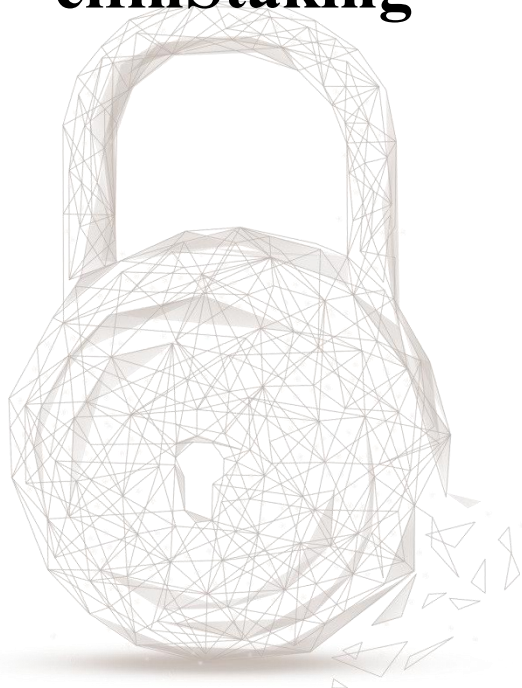




Smart Contract Audit Report

for

elfinStaking





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Blockchain Security

Audit Number: 202112151804

Contract Name: elfinStaking

Deployment Platform: Binance Smart Chain

Contract Address:

<https://testnet.bscscan.com/address/0x71849967498b36e20d89e79fe9e526e469497c14#code> (old)

<https://bscscan.com/address/0xeca6f5cefc7c033d036c5a3a687a7c80f2975bf9#contracts> (latest)

Audit Start Date: 2021.12.13

Audit Completion Date: 2021.12.15

Audit Update Date: 2021.12.16

Update Info: Update on chain address

Audit Result: Pass

Audit Team: Beosin Technology Co. Ltd.

Audit Results Overview

Beosin Technology has used several methods including Formal Verification, Static Analysis, Typical Case Testing and Manual Review to audit three major aspects of elfinStaking smart contracts, including Coding Conventions, General Vulnerability and Business Security. **After auditing, the elfinStaking contract was found to have 3 high risk items. As of the completion of the audit, all risk items have been fixed or properly handled. The overall result of the elfinStaking smart contract is Pass.** The following is the detailed audit information for this project.

Index	Risk items	Risk level	Fix results status
Stake-1	Excessive administrator privileges	High	Fixed
Stake-2	Bonus calculations may result in a loss of principal to the user	High	Fixed
Stake-3	Re-entry risk	High	Fixed

Table 1. Key Audit Findings

Risk Descriptions and Fix Results

[Stake-1 High] Excessive administrator privileges

Description: Cmo of the contract can withdraw the BNB in the contract at will and change the staking period, which may result in the user's principal not being withdrawn.

```
function withdrawBnb(uint256 amount) external onlyCmo {  
    require(address(this).balance >= amount, "Not enough bnb");  
    payable(_cmo).transfer(amount);  
}
```

Figure 1 source code of related function (1/2)

```
function setDuration(uint _duration) external onlyCmo {  
    require(duration > 0, "Duration must gather then 0");  
    duration = _duration;  
}
```

Figure 2 source code of related function (2/2)

Fix recommendations: It is recommended to delete the related functions.

Fix results: Fixed.

