**Green Pace Developer: Security Policy Guide Template**



# Green Pace Secure Development Policy

## Contents

[Overview 2](#_gjdgxs)

[Purpose 2](#_30j0zll)

[Scope 2](#_1fob9te)

[Module Three Milestone 2](#_3znysh7)

[Ten Core Security Principles 2](#_2et92p0)

[C/C++ Ten Coding Standards 3](#_3dy6vkm)

[Coding Standard 1 4](#_1t3h5sf)

[Coding Standard 2 5](#_4d34og8)

[Coding Standard 3 6](#_2s8eyo1)

[Coding Standard 4 7](#_17dp8vu)

[Coding Standard 5 8](#_3rdcrjn)

[Coding Standard 6 9](#_26in1rg)

[Coding Standard 7 10](#_lnxbz9)

[Coding Standard 8 11](#_35nkun2)

[Coding Standard 9 13](#_1ksv4uv)

[Coding Standard 10 14](#_44sinio)

[Defense-in-Depth Illustration 15](#_2jxsxqh)

[Project One 15](#_z337ya)

[1.](#_3j2qqm3) Revise the C/C++ Standards 15

[2.](#_1y810tw) Risk Assessment 15

[3.](#_4i7ojhp) Automated Detection 15

[4.](#_2xcytpi) Automation 15

[5.](#_1ci93xb) Summary of Risk Assessments 16

[6.](#_3whwml4) Create Policies for Encryption and Triple A 16

[7.](#_2bn6wsx) Map the Principles 17

[Audit Controls and Management 18](#_qsh70q)

[Enforcement 18](#_3as4poj)

[Exceptions Process 18](#_1pxezwc)

[Distribution 19](#_49x2ik5)

[Policy Change Control 19](#_2p2csry)

[Policy Version History 19](#_147n2zr)

[Appendix A Lookups 19](#_3o7alnk)

[Approved C/C++ Language Acronyms 19](#_23ckvvd)

## Overview

Software development at Green Pace requires consistent implementation of secure principles to all developed applications. Consistent approaches and methodologies must be maintained through all policies that are uniformly defined, implemented, governed, and maintained over time.

## Purpose

This policy defines the core security principles; C/C++ coding standards; authorization, authentication, and auditing standards; and data encryption standards. This article explains the differences between policy, standards, principles, and practices (guidelines and procedure): [Understanding the Hierarchy of Principles, Policies, Standards, Procedures, and Guidelines](https://www.linkedin.com/pulse/understanding-hierarchy-principles-policies-standards-wally-beddoe/).

## Scope

This document applies to all staff that create, deploy, or support custom software at Green Pace.

## Module Three Milestone

### Ten Core Security Principles

| **Principles** | Write a short paragraph explaining each of the 10 principles of security. |
| --- | --- |
| 1. ValidateInput Data | Validating input data is an essential principle of security that involves verifying the accuracy, completeness, and integrity of data received by a system. This principle ensures that the data entered by users is appropriate for the system's purpose and does not contain malicious code or other security threats. Validation of input data involves several techniques, such as data type validation, data length validation, data range validation, data format validation, and data consistency validation. By implementing input data validation, systems can reduce the risk of data corruption, unauthorized access, and system crashes caused by invalid data. Validating input data is particularly important in web applications, where users can input data directly into the system through forms and other interactive elements. |
| 1. Heed Compiler Warnings | The warnings can be indicative of potential vulnerabilities or errors in the code that may lead to security breaches or other problems. By addressing these warnings and errors, developers can improve the security and functionality of their software. It is important to take these warnings seriously and address them promptly, as ignoring them can lead to serious security vulnerabilities that can be exploited by malicious actors. |
| 1. Architect and Design for Security Policies | When designing a secure system, it is important to consider security policies at every stage of the architectural and design process. By doing so, potential vulnerabilities can be identified and addressed early on in the development process, rather than being discovered after deployment. Architects and designers must carefully consider how security policies will be implemented and enforced throughout the system, from the initial design of the user interface to the underlying code and network infrastructure. This can include measures such as access controls, data encryption, and secure communication protocols. By prioritizing security policies in the architecture and design process, potential threats can be mitigated and overall system security can be improved. |
| 1. Keep It Simple | The more complex a security system is, the greater the likelihood that there will be vulnerabilities or weaknesses that can be exploited by attackers. By keeping security policies and procedures simple, it is easier to ensure that they are effective and can be implemented consistently. This principle encourages security professionals to focus on implementing only the security measures that are necessary and to avoid overcomplicating security systems. |
| 1. Default Deny | Default deny involves denying all access to resources by default and only granting access when explicitly authorized. This principle is designed to minimize the risk of unauthorized access to sensitive information or resources. By using this approach, organizations can ensure that only authorized users and systems have access to critical resources, reducing the risk of data breaches and other security incidents. However, implementing Default Deny policies can be complex and may require significant planning and configuration to ensure that legitimate access is not inadvertently blocked. |
| 1. Adhere to the Principle of Least Privilege | Adhere to the principle of least privilege  involves granting users or processes only the minimum level of access necessary to complete their tasks. This principle is relevant for all types of systems and applications, and should be implemented as part of a layered security approach. |
| 1. Sanitize Data Sent to Other Systems | Sanitizing data sent to other systems is an important security principle that involves cleaning and validating any data that is sent from one system to another. This helps prevent potential security vulnerabilities and attacks that can occur when untrusted data is passed between systems. By sanitizing the data, any potential malicious code or harmful content can be removed or altered to prevent it from causing harm to the receiving system or its users. |
| 1. Practice Defense in Depth | To enhance security, defense in depth strategy includes setting up several layers of protection to guard against possible attacks. With the implementation of multiple layers, if one layer is compromised, the other layers will help prevent or minimize the damage caused by the attack to the system. |
| 1. Use Effective Quality Assurance Techniques | Using effective quality assurance techniques involves testing systems and applications to identify and address vulnerabilities and weaknesses. Quality assurance techniques can include penetration testing, vulnerability scanning, code reviews, and security audits. By implementing these techniques, organizations can identify potential security risks and take appropriate measures to mitigate them before they are exploited by attackers. |
| 1. Adopt a Secure Coding Standard | Adopting a secure coding standard includes practices such as input validation, error handling, and secure authentication. By adhering to a secure coding standard, developers can reduce the risk of introducing vulnerabilities into their code and improve the overall security of their applications. |

