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



# Green Pace Secure Development Policy

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## 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 | Validate input data is used to ensure the accuracy of data entering the workflow. As a result, corrupted data cannot enter the database. Validating the input should be done before processing any possibly untrustworthy data. |
| 1. Heed Compiler Warnings | Compilers are meant to alert programmers to problems when they write code. Simply put, heeding these means taking proactive steps to address and recognize these alerts. These warnings are meant to help programmers find runtime issues, which might be difficult to find. They are not meant to be inconvenient. |
| 1. Architect and Design for Security Policies | Designed artifacts that outline security countermeasures are referred to as architect and design. Access between entities is outlined in a security policy statement. The functions that these entities possess are also outlined. The policy also specifies the necessary level of protection and what to do if the standards are not met. |
| 1. Keep It Simple | This principle means to keep design not complex and should be as simple as possible. |
| 1. Default Deny | Deny by default. An ability or course of action should be denied unless specifically allowed. This stops unexpected situations from carrying out possibly harmful or even unintentional actions. |
| 1. Adhere to the Principle of Least Privilege | granting the user, the fewest amount of permissions required is known as the least privilege. Permissions that are not required for a user's intended use should never be granted. |
| 1. Sanitize Data Sent to Other Systems | Data cleaning is the process of sanitizing data. Before data is processed, undesirable characters should be removed. When data crosses a trust barrier, it should first undergo this "sanitation" before continuing. |
| 1. Practice Defense in Depth | When you have several separate layers of security in place for a single attack, you are implementing defense in depth. The concept is that the next layer of protection will protect you in case the first one fails. |
| 1. Use Effective Quality Assurance Techniques | Even though there are many QA techniques, the following are a some of the better ones: Establish an approach, explain guidelines and requirements, and test regularly and early. |
| 1. Adopt a Secure Coding Standard | Standards and recommendations for secure code are meant to avert vulnerabilities. A few examples of guidelines for writing secure code are CERT, CVE, NVD, OWASP, and DISA STIG. |

### 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** | **Obey the one-definition rule** |
| --- | --- | --- |
| **Data Type** | [STD-001-CPP] | Every program shall contain exactly one definition of every non-inline function or variable that is odr-used in that program; no diagnostic required. The definition can appear explicitly in the program, it can be found in the standard or a user-defined library, or (when appropriate) it is implicitly-defined. An inline function shall be defined in every translation unit in which it is odr-used. |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, 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** |
| --- |
| The correct mitigation depends on programmer intent. If the programmer intends for the same class definition to be visible in both translation units because of common usage, the solution is to use a header file to introduce the object into both translation units, as shown in this compliant solution. |
| // 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

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

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astree | 22.10 | type-compatibility  definition-duplicate  undefined-extern  undefined-extern-pure-virtual  external-file-spreading  type-file-spreading | Partially checked |
| Axivion Bauhaus Suite | 7.2.0 | CertC++-DCL60 | - |
| CodeSonar | 8.1 | LANG.STRUCT.DEF.FDH  LANG.STRUCT.DEF.ODH | Function defined in header file  Object defined in header file |
| LDRA tool suite | 9.7.1 | 286 S, 287 S | Fully implemented |

