

HACKEN

SMART CONTRACT CODE REVIEW AND SECURITY ANALYSIS REPORT

Customer: BEEHIVE INNOVATION PTE.LTD.

Date: September 27th, 2021

This document may contain confidential information about IT systems and the intellectual property of the Customer as well as information about potential vulnerabilities and methods of their exploitation.

The report containing confidential information can be used internally by the Customer, or it can be disclosed publicly after all vulnerabilities are fixed – upon a decision of the Customer.

Document

| | |
|--------------------------------|---|
| Name | Smart Contract Code Review and Security Analysis Report for BEEHIVE INNOVATION PTE.LTD. |
| Approved by | Andrew Matiukhin CTO Hacken OU |
| Type | Balancer |
| Platform | Ethereum / Solidity |
| Methods | Architecture Review, Functional Testing, Computer-Aided Verification, Manual Review |
| Repository | https://github.com/beehive-innovation/rain-protocol |
| Commit | 0a05312f706bfaf9458277516b0a13cba31cefcd |
| Technical Documentation | YES |
| JS tests | YES |
| Timeline | 22 JULY 2021 - 27 SEPTEMBER 2021 |
| Changelog | 30 JULY 2021 - INITIAL AUDIT 06 AUGUST 2021 - SECOND REVIEW 27 SEPTEMBER 2021 - THIRD REVIEW |



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Introduction

Hacken OÜ (Consultant) was contracted by BEEHIVE INNOVATION PTE.LTD. (Customer) to conduct a Smart Contract Code Review and Security Analysis. This report presents the findings of the security assessment of the Customer's smart contract and its code review conducted between July 22nd, 2021 - July 30th, 2021. The second code review conducted on August 6th, 2021. The third code review conducted on September 27th, 2021.

Scope

The scope of the project is smart contracts in the zip archive:

Repository:

<https://github.com/beehive-innovation/rain-protocol>

Commit:

[0a05312f706bfaf9458277516b0a13cba31cefcd](#)

Technical Documentation: Yes

JS tests: Yes

Contracts:

[Cooldown.sol](#)

[Phased.sol](#)

[RedeemableERC20.sol](#)

[RedeemableERC20Pool.sol](#)

[SeedERC20.sol](#)

[Trust.sol](#)

We have scanned this smart contract for commonly known and more specific vulnerabilities. Here are some of the commonly known vulnerabilities that are considered:

| Category | Check Item |
|-------------|---|
| Code review | <ul style="list-style-type: none">▪ Reentrancy▪ Ownership Takeover▪ Timestamp Dependence▪ Gas Limit and Loops▪ DoS with (Unexpected) Throw▪ DoS with Block Gas Limit▪ Transaction-Ordering Dependence▪ Style guide violation▪ Costly Loop▪ ERC20 API violation▪ Unchecked external call▪ Unchecked math▪ Unsafe type inference▪ Implicit visibility level▪ Deployment Consistency▪ Repository Consistency▪ Data Consistency |

| | |
|-------------------|---|
| Functional review | <ul style="list-style-type: none"> ▪ Business Logics Review ▪ Functionality Checks ▪ Access Control & Authorization ▪ Escrow manipulation ▪ Token Supply manipulation ▪ Assets integrity ▪ User Balances manipulation ▪ Data Consistency manipulation ▪ Kill-Switch Mechanism ▪ Operation Trails & Event Generation |
|-------------------|---|

Executive Summary

According to the assessment, the Customer's smart contracts are well-secured.



Our team performed an analysis of code functionality, manual audit, and automated checks with Mythril and Slither. All issues found during automated analysis were manually reviewed, and important vulnerabilities are presented in the Audit overview section. All found issues can be found in the Audit overview section.

As a result of the audit, security engineers found 2 low severity issues which were addressed before the second review.

After the second review security engineers found all issues were resolved.

After the third review security engineers found a new function added together with two immutable state variables. No new issues were detected.



Severity Definitions

| Risk Level | Description |
|-----------------|---|
| Critical | Critical vulnerabilities are usually straightforward to exploit and can lead to assets loss or data manipulations. |
| High | High-level vulnerabilities are difficult to exploit; however, they also have a significant impact on smart contract execution, e.g., public access to crucial functions |
| Medium | Medium-level vulnerabilities are important to fix; however, they can't lead to assets loss or data manipulations. |
| Low | Low-level vulnerabilities are mostly related to outdated, unused, etc. code snippets that can't have a significant impact on execution |



Audit overview

■ ■ ■ ■ Critical

No critical issues were found.

■ ■ ■ High

No high severity issues were found.

■ ■ Medium

No medium severity issues were found.

■ Low

1. Issue: Maximum line length.

Solidity declares [maximum line length](#) that should be followed.

Recommendation: Please follow the solidity [Code Layout recommendations](#).

Fixed before the second review

2. Issue: State variable that could be immutable.

State variable which value is initialized in the constructor and never changes should be declared immutable to save gas.

Fixed before the second review



Conclusion

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools.

The audit report contains all found security vulnerabilities and other issues in the reviewed code.

As a result of the audit, security engineers found **2** low severity issues which were addressed before the second review.

After the second review security engineers found all issues were resolved.

After the third review security engineers found a new function added together with two immutable state variables. No new issues were detected.



Disclaimers

Hacken Disclaimer

The smart contracts given for audit have been analyzed in accordance with the best industry practices at the date of this report, in relation to cybersecurity vulnerabilities and issues in smart contract source code, the details of which are disclosed in this report (Source Code); the Source Code compilation, deployment, and functionality (performing the intended functions).

The audit makes no statements or warranties on the security of the code. It also cannot be considered as a sufficient assessment regarding the utility and safety of the code, bug-free status, or any other statements of the contract. While we have done our best in conducting the analysis and producing this report, it is important to note that you should not rely on this report only – we recommend proceeding with several independent audits and a public bug bounty program to ensure the security of smart contracts.

Technical Disclaimer

Smart contracts are deployed and executed on a blockchain platform. The platform, its programming language, and other software related to the smart contract can have vulnerabilities that can lead to hacks. Thus, the audit can't guarantee the explicit security of the audited smart contracts.