headquarters
600 Airport Road
Lakewood, NJ 08701
Phone (732) 942-3999
Fax (732) 942-0043
www.gaminglabs.com

November 16, 2016

Hastings International B.V
New Haven Office Center
Emancipatie Boulevard 31
P.O. Box 6052
Curacao, Dutch Caribbean

RE: Random Number Generator Report (**Gaming Laboratories International, LLC** Proposal # VN-HAI-01-01-131023 dated October 23, 2013)

Dear Ms. Annesol Melaria:

Enclosed, please find a detailed explanation of the Random Number Generator (RNG) testing results of the Realtime Gaming (RTG) RNG version 1.0.0.2, submitted by Hastings International B.V. on behalf of Realtime, for use with standard card games for GLI-19 - Interactive Gaming Systems v2.0.

If you should have any questions regarding this Random Number Generator Report, please feel free to contact our office.

Sincerely,

Ms. Mavis Chan
Technical Group Supervisor
GAMING LABORATORIES INTERNATIONAL, LLC

ENCLOSURES

RN-120-HAI-13-01

ko

Worldwide Locations

World Headquarters
Lakewood, New Jersey

U.S. Regional Offices
Colorado
Nevada

International Offices
GLI Africa
GLI Asia
GLI Australia Pty Ltd
GLI Austria GmbH
GLI Europe BV
GLI Italy
GLI South America

RANDOMNESS REPORT FOR THE REALTIME GAMING RNG VERSION 1.0.0.2

The intent of this report is to indicate that **Gaming Laboratories International**, **LLC** (GLI) has completed its evaluation of the Realtime Gaming (RTG) random number generator (RNG), version 1.0.0.2, provided by Hastings International B.V. (Hastings).

SECTION I – SCOPE OF TESTING

On behalf of Realtime Gaming, Hastings submitted the required materials, to GLI in order to conduct a random number generator analysis on the Realtime Gaming RNG version 1.0.0.2. The scope of this analysis was limited to software verification and source code review. The data analysis results from previous testing have been leveraged for this evaluation and the results are detailed herein. The RNG was tested for its ability to randomly produce outcomes for use with standard card games.

SECTION II – SOFTWARE VERIFICATION

During the analysis there were digital signatures taken of the compiled key RNG files provided. The GLI Verify® (Version 6.0) signatures are as follows:

File	Version	Type	Signature
RNG.dll	1.0.0.2	CDCK	ED39
		SHA-1	F184C6F1D9EA36491ADDA383FA8166FF44061653
		SHA-256	739FC8ED30D147BBF30EA8036E30F7BB97F2216982757047F889CE2D59261DA6
		MD5	FEA6223F2002D8C3DA6E27A54ADF1A60

Table 1. Digital Signatures

SECTION III – SOURCE CODE REVIEW

On behalf of Realtime Gaming, Hastings submitted appropriate documentation and full source code which pertains to the generation of random numbers. GLI reviewed the source code provided by tracing the path of the RNG application from the initiation of the draw to the selected output of random numbers. GLI inspected the source code, where practicable, in an attempt to find any undisclosed switches or parameters having a possible influence on randomness and fair play. GLI assessed the ability of the RNG to produce all numbers within the desired range.

Please note that the R250 algorithm implemented is not cryptographically strong on its own, however when used in conjunction with the seeding, background cycling, scaling, and other random burning of numbers by the system this results in a strong enough implementation for generation of random values for the data parameters detailed within the scope of this project.

SECTION IV – DATA ANALYSIS

The game configuration and parameters for the data previously obtained and tested are listed in Table 2 and have been carried over from previous testing. A complete listing of the individual tests applied to each data set can be found in Appendix A.

Data Set	Range
Standard Card Games	0-51
Binary Data	0-1

Table 2. Game Parameters

Three Binary Data sets were collected and analyzed for application of the DieHard Suite of Tests.

For a summary of the statistical tests applied to each data set, see *Appendix A*. For a description of the overall test methodology and a description of each test used, see *Appendix B*. The statistical testing was applied at the 95%, 98%, and 99% confidence levels.

Overall, the RNG passed the battery of tests for each configuration at the confidence levels applied.

SECTION V - SUMMARY

Overall Evaluation of the Random Number Generator

GLI's conclusion based upon the tests applied to the Realtime Gaming RNG version 1.0.0.2 data is that this random number generator has exhibited random behavior and is suitable for the applications as described herein. If a game utilizes a different range or a different number of selections from the included ranges, the RNG should be resubmitted to test that set of parameters.

Terms and Conditions:

This Report is issued solely for the benefit of the Client for use only for and limited to the specific jurisdiction or standards referenced in the Report. This Report may not be relied upon for any reason by any person or entity other than the Client including, but not necessarily limited to, the manufacturer or developer of the items, a non-GLI Laboratory, or a Regulator not named in the Report ("a Third Party").