[Stake-2 High] Bonus calculations may result in a loss of principal to the user

Description: In addition to the elfinToken, the staking rewards also include the staking token itself. When there are not enough rewards in the contract, the unclaimed principal of other users will be claimed. This results in other users not being able to collect the principal.

```
function withdraw(uint userStakingIndex) external {
    UserStakingInfo storage info = userStakingInfo[_msgSender()][userStakingIndex];
    require(canWithdraw(msg.sender, userStakingIndex), "Can not withdraw");

    PoolInfo storage pool = poolInfo[info.tokenIndex];

    uint elfinApy = 0;
    if(info.lockDay == 30) {
        elfinApy = pool.elfinApyFor30Day;
    } else if(info.lockDay == 60) {
        elfinApy = pool.elfinApyFor60Day;
    } else if(info.lockDay == 90) {
        elfinApy = pool.elfinApyFor90Day;
    } else if(info.lockDay == 180) {
        elfinApy = pool.elfinApyFor180Day;
    }
    if(elfinApy > 0) {
        _elfinToken.safeTransfer(msg.sender, ((info.stakingAmount).mul(elfinApy)).div(10000));
    }

    uint tokenApy = 0;
    if(info.lockDay == 30) {
        tokenApy = pool.tokenApyFor30Day;
    } else if(info.lockDay == 60) {
        tokenApy = pool.tokenApyFor60Day;
    } else if(info.lockDay == 90) {
        tokenApy = pool.tokenApyFor90Day;
    } else if(info.lockDay == 180) {
        tokenApy = pool.tokenApyFor180Day;
    }

    if(pool.stakingToken == IERC20(address(0))) {
        if(tokenApy > 0) {
            _msgSender().transfer(info.stakingAmount.add(((info.stakingAmount).mul(tokenApy)).div(10000))));
        } else {
            _msgSender().transfer(info.stakingAmount);
        }
    } else {
        if(tokenApy > 0) {
            pool.stakingToken.safeTransfer(msg.sender, info.stakingAmount.add(((info.stakingAmount).mul(tokenApy)).div(10000))));
        } else {
            pool.stakingToken.safeTransfer(msg.sender, info.stakingAmount);
        }
    }

    pool.currentAmount = pool.currentAmount.sub(info.stakingAmount);
    info.withdrawn = true;
    emit ElfinWithdraw(_msgSender(), userStakingIndex, info.stakingAmount);
}
```

Figure 3 source code of related function (old)

Fix recommendations: It is recommended to add a new variable to record the total amount of rewards, and determine whether the rewards are sufficient when withdrawing, without affecting the withdrawal of the user's principal. Or add a new contract for saving and sending rewards.

Fix results: Fixed. Removed reward issuance from the *withdraw* function, the contract is now only used for staking counting and principal withdrawal, and the program declares that it will issue rewards with other contracts.

```
function withdraw(uint userStakingIndex) external {
    UserStakingInfo storage info = userStakingInfo[_msgSender()][userStakingIndex];
    require(canWithdraw(msg.sender, userStakingIndex), "Can not withdraw");
    PoolInfo storage pool = poolInfo[info.tokenIndex];

    if(pool.stakingToken == IERC20(address(0))) {
        _msgSender().transfer(info.stakingAmount);
    } else {
        pool.stakingToken.safeTransfer(msg.sender, info.stakingAmount);
    }

    pool.currentAmount = pool.currentAmount.sub(info.stakingAmount);
    info.withdrawn = true;
    emit ElfinWithdraw(_msgSender(), userStakingIndex, info.stakingAmount);
}
```

Figure 4 source code of related function (latest)

[Stake-3 High] Re-entry risk

Description: Status change occurs after token transfer, with re-entry risk.

```
function withdraw(uint userStakingIndex) external {
    UserStakingInfo storage info = userStakingInfo[_msgSender()][userStakingIndex];
    require(canWithdraw(msg.sender, userStakingIndex), "Can not withdraw");
    PoolInfo storage pool = poolInfo[info.tokenIndex];

    if(pool.stakingToken == IERC20(address(0))) {
        _msgSender().transfer(info.stakingAmount);
    } else {
        pool.stakingToken.safeTransfer(msg.sender, info.stakingAmount);
    }

    pool.currentAmount = pool.currentAmount.sub(info.stakingAmount);
    info.withdrawn = true;
    emit ElfinWithdraw(_msgSender(), userStakingIndex, info.stakingAmount);
}
```

Figure 5 source code of related function (old)

Fix recommendations: It is recommended to execute the transfer at the end.

Fix results: Fixed.

```
function withdraw(uint userStakingIndex) external {
    UserStakingInfo storage info = userStakingInfo[_msgSender()][userStakingIndex];
    require(canWithdraw(msg.sender, userStakingIndex), "Can not withdraw");
    PoolInfo storage pool = poolInfo[info.tokenIndex];

    pool.currentAmount = pool.currentAmount.sub(info.stakingAmount);
    info.withdrawn = true;

    if(pool.stakingToken == IERC20(address(0))) {
        _msgSender().transfer(info.stakingAmount);
    } else {
        pool.stakingToken.safeTransfer(msg.sender, info.stakingAmount);
    }

    emit ElfinWithdraw(_msgSender(), userStakingIndex, info.stakingAmount);
}
```

Figure 6 source code of related function (latest)



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Other Audit Items Descriptions

Contract owners need to pay attention to the regularity of adding tokens when adding token stake pools to avoid adding deflationary tokens.