#### Coding Standard 2

| **Coding Standard** | **Label** | **Do not read uninitialized memory** |
| --- | --- | --- |
| **Data Value** | [STD-002-CPP] | The default initialization of an object is described by paragraph 7 of the same subclause:  To default-initialize an object of type T means:  — if T is a (possibly cv-qualified) class type, the default constructor for T is called (and the initialization is ill-formed if T has no default constructor or overload resolution results in an ambiguity or in a function that is deleted or inaccessible from the context of the initialization);  — if T is an array type, each element is default-initialized;  — otherwise, no initialization is performed.  If a program calls for the default initialization of an object of a const-qualified type T, T shall be a class type with a user-provided default constructor.  As a result, objects of type T with automatic or dynamic storage duration must be explicitly initialized before having their value read as part of an expression unless T is a class type or an array thereof or is an unsigned narrow character type. If T is an unsigned narrow character type, it may be used to initialize an object of unsigned narrow character type, which results in both objects having an indeterminate value. This technique can be used to implement copy operations such as std::memcpy() without triggering undefined behavior. |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, an 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** |
| --- |
| In this compliant solution, the 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | Medium | 12 | 1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astrée | 22.10 | uninitialized-read | Partially checked |
| Helix QAC | 2021.2 | C++2726, C++2727, C++2728, C++2961, C++2962, C++2963, C++2966, C++2967, C++2968, C++2971, C++2972, C++2973, C++2976, C++2977, C++2978 | - |
| LDRA tool suite | 9.7.1 | 53 D, 69 D, 631 S, 652 S | Partially implemented |
| Polyspace Bug Finder | R2022 | CERT C++: EXP53-CPP | Checks for:   * Non-initialized variable * Non-initialized pointer   Rule partially covered. |

#### Coding Standard 3

| **Coding Standard** | **Label** | **Do not attempt to create a std::string from a null pointer** |
| --- | --- | --- |
| **String Correctness** | [STD-003-CPP] | The std::basic\_string type uses the traits design pattern to handle implementation details of the various string types, resulting in a series of string-like classes with a common, underlying implementation. Specifically, the std::basic\_string class is paired with std::char\_traits to create the std::string, std::wstring, std::u16string, and std::u32string classes. The std::char\_traits class is explicitly specialized to provide policy-based implementation details to the std::basic\_string type. One such implementation detail is the std::char\_traits::length() function, which is frequently used to determine the number of characters in a null-terminated string. According to the C++ Standard, [char.traits.require], Table 62 [ISO/IEC 14882-2014], passing a null pointer to this function is undefined behavior because it would result in dereferencing a null pointer. |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, 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** |
| --- |
| In this compliant solution, 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Likely | Medium | 18 | 1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astrée | 20.10 | Assert\_failure | - |
| Helix QAC | 2021.2 | C++4770, C++4771, C++4772, C++4773, C++4774 | - |
| Klocwork | 2021.1 | 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 | 2021.1 | CERT\_CPP-STR51-a | Avoid null pointer dereferencing |

#### Coding Standard 4

| **Coding Standard** | **Label** | **Prevent SQL injection** |
| --- | --- | --- |
| **SQL Injection** | [STD-004-JAVA] | SQL injection vulnerabilities arise in applications where elements of a SQL query originate from an untrusted source. Without precautions, the untrusted data may maliciously alter the query, resulting in information leaks or data modification. The primary means of preventing SQL injection are sanitization and validation, which are typically implemented as parameterized queries and stored procedures. |

| **Noncompliant Code** |
| --- |
| This noncompliant code example shows JDBC code to authenticate a user to a system. The password is passed as a char array, the database connection is created, and then the passwords are hashed. |
| 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | Medium | 12 | 1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Coverity | 7.5 | SQLI  FB.SQL\_PREPARED\_STATEMENT\_GENERATED\_  FB.SQL\_NONCONSTANT\_STRING\_PASSED\_TO\_EXECUTE | Implemented |
| The Checker Framework | 2.1.3 | Tainting Checker | Trust and security errors (see Chapter 8) |
| Fortify | 1.0 | HTTP\_Response\_Splitting  SQL\_Injection\_\_Persistence  SQL\_Injection | Implemented |
| Parasoft Jtest | 2021.1 | CERT.IDS00.TDSQL | Protect against SQL injection |