Any report produced by GLI is proprietary to GLI and the Client, because it contains confidential information of commercial value, the exposure of which to third parties could adversely affect both GLI and the Client. Accordingly, such confidential information is supplied in confidence, on the strict condition that no part of it will be reprinted or reproduced or transmitted to any parties external to the original contract without the prior written approval of the Parties. In particular, it will not be exposed to any person or organization which may be in competition with any of the Parties without the prior written approval of that Party. The testing performed by GLI is proprietary to GLI and/or various regulators. No third party may use, rely or refer to a GLI evaluation report, test report, certification document or test results without written permission of GLI and the respective regulator. Notwithstanding the above, the Parties may disclose confidential information if required to do so by regulatory agencies, pursuant to the laws and regulations of an applicable jurisdiction or by an order of a properly designated Court of Law in a relevant jurisdiction. However, in either case the Parties agree to immediately notify the other party of such a request.

Notwithstanding the above, any regulator may reprint, reproduce and transmit any document or information to any party that the regulator, in their sole discretion, deems appropriate.

The certification or analysis results established by this report applies exclusively to tests conducted, using current and retrospective methods developed by GLI Test Labs, on the specific items submitted, by the manufacturer or any other party, which are described on page one of this report. It is the responsibility of the manufacturer and/or developer of the items submitted to apply for, obtain and maintain all necessary gaming licensure in each jurisdiction in which they do business, including state and tribal jurisdictions, where applicable. Any electrostatic test methods used by GLI Test Labs are intended only to simulate techniques observed in the field being used to attempt to disrupt the integrity of Electronic Gaming Devices. During the course of the testing, GLI Test Labs checks for marks, symbols or documents indicating that a device has undergone product safety or RoHS compliance testing, if required. GLI Test Labs also performs a cursory review of information accompanying the items submitted, where possible and when provided, for evidence that the items have undergone compliance testing for Electromagnetic Interference (EMI), Radio Frequency Interference (RFI), Magnetic Interference, Liquid Spills, Power Fluctuations, Electrostatic Immunity, Electromagnetic Compatibility and Environmental conditions. Compliance with any such regulations related to the aforementioned testing is the sole responsibility of the manufacturer and/or developer of the items submitted; GLI Test Labs accepts no responsibility, makes no representations and disclaims any liability with respect to all such non-gaming testing. Details of the testing methods used, excluded testing, and actual data showing the testing results are available to the Recipient(s) upon written request.

GLI TEST LABS WARRANTS TO THE RECIPIENT THAT ALL SERVICES PROVIDED BY GLI TEST LABS HEREUNDER HAVE BEEN PERFORMED IN ACCORDANCE WITH ESTABLISHED AND RECOGNIZED TESTING PROCEDURES AND WITH REASONABLE CARE IN ACCORDANCE WITH APPLICABLE LAWS. GLI TEST LABS DOES NOT MAKE, AND EXPRESSLY DISCLAIMS, ALL OTHER WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, SUITABILITY OR FITNESS FOR A PARTICULAR PURPOSE. WITHOUT LIMITING ANY OF THE FOREGOING, UNDER NO CIRCUMSTANCES SHOULD THE CERTIFICATION OR ANALYSIS RESULTS ESTABLISHED BY THIS REPORT BE CONSTRUED TO IMPLY ANY ENDORSEMENT OR WARRANTY REGARDING THE FUNCTIONALITY, QUALITY OR PERFORMANCE OF THE SUBJECT HARDWARE OR SOFTWARE, AND NO PERSON OR PARTY SHALL STATE OR IMPLY ANYTHING TO THE CONTRARY. THE LIABILITY AND OBLIGATIONS OF GLI TEST LABS HEREUNDER, AND THE REMEDY OF THE RECIPIENT, UNDER OR IN CONNECTION WITH THIS AGREEMENT SHALL BE LIMITED TO, AT GLI TEST LAB'S OPTION, REPLACEMENT OF THE SERVICES PROVIDED OR THE REFUND BY GLI TEST LABS OF ANY MONIES RECEIVED BY IT FOR THE SERVICES PROVIDED. IN NO EVENT SHALL GLI TET LABS BE RESPONSIBLE TO THE RECIPIENT OR ANY THIRD PARTY FOR ANY CONSEQUENTIAL, INCIDENTAL, DIRECT, INDIRECT OR SPECIAL DAMAGES, INCLUDING WITHOUT LIMITATION DAMAGES FOR LOST PROFITS OR REVENUE, BUSINESS INTERRUPTION, OR PUNITIVE DAMAGES, EVEN IF GLI TEST LABS HAD BEEN ADVISED OF THE POTENTIAL FOR SUCH DAMAGES AND WHETHER SUCH DAMAGES ARISE IN CONTRACT, NEGLIGENCE, TORT, UNDER STATUTE, IN EQUITY, AT LAW OR OTHERWISE. ALL RIGHTS AND REMEDIES OF THIRD PARTIES RELATING TO PRODUCTS AND SERVICES THAT ARE THE SUBJECT OF THE CERTIFICATION OR ANALYSIS RESULTS ESTABLISHED BY THIS REPORT SHALL BE THE EXCLUSIVE RESPONSIBILITY OF THE RECIPIENT AND GLI TEST LABS EXPRESSLY DISCLAIMS ANY LIABILITY WHATSOEVER IN CONNECTION WITH SUCH THIRD PARTY RIGHTS AND REMEDIES. GLI TEST LABS AND THE RECIPIENT ACKNOWLEDGE AND AGREE THAT THE SERVICES PROVIDED BY GLI TEST LABS HEREUNDER COULD NOT BE RENDERED BY GLI TEST LABS UNDER THE TERMS PROVIDED HEREIN WITHOUT AN INCREASE IN COST IF GLI TEST LABS WAS REQUIRED TO PROVIDE ANY WARRANTIES IN ADDITION TO, OR IN LIEU OF, OR WAS REQUIRED TO ASSUME ANY LIABILITY IN EXCESS OF, THE FOREGOING.