### C/C++ Ten Coding Standards

Complete the coding standards portion of the template according to the Module Three milestone requirements. In Project One, follow the instructions to add a layer of security to the existing coding standards. Please start each standard on a new page, as they may take up more than one page. The first seven coding standards are labeled by category. The last three are blank so you may choose three additional standards. Be sure to label them by category and give them a sequential number for that category. Add compliant and noncompliant sections as needed to each coding standard.

#### Coding Standard 1

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **Data Type** | [STD-001-CPP] | Obey the one-definition rule |

| **Noncompliant Code** |
| --- |
| Two different translation units define a class of the same name with differing definitions. |
| // a.cpp  **struct** S {  **int** a;  };    // b.cpp  **class** S {  **public**:  **int** a;  }; |

| **Compliant Code** |
| --- |
| Use of a header file to introduce the object into both translation units. |
| // S.h  **struct** S {  **int** a;  };    // a.cpp  #include "S.h"    // b.cpp  #include "S.h" |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  3: Architect and Design for Security Policies  4: Keep It Simple  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | unlikely | High | 3 | 3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **type-compatibility**  **definition-duplicate**  **undefined-extern**  **undefined-extern-pure-virtual**  **external-file-spreading**  **type-file-spreading** | Partially checked |
| [Axivion Bauhaus Suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Axivion+Bauhaus+Suite) | 7.2.0 | **CertC++-DCL60** |  |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **LANG.STRUCT.DEF.FDH LANG.STRUCT.DEF.ODH** | Function defined in header file  Object defined in header file |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **C++1067, C++1509, C++1510** |  |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/LDRA) | 9.7.1 | **286 S, 287 S** | Fully implemented |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-DCL60-a** | A class, union or enum name (including qualification, if any) shall be a unique identifier |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Polyspace+Bug+Finder) | R2023a | [CERT C++: DCL60-CPP](https://www.mathworks.com/help/bugfinder/ref/certcdcl60cpp.html) | Checks for inline constraints not respected (rule partially covered) |
| [RuleChecker](https://wiki.sei.cmu.edu/confluence/display/cplusplus/RuleChecker) | 22.10 | **type-compatibility**  **definition-duplicate**  **undefined-extern**  **undefined-extern-pure-virtual**  **external-file-spreading**  **type-file-spreading** | Partially check |

#### Coding Standard 2

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **Data Value** | [STD-002-CPP] | Do not read uninitialized memory |

| **Noncompliant Code** |
| --- |
| Uninitialized local variable is evaluated as part of an expression to print its value, resulting in undefined behavior. |
| #include <iostream>    void f() {  **int** i;    std::cout << i;  } |

