



**PALADIN**  
BLOCKCHAIN SECURITY

# Smart Contract Security Assessment

Preliminary Report

For Excalibur (Bonding)

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The audit report has made all reasonable attempts to provide clear and articulate recommendations to the Project team with respect to the rectification, amendment and/or revision of any highlighted issues, vulnerabilities or exploits within the contracts provided. It is the sole responsibility of the Project team to sufficiently test and perform checks, ensuring that the contracts are functioning as intended, specifically that the functions therein contained within said contracts have the desired intended effects, functionalities and outcomes of the Project team.

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# 1 Overview

This report has been prepared for Excalibur Exchange's Bonding contracts on the Fantom Opera network. Paladin provides a user-centred examination of the smart contracts to look for vulnerabilities, logic errors or other issues from both an internal and external perspective.

## 1.1 Summary

<b>Project Name</b>	Excalibur Exchange (Bonding)
<b>URL</b>	<a href="https://excalibur.exchange/">https://excalibur.exchange/</a>
<b>Platform</b>	Fantom Opera
<b>Language</b>	Solidity

## 1.2 Contracts Assessed

<b>Name</b>	<b>Contract</b>	<b>Live Code Match</b>
Bonding	Bonding.sol	
BondingFactory	BondingFactory.sol	

## 1.3 Findings Summary

Severity	Found	Resolved	Partially Resolved	Acknowledged (no change made)
● High	1	1	-	-
● Medium	1	1	-	-
● Low	0	-	-	-
● Informational	8	8	-	-
Total	10	10	-	-

### Classification of Issues

Severity	Description
● High	Exploits, vulnerabilities or errors that will certainly or probabilistically lead towards loss of funds, control, or impairment of the contract and its functions. Issues under this classification are recommended to be fixed with utmost urgency.
● Medium	Bugs or issues that may be subject to exploit, though their impact is somewhat limited. Issues under this classification are recommended to be fixed as soon as possible.
● Low	Effects are minimal in isolation and do not pose a significant danger to the project or its users. Issues under this classification are recommended to be fixed nonetheless.
● Informational	Consistency, syntax or style best practices. Generally pose a negligible level of risk, if any.

## 1.3.1 Bonding

ID	Severity	Summary	Status
01	MEDIUM	Second deposits at a later time take less than the vesting period to vest	RESOLVED
02	INFO	Contract contains unused functionality	RESOLVED
03	INFO	factory can be made immutable	RESOLVED
04	INFO	Typographical error	RESOLVED
05	INFO	Best practices should be observed	RESOLVED
06	INFO	Lack of validation	RESOLVED

## 1.3.2 BondingFactory

ID	Severity	Summary	Status
07	HIGH	Removing an element while looping over an array might revert if multiple elements are deleted	RESOLVED
08	INFO	Contract contains unused functionality	RESOLVED
09	INFO	grailToken and treasury can be made immutable	RESOLVED
10	INFO	Several variables can be made constant	RESOLVED

## 2 Findings

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### 2.1 Bonding

The Bonding Contract is inspired by the Olympus DAO bonds mechanism. However, it is completely developed ground up and is not forked from the Olympus DAO protocol. Users can deposit a configured token into the Bonding contract and will in turn receive vesting GRAIL tokens over time for the next few days. The idea is that users can provide LP tokens to the protocol and receive discounted but vested GRAIL tokens in return. It essentially allows users to buy GRAIL futures at a discount.

The contract specifies a maximum deposit amount which is the maximum that all users combined can deposit. There is no lower per-user maximum which means a single user could take the whole remainder.



#### 2.1.1 Privileged Roles



The following functions can be called by the owner of the contract:

- `updateRatio`
- `activate`







## 2.1.2 Issues & Recommendations

Issue #01	Second deposits at a later time take less than the vesting period to vest
Severity	 MEDIUM SEVERITY
Location	<u>Line 150</u> <code>pending = user.totalDueRewardsAmount.sub(user.rewardDebt);</code>
Description	When a user deposits for a second time into the protocol, the vesting period of this second deposit is shortened due to the current vesting mechanism. We expect this to be unintentional as we assume the developer intended to make each vesting period equal to the vesting period set in the contract.
Recommendation	A redesign of the vesting mechanism will be required to fix this issue. We recommend the client refer to the Olympus DAO BondDepository contracts for inspiration.
Resolution	 RESOLVED The client now follows the method implemented by Olympus DAO. Through client interactions, we realized this method is indeed not ideal either as it delays the first deposit, however, it is the standard for now.