#### Coding Standard 5

| **Coding Standard** | **Label** | **Do not access freed memory** |
| --- | --- | --- |
| **Memory Protection** | [STD-005-CPP] | Evaluating a pointer—including dereferencing the pointer, using it as an operand of an arithmetic operation, type casting it, and using it as the right-hand side of an assignment—into memory that has been deallocated by a memory management function is undefined behavior. Pointers to memory that has been deallocated are called dangling pointers. Accessing a dangling pointer can result in exploitable vulnerabilities.  It is at the memory manager's discretion when to reallocate or recycle the freed memory. When memory is freed, all pointers into it become invalid, and its contents might either be returned to the operating system, making the freed space inaccessible, or remain intact and accessible. As a result, the data at the freed location can appear to be valid but change unexpectedly. Consequently, memory must not be written to or read from once it is freed. |

| **Noncompliant Code** |
| --- |
| n this noncompliant code example, s is dereferenced after it has been deallocated. If this access results in a write-after-free, the vulnerability can be exploited to run arbitrary code with the permissions of the vulnerable process. Typically, dynamic memory allocations and deallocations are far removed, making it difficult to recognize and diagnose such problems. |
| #include <new>    struct S {  void f();  };    void g() noexcept(false) {  S \*s = new S;  // ...  delete s;  // ...  s->f();  } |

| **Compliant Code** |
| --- |
| in this compliant solution, 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Likely | Medium | 18 | 1 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| 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. |
| 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 |
| Parasoft C/C++test | 2021.1 | CERT\_CPP-MEM50-a | Do not use resources that have been freed |
| Parasoft Insure++ | - | - | Runtime detection |

#### Coding Standard 6

| **Coding Standard** | **Label** | **Use a static assertion to test the value of a constant expression** |
| --- | --- | --- |
| **Assertions** | [STD-006-CPP] | Assertions are a valuable diagnostic tool for finding and eliminating software defects that may result in vulnerabilities (see MSC11-C. Incorporate diagnostic tests using assertions). The runtime assert() macro has some limitations, however, in that it incurs a runtime overhead and because it calls abort(). Consequently, the runtime assert() macro is useful only for identifying incorrect assumptions and not for runtime error checking. As a result, runtime assertions are generally unsuitable for server programs or embedded systems. |

| **Noncompliant Code** |
| --- |
| This 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 assertions involving only constant expressions, a preprocessor conditional statement may be used, as in this compliant solution: |
| 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Low | Unlikely | High | 1 | 3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Axivion Bauhaus Suite | 7.2.0 | CertC-DCL03 | - |
| Clang | 3.9 | misc-static-assert | Checked by clang-tidy |
| ECLAIR | 1.2 | CC2.DCL03 | Fully implemented |
| LDRA tool suite | 9.7.1 | 44 S | Fully implemented |

#### Coding Standard 7

| **Coding Standard** | **Label** | **Do not abruptly terminate the program** |
| --- | --- | --- |
| **Exceptions** | [STD-007-CPP] | The std::abort(), std::quick\_exit(), and std::\_Exit() functions are used to terminate the program in an immediate fashion. They do so without calling exit handlers registered with std::atexit() and without executing destructors for objects with automatic, thread, or static storage duration. How a system manages open streams when a program ends is implementation-defined [ISO/IEC 9899:1999]. Open streams with unwritten buffered data may or may not be flushed, open streams may or may not be closed, and temporary files may or may not be removed. Because these functions can leave external resources, such as files and network communications, in an indeterminate state, they should be called explicitly only in direct response to a critical error in the application. (See ERR50-CPP-EX1 for more information.)  The std::terminate() function calls the current terminate\_handler function, which defaults to calling std::abort(). |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, 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** |
| --- |
| In this compliant solution, 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Low | Probable | Medium | 4 | 3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| CodeSonar | 6.1p0 | BADFUNC.ABORT  BADFUNC.EXIT | Use of abort  Use of exit |
| Klocwork | 2021.1 | MISRA.CATCH.ALL  CERT.ERR.ABRUPT\_TERM | - |
| LDRA tool suite | 9.7.1 | 122 S | Enhanced Enforcement |
| Polyspace Bug Finder | R2021a | CERT C++: ERR50-CPP | Checks for implicit call to terminate() function (rule partially covered) |

