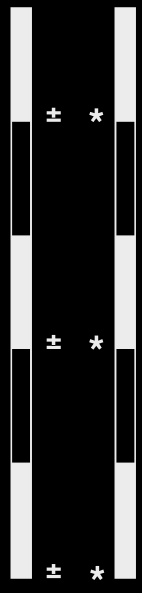
VERILOG

2024

MANTLE STAKING HUB: SECURITY REVIEW REPORT



Apr 3, 2024

Contents

1 | Introduction

Figure 1.1: Mantle Staking Hub Report Cover

This report presents our engineering engagement with the Mantle team on the development of their staking hub - Mantle Staking Hub.

Project Name	**Mantle Staking Hub**
Repository Link	https://github.com/mantle-xyz/staking-hub
First Commit Hash	First: 4e7cb82;
Final Commit Hash	Final: 381d1a8;
Language	Solidity
Chain	Mantle

2 | About Verilog Solutions

Founded by a group of cryptography researchers and smart contract engineers in North America, Verilog Solutions elevates the security standards for Web3 ecosystems by being a full-stack Web3 security firm covering smart contract security, consensus security, and operational security for Web3 projects.
Verilog Solutions team works closely with major ecosystems and Web3 projects and applies a quality-above-quantity approach with a continuous security model. Verilog Solutions onboards the best and most innovative projects and provides the best-in-class advisory services on security needs, including on-chain and off-chain components.

3 | Service Scope

3.1 | Service Stages

Our auditing service includes the following two stages:

- Smart Contract Auditing Service

3.1.1 | Smart Contract Auditing Service

The Verilog Solutions team analyzed the entire project using a detailed-oriented approach to capture the fundamental logic and suggested improvements to the existing code. Details can be found under Findings And Improvement Suggestions.

3.2 | Methodology

- **Code Assessment**
  - We evaluate the overall quality of the code and comments as well as the architecture of the repository.
  - We help the project dev team improve the overall quality of the repository by providing suggestions on refactorization to follow the best practices of Web3 software engineering.
- **Code Logic Analysis**
  - We dive into the data structures and algorithms in the repository and provide suggestions to improve the data structures and algorithms for the lower time and space complexities.
  - We analyze the hierarchy among multiple modules and the relations among the source code files in the repository and provide suggestions to improve the code architecture with better readability, reusability, and extensibility.
- **Business Logic Analysis**
  - We study the technical whitepaper and other documents of the project and compare its specifications with the functionality implemented in the code for any potential mismatch between them.
  - We analyze the risks and potential vulnerabilities in the business logic and make suggestions to improve the robustness of the project.
- **Access Control Analysis**
  - We perform a comprehensive assessment of the special roles of the project, including their authorities and privileges.
  - We provide suggestions regarding the best practice of privilege role management according to the standard operating procedures (SOP).
- **Off-Chain Components Analysis**
  - We analyze the off-chain modules that are interacting with the on-chain functionalities and provide suggestions according to the SOP.
  - We conduct a comprehensive investigation for potential risks and hacks that may happen on the off-chain components and provide suggestions for patches.

3.3 | Audit Scope

Our auditing for Mantle Staking Hub covered the Solidity smart contracts under the folder 'src' in the repository (https://github.com/mantle-xyz/staking-hub) with commit hash **4e7cb82**.

4 | Findings and Improvement Suggestions

Severity	Total	Acknowledged	Resolved
High	0	0	0
Medium	1	1	1
Low	1	1	1
Informational	1	1	1

4.1 | Medium

4.1.1 | The `previewWithdraw()` should be used to calculate shares to burn rather than `previewDeposit()`

Severity	Low
Source	src/MNTStaking.sol#L579;
Commit	4e7cb82;
Status	Resolved in commit 4b12fe8;

- **Description**
  The `MNTStaking._unstake()` calculates the number of shares to burn with `previewDeposit()`. It should use `previewWithdraw()` instead.
  `previewDeposit()` rounds numbers down and `previewWithdraw()` rounds numbers up. The amount should be rounded up when calculating the amount of shares to burn. Rounding down would have some small amount of shares left unburned. With round down, attackers could intentionally stake and unstake to accumulate the small shares and finally burn the shares to withdraw the underlying assets with zero cost.

```
  /** @dev See {IERC4626-previewDeposit}. */
nction previewDeposit(uint256 assets) public view virtual override returns (uint256) {
  return _convertToShares(assets, MathUpgradeable.Rounding.Down);

* @dev See {IERC4626-previewWithdraw}. */
nction previewWithdraw(uint256 assets) public view virtual override returns (uint256) {
  return _convertToShares(assets, MathUpgradeable.Rounding.Up);
```