| **Compliant Code** |
| --- |
| Object is initialized prior to printing its value. |
| #include <iostream>    void f() {  **int** i = 0;    std::cout << i;  } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  1: ValidateInput Data  4: Keep It Simple  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | Medium | P12 | L1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **uninitialized-read** | Partially checked |
| [Clang](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Clang) | 3.9 | -Wuninitialized  clang-analyzer-core.UndefinedBinaryOperatorResult | Does not catch all instances of this rule, such as uninitialized values read from heap-allocated memory. |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **LANG.STRUCT.RPL LANG.MEM.UVAR** | Return pointer to local  Uninitialized variable |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **DF726, DF2727, DF2728, DF2961, DF2962, DF2963, DF2966, DF2967, DF2968, DF2971, DF2972, DF2973, DF2976, DF2977, DF978** |  |
| [Klocwork](https://www.securecoding.cert.org/confluence/display/cplusplus/Klocwork) | 2023.1 | **UNINIT.CTOR.MIGHT**  **UNINIT.CTOR.MUST**  **UNINIT.HEAP.MIGHT**  **UNINIT.HEAP.MUST**  **UNINIT.STACK.ARRAY.MIGHT**  **UNINIT.STACK.ARRAY.MUST**  **UNINIT.STACK.ARRAY.PARTIAL.MUST**  **UNINIT.STACK.MIGHT**  **UNINIT.STACK.MUST** |  |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/LDRA) | 9.7.1 | **53 D, 69 D, 631 S, 652 S** | Partially implemented |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-EXP53-a** | Avoid use before initialization |
| [Parasoft Insure++](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) |  |  | Runtime detection |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Polyspace+Bug+Finder) | R2023a | [CERT C++: EXP53-CPP](https://www.mathworks.com/help/bugfinder/ref/certcexp53cpp.html) | Checks for:   * Non-initialized variable * Non-initialized pointer   Rule partially covered. |
| [PRQA QA-C++](https://www.securecoding.cert.org/confluence/pages/viewpage.action?pageId=142409849) | 4.4 | **2726, 2727, 2728, 2961, 2962, 2963, 2966, 2967, 2968, 2971, 2972, 2973, 2976, 2977, 2978** |  |
| [PVS-Studio](https://wiki.sei.cmu.edu/confluence/display/cplusplus/PVS-Studio) | 7.24 | [**V546**](https://pvs-studio.com/en/docs/warnings/v546/), [**V573**](https://pvs-studio.com/en/docs/warnings/v573/), [**V614**](https://pvs-studio.com/en/docs/warnings/v614/), [**V670**](https://pvs-studio.com/en/docs/warnings/v670/), [**V679**](https://pvs-studio.com/en/docs/warnings/v679/), [**V730**](https://pvs-studio.com/en/docs/warnings/v730/), [**V788**](https://pvs-studio.com/en/docs/warnings/v788/), [**V1007**](https://pvs-studio.com/en/docs/warnings/v1007/), [**V1050**](https://pvs-studio.com/en/docs/warnings/v1050/) |  |
| [RuleChecker](https://wiki.sei.cmu.edu/confluence/display/cplusplus/RuleChecker) | 22.10 | **uninitialized-read** | Partially checked |

#### Coding Standard 3

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **String Correctness** | [STD-003-CPP] | Do not attempt to create a std::string from a null pointer |

| **Noncompliant Code** |
| --- |
| A std::string object is created from the results of a call to std::getenv(). However, because std::getenv() returns a null pointer on failure, this code can lead to undefined behavior when the environment variable does not exist (or some other error occurs). |
| #include <cstdlib>  #include <string>    void f() {    std::string tmp(std::getenv("TMP"));    if (!tmp.empty()) {      // ...    }  } |

| **Compliant Code** |
| --- |
| The results from the call to std::getenv() are checked for null before the std::string object is constructed. |
| #include <cstdlib>  #include <string>    void f() {    const **char** \*tmpPtrVal = std::**getenv**("TMP");    std::string tmp(tmpPtrVal ? tmpPtrVal : "");    if (!tmp.empty()) {      // ...    }  } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  2: Heed Compiler Warnings |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Likely | Medium | P18 | L1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **assert\_failure** |  |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/c/CodeSonar) | 7.3p0 | **LANG.MEM.NPD** | Null Pointer Dereference |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **DF4770, DF4771, DF4772, DF4773, DF4774** |  |
| [Klocwork](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Klocwork) | 2023.1 | **NPD.CHECK.CALL.MIGHT NPD.CHECK.CALL.MUST NPD.CHECK.MIGHT NPD.CHECK.MUST NPD.CONST.CALL NPD.CONST.DEREF NPD.FUNC.CALL.MIGHT NPD.FUNC.CALL.MUST NPD.FUNC.MIGHT NPD.FUNC.MUST NPD.GEN.CALL.MIGHT NPD.GEN.CALL.MUST NPD.GEN.MIGHT NPD.GEN.MUST RNPD.CALL RNPD.DEREF** |  |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-STR51-a** | Avoid null pointer dereferencing |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/c/Polyspace+Bug+Finder) | R2023a | [CERT C++: STR51-CPP](https://www.mathworks.com/help/bugfinder/ref/certcstr51cpp.html) | Checks for string operations on null pointer (rule partially covered). |