The reward contracts declared by the project parties are outside the scope of this audit. This contract can only be staked and withdrawn, and the stake needs to reach time before it can be withdrawn, up to 25 days.

Appendix 1 Vulnerability Severity Level

Vulnerability Level	Description	Example
Critical	Vulnerabilities that lead to the complete destruction of the project and cannot be recovered. It is strongly recommended to fix.	Malicious tampering of core contract privileges and theft of contract assets.
High	Vulnerabilities that lead to major abnormalities in the operation of the contract due to contract operation errors. It is strongly recommended to fix.	Unstandardized docking of the USDT interface, causing the user's assets to be unable to withdraw.
Medium	Vulnerabilities that cause the contract operation result to be inconsistent with the design but will not harm the core business. It is recommended to fix.	The rewards that users received do not match expectations.
Low	Vulnerabilities that have no impact on the operation of the contract, but there are potential security risks, which may affect other functions. The project party needs to confirm and determine whether the fix is needed according to the business scenario as appropriate.	Inaccurate annual interest rate data queries.
Info	There is no impact on the normal operation of the contract, but improvements are still recommended to comply with widely accepted common project specifications.	It is needed to trigger corresponding events after modifying the core configuration.

Appendix 2 Description of Audit Categories

No.	Categories	Subitems
1	Coding Conventions	Compiler Version Security
		Deprecated Items
		Redundant Code
		require/assert Usage
		Gas Consumption
2	General Vulnerability	Integer Overflow/Underflow
		Reentrancy
		Pseudo-random Number Generator (PRNG)
		Transaction-Ordering Dependence
		DoS (Denial of Service)
		Function Call Permissions
		call/delegatecall Security
		Returned Value Security
		tx.origin Usage
		Replay Attack
		Overriding Variables
3	Business Security	Business Logics
		Business Implementations

1. Coding Conventions

1.1. Compiler Version Security

The old version of the compiler may cause various known security issues. Developers are advised to specify the contract code to use the latest compiler version and eliminate the compiler alerts.

1.2. Deprecated Items

The Solidity smart contract development language is in rapid iteration. Some keywords have been deprecated by newer versions of the compiler, such as `throw`, `years`, etc. To eliminate the potential pitfalls they may cause, contract developers should not use the keywords that have been deprecated by the current compiler version.

1.3. Redundant Code

Redundant code in smart contracts can reduce code readability and may require more gas consumption for contract deployment. It is recommended to eliminate redundant code.

1.4. SafeMath Features

Check whether the functions within the SafeMath library are correctly used in the contract to perform mathematical operations, or perform other overflow prevention checks.

1.5. require/assert Usage

Solidity uses state recovery exceptions to handle errors. This mechanism will undo all changes made to the state in the current call (and all its subcalls) and flag the errors to the caller. The functions `assert` and `require` can be used to check conditions and throw exceptions when the conditions are not met. The `assert` function can only be used to test for internal errors and check non-variables. The `require` function is used to confirm the validity of conditions, such as whether the input variables or contract state variables meet the conditions, or to verify the return value of external contract calls.

1.6. Gas Consumption

The smart contract virtual machine needs gas to execute the contract code. When the gas is insufficient, the code execution will throw an out of gas exception and cancel all state changes. Contract developers are required to control the gas consumption of the code to avoid function execution failures due to insufficient gas.

1.7. Visibility Specifiers

Check whether the visibility conforms to design requirement.

1.8. Fallback Usage

Check whether the Fallback function has been used correctly in the current contract.

2. General Vulnerability

2.1. Integer overflow

Integer overflow is a security problem in many languages, and they are especially dangerous in smart contracts. Solidity can handle up to 256-bit numbers ($2^{256}-1$). If the maximum number is increased by 1, it will overflow to 0. Similarly, when the number is a `uint` type, 0 minus 1 will underflow to get the maximum number value. Overflow conditions can lead to incorrect results, especially if its possible results are not

expected, which may affect the reliability and safety of the program. For the compiler version after Solidity 0.8.0, smart contracts will perform overflow checking on mathematical operations by default. In the previous compiler versions, developers need to add their own overflow checking code, and SafeMath library is recommended to use.

2.2. Reentrancy

The reentrancy vulnerability is the most typical Ethereum smart contract vulnerability, which has caused the DAO to be attacked. The risk of reentry attack exists when there is an error in the logical order of calling the `call.value()` function to send assets.