#### Coding Standard 8

| **Coding Standard** | **Label** | **Write constructor member initializers in the canonical order** |
| --- | --- | --- |
| [Student Choice] | [STD-008-CPP] | The member initializer list for a class constructor allows members to be initialized to specified values and for base class constructors to be called with specific arguments. However, the order in which initialization occurs is fixed and does not depend on the order written in the member initializer list. |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, 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** |
| --- |
| This compliant solution changes 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):** [Name the principle and explain how it maps to this standard.] |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| Medium | Unlikely | Medium | 4 | 3 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astrée | 20.10 | initializer-list-order | Fully checked |
| Axivion Bauhaus Suite | 7.2.0 | CertC++-OOP53 | - |
| LDRA tool suite | 9.7.1 | 206 S | Fully implemented |
| Parasoft C/C++test | 2021.1 | CERT\_CPP-OOP53-a | List members in an initialization list in the order in which they are declared |

#### Coding Standard 9

| **Coding Standard** | **Label** | **Use valid iterator ranges** |
| --- | --- | --- |
| Containers | [STD-009-CPP] | When iterating over elements of a container, the iterators used must iterate over a valid range. An iterator range is a pair of iterators that refer to the first and past-the-end elements of the range respectively. |

| **Noncompliant Code** |
| --- |
| In this noncompliant example, the two iterators that delimit the range point into the same container, but the first iterator does not precede the second. On each iteration of its internal loop, std::for\_each() compares the first iterator (after incrementing it) with the second for equality; as long as they are not equal, it will continue to increment the first iterator. Incrementing the iterator representing the past-the-end element of the range results in undefined behavior. |
| #include <algorithm>  #include <iostream>  #include <vector>    void f(const std::vector<int> &c) {  std::for\_each(c.end(), c.begin(), [](int i) { std::cout << i; });  } |

| **Compliant Code** |
| --- |
| In this compliant solution, the iterator values passed to std::for\_each() are passed in the proper order. |
| #include <algorithm>  #include <iostream>  #include <vector>    void f(const std::vector<int> &c) {  std::for\_each(c.begin(), c.end(), [](int i) { std::cout << i; });  } |

**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** |
| --- | --- | --- | --- | --- |
| High | Probable | High | 6 | 2 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astrée | 20.10 | overflow\_upon\_dereference | - |
| Helix QAC | 2021.2 | C++3802 | - |
| Parasoft C/C++test | 2021.1 | CERT\_CPP-CTR53-a  CERT\_CPP-CTR53-b | Do not use an iterator range that isn't really a range  Do not compare iterators from different containers |
| PVS-Studio | 7.14 | V539, V662, V789 | - |

#### Coding Standard 10

| **Coding Standard** | **Label** | **Do not access an object outside of its lifetime** |
| --- | --- | --- |
| Expressions | [STD-010-CPP] | Every object has a lifetime in which it can be used in a well-defined manner. The lifetime of an object begins when sufficient, properly aligned storage has been obtained for it and its initialization is complete. The lifetime of an object ends when a nontrivial destructor, if any, is called for the object and the storage for the object has been reused or released. Use of an object, or a pointer to an object, outside of its lifetime frequently results in undefined behavior. |

| **Noncompliant Code** |
| --- |
| In this noncompliant code example, 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** |
| --- |
| [In this compliant solution, storage is obtained for the pointer prior to calling S::mem\_fn(). |
| [Compliant code block; code should be indented using 12-point Courier New font.] |

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

| struct S {  void mem\_fn();  };    void f() {  S \*s = new S;  s->mem\_fn();  delete s;  } |
| --- |

**Threat Level**

| **Severity** | **Likelihood** | **Remediation Cost** | **Priority** | **Level** |
| --- | --- | --- | --- | --- |
| High | Probable | High | 6 | 2 |