#### Coding Standard 4

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **SQL Injection** | [STD-004-CPP] | Prevent SQL injection |

| **Noncompliant Code** |
| --- |
| Without precautions, the untrusted data may maliciously alter the query. |
| uName = getRequestString("username");  uPass = getRequestString("userpassword");  sql = “SELECT \* FROM Users WHERE Name = " + uName + " AND Pass = " +  uPass + ” |

| **Compliant Code** |
| --- |
| The primary means of preventing SQL injection are sanitization and validation, which are typically implemented as parameterized queries and stored procedures. |
| PreparedStatement pStmt = PreparedStatement();  std::cin >> username;  std::cin >> userpassword;  sql = “SELECT \* FROM Users WHERE Name = %s AND Pass = %s;”, username,  userpassword}; |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  1: ValidateInput Data  7: Sanitize Data Sent to Other Systems  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | Medium | P12 | L1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [The Checker Framework](https://wiki.sei.cmu.edu/confluence/display/java/The+Checker+Framework) | 2.1.3 | **Tainting Checker** | Trust and security errors (see Chapter 8) |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/c/CodeSonar) | 7.3p0 | **JAVA.IO.INJ.SQL** | SQL Injection (Java) |
| [Coverity](https://wiki.sei.cmu.edu/confluence/display/java/Coverity) | 7.5 | **SQLI FB.SQL\_PREPARED\_STATEMENT\_GENERATED\_ FB.SQL\_NONCONSTANT\_STRING\_PASSED\_TO\_EXECUTE** | Implemented |
| [Findbugs](https://wiki.sei.cmu.edu/confluence/display/java/Findbugs) | 1.0 | **SQL\_NONCONSTANT\_STRING\_PASSED\_TO\_EXECUTE** | Implemented |
| [Fortify](https://wiki.sei.cmu.edu/confluence/display/java/Fortify) | 1.0 | **HTTP\_Response\_Splitting SQL\_Injection\_\_Persistence SQL\_Injection** | Implemented |
| [Klocwork](https://wiki.sei.cmu.edu/confluence/display/java/Klocwork) |  | **SV.DATA.BOUND SV.DATA.DB SV.HTTP\_SPLIT SV.PATH SV.PATH.INJ SV.SQL** | Implemented |
| [Parasoft Jtest](https://wiki.sei.cmu.edu/confluence/display/java/Parasoft) | 2022.2 | **CERT.IDS00.TDSQL** | Protect against SQL injection |
| [SonarQube](https://wiki.sei.cmu.edu/confluence/display/java/SonarQube) | 6.7 | [**S2077**](https://rules.sonarsource.com/java/RSPEC-2077)  [**S3649**](https://rules.sonarsource.com/java/RSPEC-3649) | [Executing SQL queries is security-sensitive](https://rules.sonarsource.com/java/RSPEC-2077)  [SQL queries should not be vulnerable to injection attacks](https://rules.sonarsource.com/java/RSPEC-3649) |
| [SpotBugs](https://wiki.sei.cmu.edu/confluence/display/java/SpotBugs) | 4.6.0 | **SQL\_NONCONSTANT\_STRING\_PASSED\_TO\_EXECUTE SQL\_PREPARED\_STATEMENT\_GENERATED\_FROM\_NONCONSTANT\_STRING** | Implemented |

#### Coding Standard 5

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **Memory Protection** | [STD-005-CPP] | Do not access freed memory |

| **Noncompliant Code** |
| --- |
| s is dereferenced after it has been deallocated. If this access results in a write-after-free, this can be exploited to run arbitrary code with the permissions of the vulnerable process. |
| #include <new>    struct S {    void f();  };    void g() noexcept(false) {    S \*s = new S;    // ...    delete s;    // ...    s->f();  } |

| **Compliant Code** |
| --- |
| The dynamically allocated memory is not deallocated until it is no longer required. |
| #include <new>    struct S {    void f();  };    void g() noexcept(false) {    S \*s = new S;    // ...    s->f();    delete s;  } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  2: Heed Compiler Warnings  5: Default Deny  6: Adhere to the Principle of Least Privilege  9: Use Effective Quality Assurance Techniques |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Likely | Medium | P18 | L1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
|  |  |  |  |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **dangling\_pointer\_use** |  |
| [Axivion Bauhaus Suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Axivion+Bauhaus+Suite) | 7.2.0 | **CertC++-MEM50** |  |
| [Clang](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Clang) | 3.9 | clang-analyzer-cplusplus.NewDelete  clang-analyzer-alpha.security.ArrayBoundV2 | Checked by clang-tidy, but does not catch all violations of this rule. |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **ALLOC.UAF** | Use after free |
| [Compass/ROSE](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Rose) |  |  |  |
| [Coverity](https://wiki.sei.cmu.edu/confluence/display/c/Coverity) | v7.5.0 | **USE\_AFTER\_FREE** | Can detect the specific instances where memory is deallocated more than once or read/written to the target of a freed pointer |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **C++4303, C++4304** |  |
| [Klocwork](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Klocwork) | 2023.1 | **UFM.DEREF.MIGHT**  **UFM.DEREF.MUST**  **UFM.FFM.MIGHT**  **UFM.FFM.MUST**  **UFM.RETURN.MIGHT**  **UFM.RETURN.MUST**  **UFM.USE.MIGHT**  **UFM.USE.MUST** |  |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/LDRA) | 9.7.1 | **483 S, 484 S** | Partially implemented |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-MEM50-a** | Do not use resources that have been freed |
| [Parasoft Insure++](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) |  |  | Runtime detection |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Polyspace+Bug+Finder) | R2023a | [CERT C++: MEM50-CPP](https://www.mathworks.com/help/bugfinder/ref/certcmem50cpp.html) | Checks for:   * Pointer access out of bounds * Deallocation of previously deallocated pointer * Use of previously freed pointer   Rule partially covered. |
| [PRQA QA-C++](https://www.securecoding.cert.org/confluence/pages/viewpage.action?pageId=142409849) | 4.4 | **4303, 4304** |  |
| [PVS-Studio](https://wiki.sei.cmu.edu/confluence/display/cplusplus/PVS-Studio) | 7.24 | [**V586**](https://pvs-studio.com/en/docs/warnings/v586/), [**V774**](https://pvs-studio.com/en/docs/warnings/v774/) |  |