Issue #02	Contract contains unused functionality
Severity	 INFORMATIONAL
Location	<u>Line 4</u> <code>import "@openzeppelin/contracts/access/Ownable.sol";</code>
Description	The contract contains a section of code which is not used. This can be confusing to third-party code reviewers and can make the code less accessible. The following section of code can therefore be removed.
Recommendation	Consider removing the line of code in an effort to keep the contract as simple as possible.
Resolution	 RESOLVED



Issue #03	factory can be made immutable
Severity	 INFORMATIONAL
Description	Variables that are only set in the constructor but never modified can be indicated as such with the immutable keyword. This is considered best practice since it makes the code more accessible for third-party reviewers and saves gas.
Recommendation	Consider making the aforementioned variables explicitly immutable.
Resolution	 RESOLVED

Issue #04	Typographical error
Severity	 INFORMATIONAL
Location	<u>Line 92</u> require(msg.sender == owner(), "isOwner: caller is not the owner");
Description	The contract has a typographical error at the above line of code.
Recommendation	Consider fixing the typographical error.
Resolution	 RESOLVED



## Severity

 INFORMATIONAL

## Description

Line 115

```
return activated && startTime <= currentBlockTimestamp &&
depositEndTime() > currentBlockTimestamp && totalDepositAmount <
maxDepositAmount;
```

Line 244

```
if (!canHarvestBeforeEnd && currentBlockTimestamp <
rewardsEndTime()) return;
```

When developing smart contracts with multiple periods, each period should be as distinct as possible from each other to avoid overlap as overlapping could allow multiple actions to be executed within the same block and potentially in an unexpected order. It is therefore a best practice to clearly separate periods. Consider using `<=` to postpone the final harvest to right after the end time.

The exception of this best practice is the following code section.

Line 131

```
if (_currentBlockTimestamp() < depositEndTime()) return
calculateRewards(maxDepositAmount);
```

Here, we believe it would be more defensive to use `<=` as it would return a less favorable amount for longer and therefore reduce risks.

## Recommendation

Consider using

- `startTime < currentBlockTimestamp`
- `currentBlockTimestamp <= rewardsEndTime()`
- `_currentBlockTimestamp() <= depositEndTime()`

## Resolution

 RESOLVED

**Issue #06****Lack of validation****Severity** INFORMATIONAL**Description**

The contract contains sections of code which lack proper validation. This could cause errors in case unexpected inputs are provided.

Line 225

```
function activate() external onlyOwner {
```

activate should only be possible before startTime and should only be callable once.

**Recommendation**

Consider using the following requirements.

```
require(_currentBlockTimestamp() < startTime, ""); require(!  
activated, "");
```

**Resolution** RESOLVED

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## 2.2 BondingFactory

The BondingFactory is the main contract used by governance to create new Bonds. Each bond is defined by a set of periods, a discounted price for GRAIL and the LP token that must be supplied. The main function which the governance will periodically be calling is `createBonding` to deploy new bond instances.

The protocol has an extra safeguard such that at any point in time, all active bonds cannot increase the total GRAIL supply by more than 10%. This should reduce the risk of any detrimental issues if a bond is misconfigured.



### 2.2.1 Privileged Roles



The following functions can be called by the owner of the contract:

- `createBonding`
- `transferOwnership`
- `renounceOwnership`



## 2.2.2 Issues & Recommendations

<b>Issue #07</b>	<b>Removing an element while looping over an array might revert if multiple elements are deleted</b>
<b>Severity</b>	 HIGH SEVERITY
<b>Location</b>	<u>Line 147</u> <code>for (uint256 i = 0; i &lt; indexesToRemove.length; i++){</code>
<b>Description</b>	<p>The contract contains a for loop that removes elements from the list it is looping over. This is extremely undesirable as the list is changed and the loop indices no longer makes sense when removing an element.</p> <p>Specifically, if the <code>indexesToRemove</code> contains the last element apart from an earlier element, it will revert.</p>
<b>Recommendation</b>	Consider looping from the back of the array to the front to avoid this issue. This is because only the indexes at the end are changed, which would already have been handled when looping from back to front.
<b>Resolution</b>	 RESOLVED <p>The client now iterates over the array back-to-front which avoids this issue.</p>

<b>Issue #08</b>	<b>Contract contains unused functionality</b>
<b>Severity</b>	 INFORMATIONAL
<b>Description</b>	<p>The contract contains a section of code which is not used. This can be confusing to third-party code reviewers and can make the code less accessible. The following section of code can therefore be removed.</p> <p>Line 5 <code>import "@openzeppelin/contracts/utils/ReentrancyGuard.sol";</code></p>
<b>Recommendation</b>	Consider removing the aforementioned line of code in an effort to keep the contract as simple as possible.
<b>Resolution</b>	 RESOLVED

## Issue #09 **grailToken and treasury can be made immutable**

### Severity

 INFORMATIONAL

### Description

Variables that are only set in the constructor but never modified can be indicated as such with the `immutable` keyword. This is considered best practice since it makes the code more accessible for third-party reviewers and saves gas.

**Recommendation** Consider making the above variables explicitly `immutable`.

### Resolution

 RESOLVED

## Issue #10 **Several variables can be made constant**

### Severity

 INFORMATIONAL

### Description

Variables that are never modified can be indicated as such with the `constant` keyword:

- `MAX_MINTABLE_GRAIL_PERCENT`
- `MIN_VESTING_PERIOD`
- `MIN_DEPOSIT_DURATION`

This is considered best practice since it makes the code more accessible for third-party reviewers and saves gas.

**Recommendation** Consider making the variables explicitly `constant`.

### Resolution

 RESOLVED



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