METATRUST

Draft
Security Assessment for

131-2022-05-backd (1OK-FLP) (1Negative-SP)

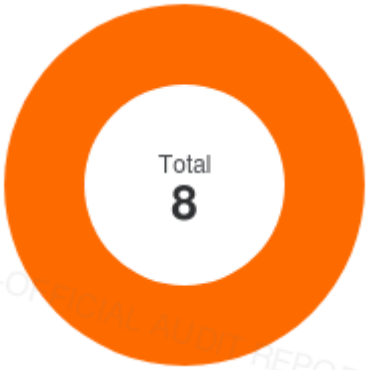
July 23, 2023

Executive Summary

Overview	
Project Name	131-2022-05-backd (1OK-FLP) (1Negative-SP)
Codebase URL	https://github.com/daoyuan14/2022-05-backd/
Scan Engine	AI Analyzer
Scan Time	2023/07/23 21:39:24
Commit Id	bffa09a

Total	
Critical Issues	0
High risk Issues	8
Medium risk Issues	0
Low risk Issues	0
Informational Issues	0

Critical Issues	The issue can cause large economic losses, large-scale data disorder, loss of control of authority management, failure of key functions, or indirectly affect the correct operation of other smart contracts interacting with it.
High Risk Issues	The issue puts a large number of users' sensitive information at risk or is reasonably likely to lead to catastrophic impacts on clients' reputations or serious financial implications for clients and users.
Medium Risk Issues	The issue puts a subset of users' sensitive information at risk, would be detrimental to the client's reputation if exploited, or is reasonably likely to lead to moderate financial impact.
Low Risk Issues	The risk is relatively small and could not be exploited on a recurring basis, or is a risk that the client has indicated is low-impact in view of the client's business circumstances.
Informational Issue	The issue does not pose an immediate risk but is relevant to security best practices or Defence in Depth.



Critical Issues	0%	0
High risk Issues	100%	8
Medium risk Issues	0%	0
Low risk Issues	0%	0
Informational Issues	0%	0

Summary of Findings

MetaScan security assessment was performed on **July 23, 2023 21:39:24** on project **131-2022-05-backd (1OK-FLP) (1Negative-SP)** with the repository **https://github.com/daoyuan14/2022-05-backd/** on branch **default branch**. The assessment was carried out by scanning the project's codebase using the scan engine **AI Analyzer**. There are in total **8** vulnerabilities / security risks discovered during the scanning session, among which **0** critical vulnerabilities, **8** high risk vulnerabilities, **0** medium risk vulnerabilities, **0** low risk vulnerabilities, **0** informational issues.

ID	Description	Severity
MSA-001	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-002	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-003	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-004	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-005	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-006	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-007	MWE-200: Insecure LP Token Value Calculation	High risk
MSA-008	MWE-200: Insecure LP Token Value Calculation	High risk

Findings

Critical (0)

No Critical vulnerabilities found here

High risk (8)

1. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/swappers/SwapperRouter.sol #162-191

```
162     function _swapForWeth(address token_) internal returns (uint256 amountOut) {
163         if (token_ == address(_WETH)) return _WETH.balanceOf(address(this));
164 
165         // Handling ETH -> WETH
166         if (token_ == address(0)) {
167             uint256 ethBalance_ = address(this).balance;
168             if (ethBalance_ == 0) return 0;
169             _WETH.deposit{value: ethBalance_}();
170             return ethBalance_;
171         }
172 
173         // Handling Curve Pool swaps
174         ICurveSwapEth curvePool_ = curvePools[token_];
175         if (address(curvePool_) != address(0)) {
176             uint256 amount_ = IERC20(token_).balanceOf(address(this));
177             if (amount_ == 0) return 0;
178             _approve(token_, address(curvePool_));
179             (uint256 wethIndex_, uint256 tokenIndex_) = _getIndices(curvePool_, token_);
180             curvePool_.exchange(
181                 tokenIndex_,
182                 wethIndex_,
183                 amount_,
184                 _minWethAmountOut(amount_, token_)
185             );
186             return _WETH.balanceOf(address(this));
187         }
188 
189         // Handling ERC20 -> WETH
190         return _swap(token_, address(_WETH), IERC20(token_).balanceOf(address(this)));
191     }
```