#### Coding Standard 6

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **Assertions** | [STD-006-CPP] | Use a static assertion to test the value of a constant expression |

| **Noncompliant Code** |
| --- |
| Uses the assert() macro to assert a property concerning a memory-mapped structure that is essential for the code to behave correctly. |
| #include <assert.h>    struct timer {    unsigned **char** MODE;    unsigned **int** DATA;    unsigned **int** COUNT;  };    **int** func(void) {  **assert**(sizeof(struct timer) == sizeof(unsigned **char**) + sizeof(unsigned **int**) + sizeof(unsigned **int**));  } |

| **Compliant Code** |
| --- |
| For constant expressions, a preprocessor conditional statement may be used. |
| struct timer {    unsigned **char** MODE;    unsigned **int** DATA;    unsigned **int** COUNT;  };    #if (sizeof(struct timer) != (sizeof(unsigned char) + sizeof(unsigned int) + sizeof(unsigned int)))    #error "Structure must not have any padding"  #endif |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  2:Heed Compiler Warnings  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Low | Unlikely | High | P1 | L3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Axivion Bauhaus Suite](https://wiki.sei.cmu.edu/confluence/display/c/Axivion+Bauhaus+Suite) | 7.2.0 | **CertC-DCL03** |  |
| [Clang](https://wiki.sei.cmu.edu/confluence/display/c/Clang) | 3.9 | misc-static-assert | Checked by clang-tidy |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/c/CodeSonar) | 7.3p0 | **(customization)** | Users can implement a custom check that reports uses of the assert() macro |
| [Compass/ROSE](https://wiki.sei.cmu.edu/confluence/display/c/Rose) |  |  | Could detect violations of this rule merely by looking for calls to assert(), and if it can evaluate the assertion (due to all values being known at compile time), then the code should use static-assert instead; this assumes ROSE can recognize macro invocation |
| [ECLAIR](https://wiki.sei.cmu.edu/confluence/display/c/ECLAIR) | 1.2 | **CC2.DCL03** | Fully implemented |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/c/LDRA) | 9.7.1 | **44 S** | Fully implemented |

#### Coding Standard 7

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| **Exceptions** | [STD-007-CPP] | Do not abruptly terminate the program |

| **Noncompliant Code** |
| --- |
| The call to f(), which was registered as an exit handler with std::at\_exit(), may result in a call to std::terminate() because throwing\_func() may throw an exception. |
| #include <cstdlib>    void throwing\_func() noexcept(false);    void f() { // Not invoked by the program except as an exit handler.    throwing\_func();  }    **int** main() {    if (0 != std::**atexit**(f)) {      // Handle error    }    // ...  } |

| **Compliant Code** |
| --- |
| f() handles all exceptions thrown by throwing\_func() and does not rethrow. |
| #include <cstdlib>    void throwing\_func() noexcept(false);    void f() { // Not invoked by the program except as an exit handler.    try {      throwing\_func();    } catch (...) {      // Handle error    }  }    **int** main() {    if (0 != std::**atexit**(f)) {      // Handle error    } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  9: Use Effective Quality Assurance Techniques  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Low | Probable | Medium | P4 | L3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **stdlib-use** | Partially checked |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **BADFUNC.ABORT BADFUNC.EXIT** | Use of abort Use of exit |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **C++5014** |  |
| [Klocwork](https://www.securecoding.cert.org/confluence/display/cplusplus/Klocwork) | 2023.1 | **MISRA.TERMINATE**  **CERT.ERR.ABRUPT\_TERM** |  |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/LDRA) | 9.7.1 | **122 S** | Enhanced Enforcement |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-ERR50-a CERT\_CPP-ERR50-b CERT\_CPP-ERR50-c CERT\_CPP-ERR50-d CERT\_CPP-ERR50-e CERT\_CPP-ERR50-f CERT\_CPP-ERR50-g CERT\_CPP-ERR50-h CERT\_CPP-ERR50-i CERT\_CPP-ERR50-j CERT\_CPP-ERR50-k CERT\_CPP-ERR50-l CERT\_CPP-ERR50-m CERT\_CPP-ERR50-n** | The execution of a function registered with 'std::atexit()' or 'std::at\_quick\_exit()' should not exit via an exception Never allow an exception to be thrown from a destructor, deallocation, and swap Do not throw from within destructor There should be at least one exception handler to catch all otherwise unhandled exceptions An empty throw (throw;) shall only be used in the compound-statement of a catch handler Exceptions shall be raised only after start-up and before termination of the program Each exception explicitly thrown in the code shall have a handler of a compatible type in all call paths that could lead to that point Where a function's declaration includes an exception-specification, the function shall only be capable of throwing exceptions of the indicated type(s) Function called in global or namespace scope shall not throw unhandled exceptions Always catch exceptions Properly define exit handlers The 'abort()' function from the 'stdlib.h' or 'cstdlib' library shall not be used Avoid throwing exceptions from functions that are declared not to throw The 'quick\_exit()' and '\_Exit()' functions from the 'stdlib.h' or 'cstdlib' library shall not be used |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Polyspace+Bug+Finder) | R2023a | [CERT C++: ERR50-CPP](https://www.mathworks.com/help/bugfinder/ref/certcerr50cpp.html) | Checks for implicit call to terminate() function (rule partially covered) |
| [PRQA QA-C++](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=88046345) | 4.4 | **5014** |  |
| [PVS-Studio](https://wiki.sei.cmu.edu/confluence/display/cplusplus/PVS-Studio) | 7.24 | [**V667**](https://pvs-studio.com/en/docs/warnings/v667/)**,** [**V2014**](https://pvs-studio.com/en/docs/warnings/v2014/) |  |
| [RuleChecker](https://wiki.sei.cmu.edu/confluence/display/cplusplus/RuleChecker) | 22.10 | **stdlib-use** | Partially checked |