APPENDIX A: Statistical Test Summary

Data Set	Range	Tests Names: Successive Pairs	Coupon	Tot. Dist.	DieHard
Standard Card Games	0-51	X	X	X	
Binary Data	0-1				X

Table A-1. Tests Applied

APPENDIX B: Test Descriptions

B.1 **Definitions.** The following terms apply to the below test descriptions. RNG output is often collected multiple numbers at a time. Each set of numbers is called a draw. Each individual number has a particular order within the *draw*. This is referred to as the number *position*.

B.2 **Distribution Comparisons.** Many of the tests compare an observed numerical distribution with an expected distribution. Unless otherwise specified, this is done by means of a statistical chi-square goodness-of-fit test. The value chi-square is computed in the standard way. If k is a possible value, o_k is the observed count of that value, and e_k is the expected count:

$$\chi^2 = \sum_k \frac{(o_k - e_k)^2}{e_k}$$

In the case where expected counts are too small for accurate use of the above formula, values are 'binned' together to ensure an appropriate minimum expected count. The resultant value for chi-square is compared against the distribution for the appropriate number of degrees of freedom. Unusually high (distribution mismatch) or unusually low (insufficient randomness) chi-square values can be causes for data failure.

B.3 **Meta-testing**. Evaluation of groups of *p*-values may include a meta-test for extremity of high or low *p*-values, a meta-test for frequency of high or low *p*-values, and a meta-test for uniformity of *p*-values, as appropriate.

B.4 **Confidence Level**. The statistical tests conducted by GLI are done at a particular *confidence level*. Common confidence levels used include 95%, 98%, and 99%, depending on jurisdictional requirements, and intended use of the RNG. High confidence level testing has low risk of mistakenly failing a good RNG, but higher risk of passing a bad RNG. Lower confidence level testing has increased power of detecting bad RNGs, while also increasing the risk of false failures of good RNGs. Specifically, the confidence level represents the probability that an ideal source of randomness would pass the testing. If an RNG passes statistical tests at a given confidence level, passage at all *higher* confidence levels is implied.

B.5 **Tests**. Some tests are only applicable to certain types of data. Some tests may be applied only to a portion of the data. Some tests may require that the data be parsed, binned, or otherwise transformed, as necessitated by data format.

Coupon Collector's:

The Coupon Collector's Test is applied positionally. The data is parsed until all possible values have been observed, then the number of values checked is recorded and the count is restarted. This is compared with the expected distribution.

For example, if the set of all possible values is $\{0, 1, 2\}$ and the first position of each draw is

$$1, 0, 1, 0, 2, 0, 1, 2, \ldots,$$

then all values are observed in the first position by the fifth draw. All values are then observed within the next 3 draws, so the first two statistics for the first position would be 5 and 3.

DieHard:

The DieHard Battery of Tests is a standard assessment of the randomness in raw outcomes generated from an RNG. The collection, designed by George Marsaglia, tests for a variety of patterns in the individual binary bits of RNG output. GLI uses a custom implementation to conduct DieHard testing.

Successive Pairs:

The Successive Pairs Test tallies the observed occurrences of each of the possible successive pairs values and compares them against the expected distribution.

Total Distribution:

The Total Distribution Test is a simple tally of all observed values throughout the data. This is compared with the expected distribution. Typically the expected distribution is a uniform distribution. In the case of unequal weighting of values, an appropriate discrete distribution is used.