protocol/contracts/swappers/SwapperRouter.sol #125-155

```
125     function swap(
126         address fromToken_,
127         address toToken_,
128         uint256 amountIn_
129     ) public payable override returns (uint256 amountOut) {
130         // Validating ETH value sent
131         require(msg.value == (fromToken_ == address(0) ? amountIn_ : 0), Error.INVALID_AMOUNT);
132         if (amountIn_ == 0) {
133             emit Swapped(fromToken_, toToken_, 0, 0);
134             return 0;
135         }
136 
137         // Handling swap between the same token
138         if (fromToken_ == toToken_) {
139             if (fromToken_ == address(0)) {
140                 payable(msg.sender).transfer(amountIn_);
141             }
142             emit Swapped(fromToken_, toToken_, amountIn_, amountIn_);
143             return amountIn_;
144         }
145 
146         // Transferring to contract if ERC20
147         if (fromToken_ != address(0)) {
148             IERC20(fromToken_).safeTransferFrom(msg.sender, address(this), amountIn_);
149         }
150 
151         // Swapping token via WETH
152         uint256 amountOut_ = _swapWethForToken(toToken_, _swapForWeth(fromToken_));
153         emit Swapped(fromToken_, toToken_, amountIn_, amountOut_);
154         return _returnTokens(toToken_, amountOut_);
155     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

2. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/swappers/SwapperRouter.sol #414-425

```
414     function _minTokenAmountOut(uint256 wethAmount_, address token_)
415         internal
416         view
417         returns (uint256 minAmountOut)
418     {
419         uint256 priceInEth_ = _getPriceInEth(token_);
420         if (priceInEth_ == 0) return 0;
421         return
422             wethAmount_.scaledDiv(priceInEth_).scaledMul(slippageTolerance).scaleTo(
423                 IERC20Full(token_).decimals()
424             );
425     }
```

protocol/contracts/swappers/SwapperRouter.sol #198-227

```
198     function _swapWethForToken(address token_, uint256 amount_)
199         internal
200         returns (uint256 amountOut)
201     {
202         if (amount_ == 0) return 0;
203         if (token_ == address(_WETH)) return amount_;
204 
205         // Handling WETH -> ETH
206         if (token_ == address(0)) {
207             _WETH.withdraw(amount_);
208             return amount_;
209         }
210 
211         // Handling Curve Pool swaps
212         ICurveSwapEth curvePool_ = curvePools[token_];
213         if (address(curvePool_) != address(0)) {
214             _approve(address(_WETH), address(curvePool_));
215             (uint256 wethIndex_, uint256 tokenIndex_) = _getIndices(curvePool_, token_);
216             curvePool_.exchange(
217                 wethIndex_,
218                 tokenIndex_,
219                 amount_,
220                 _minTokenAmountOut(amount_, token_)
221             );
222             return IERC20(token_).balanceOf(address(this));
223         }
224 
225         // Handling WETH -> ERC20
226         return _swap(address(_WETH), token_, amount_);
227     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

3. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/swappers/SwapperRouter.sol #433-444

```
433     function _minWethAmountOut(uint256 tokenAmount_, address token_)
434         internal
435         view
436         returns (uint256 minAmountOut)
437     {
438         uint256 priceInEth_ = _getPriceInEth(token_);
439         if (priceInEth_ == 0) return 0;
440         return
441             tokenAmount_.scaledMul(priceInEth_).scaledMul(slippageTolerance).scaleFrom(
442                 IERC20Full(token_).decimals()
443             );
444     }
```

protocol/contracts/swappers/SwapperRouter.sol #162-191

```
162     function _swapForWeth(address token_) internal returns (uint256 amountOut) {
163         if (token_ == address(_WETH)) return _WETH.balanceOf(address(this));
164 
165         // Handling ETH -> WETH
166         if (token_ == address(0)) {
167             uint256 ethBalance_ = address(this).balance;
168             if (ethBalance_ == 0) return 0;
169             _WETH.deposit{value: ethBalance_}();
170             return ethBalance_;
171         }
172 
173         // Handling Curve Pool swaps
174         ICurveSwapEth curvePool_ = curvePools[token_];
175         if (address(curvePool_) != address(0)) {
176             uint256 amount_ = IERC20(token_).balanceOf(address(this));
177             if (amount_ == 0) return 0;
178             _approve(token_, address(curvePool_));
179             (uint256 wethIndex_, uint256 tokenIndex_) = _getIndices(curvePool_, token_);
180             curvePool_.exchange(
181                 tokenIndex_,
182                 wethIndex_,
183                 amount_,
184                 _minWethAmountOut(amount_, token_)
185             );
186             return _WETH.balanceOf(address(this));
187         }
188 
189         // Handling ERC20 -> WETH
190         return _swap(token_, address(_WETH), IERC20(token_).balanceOf(address(this)));
191     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

4. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/pool/LiquidityPool.sol #504-525