#### Coding Standard 8

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| Expressions | [STD-008-CPP] | Do not access an object outside of its lifetime |

| **Noncompliant Code** |
| --- |
| A pointer to an object is used to call a non-static member function of the object prior to the beginning of the pointer's lifetime, resulting in undefined behavior. |
| struct S {    void mem\_fn();  };    void f() {    S \*s;    s->mem\_fn();  } |

| **Compliant Code** |
| --- |
| Storage is obtained for the pointer prior to calling S::mem\_fn(). |
| struct S {    void mem\_fn();  };    void f() {    S \*s = new S;    s->mem\_fn();    delete s;  } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  2: Heed Compiler Warnings  10: Adopt a Secure Coding Standard |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | High | P6 | L2 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **initializer-list-order** | Fully checked |
| [Clang](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Clang) | 3.9 | -Wreorder |  |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **LANG.STRUCT.INIT.OOMI** | Out of Order Member Initializers |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-OOP53-a** | List members in an initialization list in the order in which they are declared |

#### Coding Standard 9

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| Object Oriented Programming | [STD-009-CPP] | Write constructor member initializers in the canonical order |

| **Noncompliant Code** |
| --- |
| The member initializer list for C::C() attempts to initialize someVal first and then to initialize dependsOnSomeVal to a value dependent on someVal. Because the declaration order of the member variables does not match the member initializer order, attempting to read the value of someVal results in an unspecified value being stored into dependsOnSomeVal. |
| class C {  **int** dependsOnSomeVal;  **int** someVal;    public:    C(**int** val) : someVal(val), dependsOnSomeVal(someVal + 1) {}  }; |

| **Compliant Code** |
| --- |
| Change the declaration order of the class member variables so that the dependency can be ordered properly in the constructor's member initializer list. |
| class C {  **int** someVal;  **int** dependsOnSomeVal;    public:    C(**int** val) : someVal(val), dependsOnSomeVal(someVal + 1) {}  }; |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):**  4: Keep It Simple |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Medium | Unlikely | Medium | P4 | L3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **initializer-list-order** | Fully checked |
| [Axivion Bauhaus Suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Axivion+Bauhaus+Suite) | 7.2.0 | **CertC++-OOP53** |  |
| [Clang](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Clang) | 3.9 | -Wreorder |  |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/cplusplus/CodeSonar) | 7.3p0 | **LANG.STRUCT.INIT.OOMI** | Out of Order Member Initializers |
| [Helix QAC](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Helix+QAC) | 2023.1 | **C++4053** |  |
| [Klocwork](https://www.securecoding.cert.org/confluence/display/cplusplus/Klocwork) | 2023.1 | **CERT.OOP.CTOR.INIT\_ORDER** |  |
| [LDRA tool suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/LDRA) | 9.7.1 | **206 S** | Fully implemented |
| [Parasoft C/C++test](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Parasoft) | 2022.2 | **CERT\_CPP-OOP53-a** | List members in an initialization list in the order in which they are declared |
| [Polyspace Bug Finder](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Polyspace+Bug+Finder) | R2023a | [CERT C++: OOP53-CPP](https://www.mathworks.com/help/bugfinder/ref/certcoop53cpp.html) | Checks for members not initialized in canonical order (rule fully covered) |
| [PRQA QA-C++](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=88046345) | 4.4 | **4053** |  |
| [RuleChecker](https://wiki.sei.cmu.edu/confluence/display/cplusplus/RuleChecker) | 22.10 | **initializer-list-order** | Fully checked |
| [SonarQube C/C++ Plugin](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=88046388) | 4.10 | [**S3229**](https://www.sonarsource.com/products/codeanalyzers/sonarcfamilyforcpp/rules-cpp.html#RSPEC-3229) |  |