**Automation**

| **Tool** | **Version** | **Checker** | **Description Tool** |
| --- | --- | --- | --- |
| Astrée | 20.10 | return-reference-local  dangling\_pointer\_use | Partially checked |
| Clang | 3.9 | -Wdangling-initializer-list | Catches some lifetime issues related to incorrect use of std::initializer\_list<> |
| CodeSonar | 6.1p0 | IO.UAC  ALLOC.UAF | Use after close  Use after free |
| Parasoft C/C++test | 2021.1 | CERT\_CPP-EXP54-a  CERT\_CPP-EXP54-b  CERT\_CPP-EXP54-c | Do not use resources that have been freed  The address of an object with automatic storage shall not be returned from a function  The address of an object with automatic storage shall not be assigned to another object that may persist after the first object has ceased to exist |

### 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.

DevOps Becomes DevSecOps by incorporating security measures into every stage of the DevOps toolchain. During the phase of "Assess and Plan," threat modeling the "Design" and "Build" stages handle IDE security. Unit, integration, and other tests are added to the "Verify & Test" phase, along with automated security scanning and static application testing.

After going into production, integrity checks and defense-in-depth strategies are used in automated testing to continue prevention. Among the techniques for ongoing threat detection are network monitoring, penetration testing, network monitoring, and performance logs. Like quality assurance testing, security testing ought to be done frequently and early on.

### 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-002-CPP | High | Probable | Medium | High (12) | 1 |
| STD-003-CPP | High | Likely | Medium | High (18) | 1 |
| STD-004-CPP | High | Probable | Medium | High (12) | 1 |
| STD-005-CPP | High | Likely | Medium | High (18) | 1 |
| STD-010-CPP | High | Probable | High | Medium (6) | 2 |
| STD-006-CLG | Low | Unlikely | High | Low (1) | 3 |
| STD-007-CPP | Low | Probable | Medium | Low (4) | 3 |
| STD-008-CPP | Medium | Unlikely | Medium | Low (4) | 3 |
| STD-001-CPP | High | Unlikely | High | Low (3) | 3 |
| STD-009-CPP | High | Probable | High | Medium (6) | 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 at rest | Data that is stored is protected while it is encrypted. Hard drives, phones, computers, and cloud assets are a few examples. Encryption tools, disk encryption, computer and mobile device security can all be used to protect this data. |
| Encryption in flight | The goal of encryption at flight is to safeguard moving data. This can occur when traveling outside of a network or between two devices that are connected. Examples of how this can be secured include DLP programs, email encryption, and strong network security elements like firewalls and authentication. It is important to take into account both the potential direction and security of the data flow. |
| Encryption in use | Data that is created, updated, or otherwise classified as being in use is protected when encryption is used. Ensure data control and protection are in place both before and after use is one way to protect this data. Managing identity and access permissions will help reduce the risk to this data. |

| 1. **Triple-A Framework\*** | **Explain what it is and how and why the policy applies.** |
| --- | --- |
| Authentication | Verifying one's identity is an example of authentication. This can include multiple types, but common examples include biometric credentials, certifications, static passwords, and one-time passwords. These identity verification methods help to confirm that a person is who they say they are. |
| Authorization | Authorization is an important part of computer and information security as it defines a user's access rights and privileges. While authorization limits potential vulnerabilities when someone is interacting with sensitive material they may not need to access or the permissions one may have during access, authentication verifies an identity. Authorization establishes what a user may and cannot access in the first place. |
| Accounting | Accounting is the process of monitoring system activities by displaying data transfer information, used resources, and timestamps. This is helpful to create a "bread crumb trail" of user actions and, in the unlikely event that forensic analysis and investigation are needed, for those same reasons. |

**\***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 |  |
| 1.2 | 05/15/2024 | Module3 Milestone | Kyle Lund |  |
| 1.3 | 05/15/2024 | Module6 Project | Kyle Lund |  |

## Appendix A Lookups

### Approved C/C++ Language Acronyms

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