- **Exploit Scenario**
  N/A.
- **Recommendations**
  Use `previewWithdraw()` to calculate the number of shares to burn in `MNTStaking._unstake()`.
- **Results**
  Resolved in commit eff13ff. The `AllocateUnits.sol` contract has been simplified to an ERC20 contract.

4.2 | Low

4.2.1 | The `_isContract()` does not work properly sometimes

Severity	Low
Source	src/AllocateUnits.sol#L162-L182;
Commit	4e7cb82;
Status	Resolved in commit eff13ff;

- **Description**
  The `_isContract()` check used in `_checkSenderAndReceiverIsLegal()` does not guarantee an address is an EOA. It only checks if the address's code size is zero or not at the time of checking. The address could still be a contract address if the function is called in construction or someone deploys a contract at this address using `create2()` later
- **Exploit Scenario**
  N/A.
- **Recommendations**
  The check does not work reliably 100% of the time. Avoid relying on this check for essential functionality.
- **Results**
  Resolved in commit eff13ff. The `_checkSenderAndReceiverIsLegal()` function now checks if the address is a registered tranche address or staker address.

4.3 | Informational

4.3.1 | The name of the `uint256` parameter in `AllocateUnits.burn()` should be `_shares` instead of `_amount`

Severity	Low
Source	src/AllocateUnits.sol#L157-L160;
Commit	4e7cb82;
Status	Resolved in commit 4b12fe8;

- **Description**
  The `burn()` function burns the shares. Thus, the name of the `uint256` parameter in `AllocateUnits.burn()` should be `_shares` instead of `_amount`.

- **Recommendations**
  Change the parameter name from `_amount` to `_shares`.

```
function burn(address _owner, uint256 _shares) public onlyRole(BURNER_ROLE) returns (uint256)
    _burn(_owner, _shares);
    return _shares;
}
```

- **Results**
  Resolved in commit 4b12fe8.

5 | Notes and Additional Information

5.1 | Privileged Roles

- Privileged roles can mint/burn AllocateUnits directly.

  Privileged roles can be added by admin to mint/burn AllocateUnits directly. We should only add `MNTStaking` contract as the MINTER and BURNER role.

6 | Appendix

6.1 | Appendix I: Severity Categories

Severity	Description
High	Issues that are highly exploitable security vulnerabilities. It may cause direct loss of funds / permanent freezing of funds. All high severity issues should be resolved.
Medium	Issues that are only exploitable under some conditions or with some privileged access to the system. Users' yields/rewards/information is at risk. All medium severity issues should be resolved unless there is a clear reason not to.
Low	Issues that are low risk. Not fixing those issues will not result in the failure of the system. A fix on low severity issues is recommended but subject to the clients' decisions.
Information	Issues that pose no risk to the system and are related to the security best practices. Not fixing those issues will not result in the failure of the system. A fix on informational issues or adoption of those security best practices-related suggestions is recommended but subject to clients' decision.

6.2 | Appendix II: Status Categories

Severity	Description
Unresolved	The issue is not acknowledged and not resolved.
Partially Resolved	The issue has been partially resolved
Acknowledged	The Finding / Suggestion is acknowledged but not fixed / not implemented.
Resolved	The issue has been sufficiently resolved

7 | Disclaimer

Verilog Solutions receives compensation from one or more clients for performing the smart contract and auditing analysis contained in these reports. The report created is solely for Clients and published with their consent. As such, the scope of our audit is limited to a review of code, and only the code we note as being within the scope of our audit is detailed in this report. It is important to note that the Solidity code itself presents unique and unquantifiable risks since the Solidity language itself remains under current development and is subject to unknown risks and flaws. Our sole goal is to help reduce the attack vectors and the high level of variance associated with utilizing new and consistently changing technologies. Thus, Verilog Solutions in no way claims any guarantee of security or functionality of the technology we agree to analyze.

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