#### Coding Standard 10

| **Coding Standard** | **Label** | **Name of Standard** |
| --- | --- | --- |
| API Vulnerability Assessment | [STD-010-CPP] | Prevent data races when accessing bit-fields from multiple threads |

| **Noncompliant Code** |
| --- |
| Adjacent bit-fields may be stored in a single memory location. Consequently, modifying adjacent bit-fields in different threads is undefined behavior |
| struct MultiThreadedFlags {  unsigned int flag1 : 2;  unsigned int flag2 : 2;  };    MultiThreadedFlags flags;    void thread1() {  flags.flag1 = 1;  }    void thread2() {  flags.flag2 = 2;  } |

| **Compliant Code** |
| --- |
| compliant solution protects all accesses of the flags with a mutex, thereby preventing any data races. |
| #include <mutex>    struct MultiThreadedFlags {  unsigned int flag1 : 2;  unsigned int flag2 : 2;  };    struct MtfMutex {  MultiThreadedFlags s;  std::mutex mutex;  };    MtfMutex flags;    void thread1() {  std::lock\_guard<std::mutex> lk(flags.mutex);  flags.s.flag1 = 1;  }    void thread2() {  std::lock\_guard<std::mutex> lk(flags.mutex);  flags.s.flag2 = 2;  } |

**Note: Stop here for the milestone. Complete this section for Project One in Module Six.**

| **Principles(s):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| medium | PROBABLE | MEDIUM | **P8** | **L2** |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| [Astrée](https://wiki.sei.cmu.edu/confluence/pages/viewpage.action?pageId=222953724) | 22.10 | **read\_write\_data\_race**  **write\_write\_data\_race** | Supported |
| [Axivion Bauhaus Suite](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Axivion+Bauhaus+Suite) | 7.2.0 | **CertC++-CON52** |  |
| [CodeSonar](https://wiki.sei.cmu.edu/confluence/display/c/CodeSonar) | 7.3p0 | **CONCURRENCY.DATARACE** | Data Race |
| [Coverity](https://wiki.sei.cmu.edu/confluence/display/cplusplus/Coverity) | 6.5 | **RACE\_CONDITION** | Fully implemented |

### Defense-in-Depth Illustration

This illustration provides a visual representation of the defense-in-depth best practice of layered security.



## Project One

There are seven steps outlined below that align with the elements you will be graded on in the accompanying rubric. When you complete these steps, you will have finished the security policy.

### Revise the C/C++ Standards

You completed one of these tables for each of your standards in the Module Three milestone. In Project One, add revisions to improve the explanation and examples as needed. Add rows to accommodate additional examples of compliant and noncompliant code. Coding standards begin on the security policy.

### Risk Assessment

Complete this section on the coding standards tables. Enter high, medium, or low for each of the headers, then rate it overall using a scale from 1 to 5, 5 being the greatest threat. You will address each of the seven policy standards. Fill in the columns of severity, likelihood, remediation cost, priority, and level using the values provided in the appendix.

### Automated Detection

Complete this section of each table on the coding standards to show the tools that may be used to detect issues. Provide the tool name, version, checker, and description. List one or more tools that can automatically detect this issue and its version number, name of the rule or check (preferably with link), and any relevant comments or description—if any. This table ties to a specific C++ coding standard.

### Automation

Provide a written explanation using the image provided.



Automation will be used for the enforcement of and compliance to the standards defined in this policy. Green Pace already has a well-established DevOps process and infrastructure. Define guidance on where and how to modify the existing DevOps process to automate enforcement of the standards in this policy. Use the DevSecOps diagram and provide an explanation using that diagram as context.

[Insert your written explanations here.]

### Summary of Risk Assessments

Consolidate all risk assessments into one table including both coding and systems standards, ordered by standard number.

| Rule | Severity | Likelihood | Remediation Cost | Priority | Level |
| --- | --- | --- | --- | --- | --- |
| STD-001-CPP | High | Unlikely | Medium | High | 3 |
| STD-002-CPP | High | probable | medium | p12 | 1 |
| STD-003-CPP | high | likely | medium | P18 | 1 |
| STD-004-CPP | high | probable | medium | P12 | 1 |
| STD-005-CPP | high | likely | medium | P12 | 1 |
| STD-006-CPP | low | unlikey | high | P1 | 3 |
| STD-007-CPP | low | probable | medium | P4 | 3 |
| STD-008-CPP | HIGH | probable | high | p6 | 2 |
| STD-009-CPP | medium | unlikely | medium | p4 | 3 |
| STD-010-CPP | medium | probable | medium | p8 | 2 |

### Create Policies for Encryption and Triple A

Include all three types of encryption (in flight, at rest, and in use) and each of the three elements of the Triple-A framework using the tables provided***.***

* 1. Explain each type of encryption, how it is used, and why and when the policy applies.
  2. Explain each type of Triple-A framework strategy, how it is used, and why and when the policy applies.