2.3 Pseudo-random Number Generator (PRNG)

Random numbers may be used in smart contracts. In solidity, it is common to use block information as a random factor to generate, but such use is insecure. Block information can be controlled by miners or obtained by attackers during transactions, and such random numbers are to some extent predictable or collidable.

2.4. Transaction-Ordering Dependence

In the process of transaction packing and execution, when faced with transactions of the same difficulty, miners tend to choose the one with higher gas cost to be packed first, so users can specify a higher gas cost to have their transactions packed and executed first.

2.5. DoS(Denial of Service)

DoS, or Denial of Service, can prevent the target from providing normal services. Due to the immutability of smart contracts, this type of attack can make it impossible to ever restore the contract to its normal working state. There are various reasons for the denial of service of a smart contract, including malicious revert when acting as the recipient of a transaction, gas exhaustion caused by code design flaws, etc.

2.6. Function Call Permissions

If smart contracts have high-privilege functions, such as coin minting, self-destruction, change owner, etc., permission restrictions on function calls are required to avoid security problems caused by permission leakage.

2.7. call/delegatecall Security

Solidity provides the `call/delegatecall` function for function calls, which can cause call injection vulnerability if not used properly. For example, the parameters of the `call`, if controllable, can control this contract to perform unauthorized operations or call dangerous functions of other contracts.

2.8. Returned Value Security

In Solidity, there are `transfer()`, `send()`, `call.value()` and other methods. The transaction will be rolled back if the transfer fails, while `send` and `call.value` will return false if the transfer fails. If the return is not correctly

judged, the unanticipated logic may be executed. In addition, in the implementation of the transfer/transferFrom function of the token contract, it is also necessary to avoid the transfer failure and return false, so as not to create fake recharge loopholes.

2.9. tx.origin Usage

The tx.origin represents the address of the initial creator of the transaction. If tx.origin is used for permission judgment, errors may occur; in addition, if the contract needs to determine whether the caller is the contract address, then tx.origin should be used instead of extcodesize.

2.10. Replay Attack

A replay attack means that if two contracts use the same code implementation, and the identity authentication is in the transmission of parameters, the transaction information can be replayed to the other contract to execute the transaction when the user executes a transaction to one contract.

2.11. Overriding Variables

There are complex variable types in Solidity, such as structures, dynamic arrays, etc. When using a lower version of the compiler, improperly assigning values to it may result in overwriting the values of existing state variables, causing logical exceptions during contract execution.

Appendix 3 Disclaimer

This report is made in response to the project code. No description, expression or wording in this report shall be construed as an endorsement, affirmation or confirmation of the project. This audit is only applied to the type of auditing specified in this report and the scope of given in the results table. Other unknown security vulnerabilities are beyond auditing responsibility. Beosin Technology only issues this report based on the attacks or vulnerabilities that already existed or occurred before the issuance of this report. For the emergence of new attacks or vulnerabilities that exist or occur in the future, Beosin Technology lacks the capability to judge its possible impact on the security status of smart contracts, thus taking no responsibility for them. The security audit analysis and other contents of this report are based solely on the documents and materials that the contract provider has provided to Beosin Technology before the issuance of this report, and the contract provider warrants that there are no missing, tampered, deleted; if the documents and materials provided by the contract provider are missing, tampered, deleted, concealed or reflected in a situation that is inconsistent with the actual situation, or if the documents and materials provided are changed after the issuance of this report, Beosin Technology assumes no responsibility for the resulting loss or adverse effects. The audit report issued by Beosin Technology is based on the documents and materials provided by the contract provider, and relies on the technology currently possessed by Beosin. Due to the technical limitations of any organization, this report conducted by Beosin still has the possibility that the entire risk cannot be completely detected. Beosin disclaims any liability for the resulting losses.

The final interpretation of this statement belongs to Beosin Technology.

Appendix 4 About Beosin

BEOSIN is a leading global blockchain security company dedicated to the construction of blockchain security ecology, with team members coming from professors, post-docs, PhDs from renowned universities and elites from head Internet enterprises who have been engaged in information security industry for many years. BEOSIN has established in-depth cooperation with more than 100 global blockchain head enterprises; and has provided security audit and defense deployment services for more than 1,000 smart contracts, more than 50 blockchain platforms and landing application systems, and nearly 100 digital financial enterprises worldwide. Relying on technical advantages, BEOSIN has applied for nearly 50 software invention patents and copyrights.



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