```
504     function depositFor(
505         address account,
506         uint256 depositAmount,
507         uint256 minTokenAmount
508     ) public payable override notPaused returns (uint256) {
509         if (depositAmount == 0) return 0;
510         uint256 rate = exchangeRate();
511 
512         _doTransferIn(msg.sender, depositAmount);
513         uint256 mintedLp = depositAmount.scaledDiv(rate);
514         require(mintedLp >= minTokenAmount && mintedLp > 0, Error.INVALID_AMOUNT);
515 
516         lpToken.mint(account, mintedLp);
517         _rebalanceVault();
518 
519         if (msg.sender == account || address(this) == account) {
520             emit Deposit(msg.sender, depositAmount, mintedLp);
521         } else {
522             emit DepositFor(msg.sender, account, depositAmount, mintedLp);
523         }
524         return mintedLp;
525     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

5. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/pool/LiquidityPool.sol #608-616

```
608     function exchangeRate() public view override returns (uint256) {
609         uint256 totalUnderlying_ = totalUnderlying();
610         uint256 totalSupply = lpToken.totalSupply();
611         if (totalSupply == 0 || totalUnderlying_ == 0) {
612             return ScaledMath.ONE;
613         }
614 
615         return totalUnderlying_.scaledDiv(totalSupply);
616     }
```

protocol/contracts/pool/LiquidityPool.sol #533-559

```
533     function redeem(uint256 redeemLpTokens, uint256 minRedeemAmount)
534         public
535         override
536         returns (uint256)
537     {
538         require(redeemLpTokens > 0, Error.INVALID_AMOUNT);
539         ILpToken lpToken_ = lpToken;
540         require(lpToken_.balanceOf(msg.sender) >= redeemLpTokens, Error.INSUFFICIENT_BALANCE);
541 
542         uint256 withdrawalFee = addressProvider.isAction(msg.sender)
543             ? 0
544             : getWithdrawalFee(msg.sender, redeemLpTokens);
545         uint256 redeemMinusFees = redeemLpTokens - withdrawalFee;
546         // Pay no fees on the last withdrawal (avoid locking funds in the pool)
547         if (redeemLpTokens == lpToken_.totalSupply()) {
548             redeemMinusFees = redeemLpTokens;
549         }
550         uint256 redeemUnderlying = redeemMinusFees.scaledMul(exchangeRate());
551         require(redeemUnderlying >= minRedeemAmount, Error.NOT_ENOUGH_FUNDS_WITHDRAWN);
552 
553         _rebalanceVault(redeemUnderlying);
554 
555         lpToken_.burn(msg.sender, redeemLpTokens);
556         _doTransferOut(payable(msg.sender), redeemUnderlying);
557         emit Redeem(msg.sender, redeemUnderlying, redeemLpTokens);
558         return redeemUnderlying;
559     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

6. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/pool/LiquidityPool.sol #711-737

```
711     function _rebalanceVault(uint256 underlyingToWithdraw) internal {
712         IVault vault = getVault();
713 
714         if (address(vault) == address(0)) return;
715         uint256 lockedLp = staker.getStakedByActions();
716         uint256 totalUnderlyingStaked = lockedLp.scaledMul(exchangeRate());
717 
718         uint256 underlyingBalance = _getBalanceUnderlying(true);
719         uint256 maximumDeviation = totalUnderlyingStaked.scaledMul(getMaxReserveDeviationRatio());
720 
721         uint256 nextTargetBalance = totalUnderlyingStaked.scaledMul(getRequiredReserveRatio());
722 
723         if (
724             underlyingToWithdraw > underlyingBalance ||
725             (underlyingBalance - underlyingToWithdraw) + maximumDeviation < nextTargetBalance
726         ) {
727             uint256 requiredDeposits = nextTargetBalance + underlyingToWithdraw - underlyingBalance;
728             vault.withdraw(requiredDeposits);
729         } else {
730             uint256 nextBalance = underlyingBalance - underlyingToWithdraw;
731             if (nextBalance > nextTargetBalance + maximumDeviation) {
732                 uint256 excessDeposits = nextBalance - nextTargetBalance;
733                 _doTransferOut(payable(address(vault)), excessDeposits);
734                 vault.deposit();
735             }
736         }
737     }
```

protocol/contracts/pool/LiquidityPool.sol #533-559