Write policies for each and explain what it is, how it should be applied in practice, and why it should be used.

| 1. **Encryption** | **Explain what it is and how and why the policy applies.** |
| --- | --- |
| Encryption in rest | Rest encryption provides security for data at rest, which includes data that is stored on various devices such as hard drives, computers, mobile phones, and cloud platforms. The data is safeguarded by encryption tools, as well as disk encryption and mobile device and computer security features, among others. |
| Encryption at flight | Encryption in transit is concerned with safeguarding data that is in motion, whether it is being transferred between devices within a network or outside of a network. This can be achieved through various measures such as email encryption, DLP solutions, and robust network security features like firewalls and authentication. It is also critical to consider the path that data may take and ensure that the path is secure to prevent unauthorized access or interception of the data. |
| Encryption in use | Encryption in use is concerned with safeguarding data that is actively being used, edited, or created. To protect this data, it is important to establish data control and protection measures before and during use. This can include managing access rights and identities to minimize the risk of unauthorized access or exposure of the data. By implementing these measures, the confidentiality, integrity, and availability of the data can be maintained throughout its lifecycle. |

| 1. **Triple-A Framework\*** | **Explain what it is and how and why the policy applies.** |
| --- | --- |
| Authentication | Authentication is the process of verifying one's identity, which can involve various methods such as static passwords, one-time passwords, certifications, and biometric credentials. These methods are employed to ascertain that the individual is indeed the person they claim to be. |
| Authorization | Authorization is a crucial component of information and computer security that specifies the access rights and privileges of a user. While authentication verifies the user's identity, authorization determines what the user is allowed to access or not access, thereby minimizing potential vulnerabilities. This ensures that individuals cannot interact with sensitive data that they do not require access to, and restricts the permissions that users have during access. |
| Accounting | Accounting refers to the procedure of recording and tracking activity during interactions with a system, including timestamps, accessed resources, and data transfer information. This information is useful for creating a "bread crumb trail" of user activity and can also aid forensic analysis and investigation if needed. By maintaining a record of user activity, organizations can identify potential security breaches or unauthorized access and take appropriate measures to prevent them. |

**\***Use this checklist for the Triple A to be sure you include these elements in your policy:

* User logins
* Changes to the database
* Addition of new users
* User level of access
* Files accessed by users

### Map the Principles

Map the principles to each of the standards, and provide a justification for the connection between the two. In the Module Three milestone, you added definitions for each of the 10 principles provided. Now it’s time to connect the standards to principles to show how they are supported by principles. You may have more than one principle for each standard, and the principles may be used more than once. Principles are numbered 1 through 10. You will list the number or numbers that apply to each standard, then explain how each of these principles supports the standard. This exercise demonstrates that you have based your security policy on widely accepted principles. Linking principles to standards is a best practice.

**NOTE:** Green Pace has already successfully implemented the following:

* Operating system logs
* Firewall logs
* Anti-malware logs

The only item you must complete beyond this point is the Policy Version History table.

## Audit Controls and Management

Every software development effort must be able to provide evidence of compliance for each software deployed into any Green Pace managed environment.

Evidence will include the following:

* Code compliance to standards
* Well-documented access-control strategies, with sampled evidence of compliance
* Well-documented data-control standards defining the expected security posture of data at rest, in flight, and in use
* Historical evidence of sustained practice (emails, logs, audits, meeting notes)

## Enforcement

The office of the chief information security officer (OCISO) will enforce awareness and compliance of this policy, producing reports for the risk management committee (RMC) to review monthly. Every system deployed in any environment operated by Green Pace is expected to be in compliance with this policy at all times.

Staff members, consultants, or employees found in violation of this policy will be subject to disciplinary action, up to and including termination.

## Exceptions Process

Any exception to the standards in this policy must be requested in writing with the following information:

* Business or technical rationale
* Risk impact analysis
* Risk mitigation analysis
* Plan to come into compliance
* Date for when the plan to come into compliance will be completed

Approval for any exception must be granted by chief information officer (CIO) and the chief information security officer (CISO) or their appointed delegates of officer level.

Exceptions will remain on file with the office of the CISO, which will administer and govern compliance.

## Distribution

This policy is to be distributed to all Green Pace IT staff annually. All IT staff will need to certify acceptance and awareness of this policy annually.

## Policy Change Control

This policy will be automatically reviewed annually, no later than 365 days from the last revision date. Further, it will be reviewed in response to regulatory or compliance changes, and on demand as determined by the OCISO.

## Policy Version History

| Version | Date | Description | Edited By | Approved By |
| --- | --- | --- | --- | --- |
| 1.0 | 08/05/2020 | Initial Template | David Buksbaum |  |
| 1.1 | 03/25/2023 | Module 3 Milestone | Anthony Parker |  |
| 1.1 | 04/12/2023 | module 6 Milestone | Anthony Parker |  |

## Appendix A Lookups

### Approved C/C++ Language Acronyms

| Language | Acronym |
| --- | --- |
| C++ | CPP |
| C | CLG |
| Java | JAV |