```
533     function redeem(uint256 redeemLpTokens, uint256 minRedeemAmount)
534         public
535         override
536         returns (uint256)
537     {
538         require(redeemLpTokens > 0, Error.INVALID_AMOUNT);
539         ILpToken lpToken_ = lpToken;
540         require(lpToken_.balanceOf(msg.sender) >= redeemLpTokens, Error.INSUFFICIENT_BALANCE);
541 
542         uint256 withdrawalFee = addressProvider.isAction(msg.sender)
543             ? 0
544             : getWithdrawalFee(msg.sender, redeemLpTokens);
545         uint256 redeemMinusFees = redeemLpTokens - withdrawalFee;
546         // Pay no fees on the last withdrawal (avoid locking funds in the pool)
547         if (redeemLpTokens == lpToken_.totalSupply()) {
548             redeemMinusFees = redeemLpTokens;
549         }
550         uint256 redeemUnderlying = redeemMinusFees.scaledMul(exchangeRate());
551         require(redeemUnderlying >= minRedeemAmount, Error.NOT_ENOUGH_FUNDS_WITHDRAWN);
552 
553         _rebalanceVault(redeemUnderlying);
554 
555         lpToken_.burn(msg.sender, redeemLpTokens);
556         _doTransferOut(payable(msg.sender), redeemUnderlying);
557         emit Redeem(msg.sender, redeemUnderlying, redeemLpTokens);
558         return redeemUnderlying;
559     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

7. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/oracles/ChainlinkOracleProvider.sol #50-80

```
50      function _getPrice(
51          address asset_,
52          address denomination_,
53          bool revert_
54      ) internal view returns (uint256) {
55          try _feedRegistry.latestRoundData(asset_, denomination_) returns (
56              uint80 roundID_,
57              int256 price_,
58              uint256 startedAt,
59              uint256 timeStamp_,
60              uint80 answeredInRound_
61          ) {
62              require(timeStamp_ != 0, Error.ROUND_NOT_COMPLETE);
63              require(block.timestamp <= timeStamp_ + stalePriceDelay, Error.STALE_PRICE);
64              require(price_ != 0, Error.NEGATIVE_PRICE);
65              require(answeredInRound_ >= roundID_, Error.STALE_PRICE);
66
67              return uint256(price_).scaleFrom(_feedRegistry.decimals(asset_, denomination_));
68          } catch Error(string memory reason) {
69              if (revert_) revert(reason);
70
71              if (denomination_ == Denominations.USD) {
72                  return
73                      (_getPrice(asset_, Denominations.ETH, true) *
74                          _getPrice(Denominations.ETH, Denominations.USD, true)) / 1e18;
75              }
76              return
77                  (_getPrice(asset_, Denominations.USD, true) * 1e18) /
78                  _getPrice(Denominations.ETH, Denominations.USD, true);
79          }
80      }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

8. MWE-200: Insecure LP Token Value Calculation

High risk Security Analyzer

Liquidity token value/price can be manipulated to cause flashloan attacks.

File(s) Affected

protocol/contracts/tokenomics/VestedEscrowRevocable.sol #84-91

```
84      function balanceOf(address _recipient) external view override returns (uint256) {
85          uint256 timestamp = block.timestamp;
86          uint256 timeRevoked = revokedTime[_recipient];
87          if (timeRevoked != 0) {
88              timestamp = timeRevoked;
89          }
90          return _balanceOf(_recipient, timestamp);
91      }
```

protocol/contracts/swappers/SwapperRouter.sol #162-191

```
162     function _swapForWeth(address token_) internal returns (uint256 amountOut) {
163         if (token_ == address(_WETH)) return _WETH.balanceOf(address(this));
164
165         // Handling ETH -> WETH
166         if (token_ == address(0)) {
167             uint256 ethBalance_ = address(this).balance;
168             if (ethBalance_ == 0) return 0;
169             _WETH.deposit{value: ethBalance_}();
170             return ethBalance_;
171         }
172
173         // Handling Curve Pool swaps
174         ICurveSwapEth curvePool_ = curvePools[token_];
175         if (address(curvePool_) != address(0)) {
176             uint256 amount_ = IERC20(token_).balanceOf(address(this));
177             if (amount_ == 0) return 0;
178             _approve(token_, address(curvePool_));
179             (uint256 wethIndex_, uint256 tokenIndex_) = _getIndices(curvePool_, token_);
180             curvePool_.exchange(
181                 tokenIndex_,
182                 wethIndex_,
183                 amount_,
184                 _minWethAmountOut(amount_, token_)
185             );
186             return _WETH.balanceOf(address(this));
187         }
188
189         // Handling ERC20 -> WETH
190         return _swap(token_, address(_WETH), IERC20(token_).balanceOf(address(this)));
191     }
```

Recommendation

Do not use AMM pool or custom liquidity calculation to caculate LP token value/price.

Medium risk (0)

No Medium risk vulnerabilities found here

Low risk (0)

No Low risk vulnerabilities found here

Informational (0)

No Informational vulnerabilities found here

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