Green Pace

Green Pace Secure Development Policy

Contents

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.

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. Validate Input Data	We need to ensure that we are validating all data that is input and checking to be sure none of in data appears suspicious or potentially malicious.
2. Heed Compiler Warnings	Anytime we are presented with Compiler Warnings we should not over look them. Read the warning completely and if you are unsure, reach out to someone to gain further clarification to see if it may cause issues later on.
3. Architect and Design for Security Policies	Always keep security policies in mind while designing and architecting systems. With this topic at the forefront of our thoughts we can design around the security principals we need in place.
4. Keep It Simple	Simple code is effective. When it gets over complicated then more errors can be introduced and can make it harder to debug.
5. Default Deny	Any traffic to our network that isn't specifically and clearly authorized should be denied access by default. This is best practice for keeping data secured.
6. Adhere to the Principle of Least Privilege	We shouldn't be granting any additional privileges to users, entities, or organizations outside of what is strictly necessary.
7. Sanitize Data Sent to Other Systems	If we are pushing data to another system we have to ensure it won't get flagged as potential spam, or suspicious data so we have to cleanse our data of any potential characters that could get it marked as such.
8. Practice Defense in Depth	Layer multiple levels of security practices on top of each other so that our systems are protected from a variety of threats across the board.
9. Use Effective Quality Assurance	Testing thoroughly is key to our success, by ensuring we have a high quality of code and security we can be sure we keep our systems safe from external threats.

Principles	Write a short paragraph explaining each of the 10 principles of security.
Techniques	
10. Adopt a Secure Coding Standard	We have to set our own standard for writing code. If we can set our own standards for the quality of work we want to produce then we can keep ourselves, each other, and all members of the team accountable to our standards for security.

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	INT30-C	Ensure that unsigned integer operations do not wrap.

Noncompliant Code

This noncompliant code example can result in an unsigned integer wrap during the addition of the unsigned operands ui_a and ui_b. If this behavior is unexpected, the resulting value may be used to allocate insufficient memory for a subsequent operation or in some other manner that can lead to an exploitable vulnerability

```
void func(unsigned int ui_a, unsigned int ui_b) {
  unsigned int usum = ui_a + ui_b;
  /* ... */
}
```

Compliant Code

This compliant solution performs a precondition test of the operands of the addition to guarantee there is no possibility of unsigned wrap:

```
#include <limits.h>

void func(unsigned int ui_a, unsigned int ui_b) {
  unsigned int usum;
  if (UINT_MAX - ui_a < ui_b) {
    /* Handle error */
  } else {
    usum = ui_a + ui_b;
  }
  /* ... */
}
```

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

Principles(s): Architect and Design for Security Policies. Keeping code from wrapping ensure stable structures and allows us to design with security measures in mind.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Likely	High	P9	L2

Automation

Tool	Version	Checker	Description Tool
Astrèe	22.04	Integer-overflow	Fully checked
Axivion Bauhaus Suite	7.2.0	CertC-INT30	Implemented
CodeSonar	7.3p0	ALLOC.SIZE.ADDOFLOW ALLOC.SIZE.IOFLOW ALLOC.SIZE.MULOFLOW ALLOC.SIZE.SUBUFLOW MISC.MEM.SIZE.ADDOFLOW MISC.MEM.SIZE.BAD MISC.MEM.SIZE.MULOFLOW MISC.MEM.SIZE.SUBUFLOW	Addition overflow of allocation size Integer overflow of allocation size Multiplication overflow of allocation size Subtraction underflow of allocation size Addition overflow of size Unreasonable size argument Multiplication overflow of size Subtraction underflow of size
Coverity	2017.07	INTEGER_OVERFLOW	Implemented

Coding Standard 2

Coding Standard	Label	Name of Standard
Data Value	FIO30-C	Exclude user input from format strings

Noncompliant Code

The incorrect_password() function in this noncompliant code example is called during identification and authentication to display an error message if the specified user is not found or the password is incorrect. The function accepts the name of the user as a string referenced by user. This is an exemplar of untrusted data that originates from an unauthenticated user. The function constructs an error message that is then output to stderr using the C Standard fprintf() function.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

void incorrect_password(const char *user) {
  int ret;
  /* User names are restricted to 256 or fewer characters */
  static const char msg_format[] = "%s cannot be authenticated.\n";
  size_t len = strlen(user) + sizeof(msg_format);
  char *msg = (char *)malloc(len);
```

Noncompliant Code

```
 if (msg == NULL) {
   /* Handle error */
 }
 ret = snprintf(msg, len, msg_format, user);
 if (ret < 0) {
   /* Handle error */
 } else if (ret >= len) {
   /* Handle truncated output */
 }
 fprintf(stderr, msg);
 free(msg);
}
```

Compliant Code

This compliant solution fixes the problem by replacing the fprintf() call with a call to fputs(), which outputs msg directly to stderr without evaluating its contents:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

void incorrect_password(const char *user) {
 int ret;
 /* User names are restricted to 256 or fewer characters */
 static const char msg_format[] = "%s cannot be authenticated.\n";
 size_t len = strlen(user) + sizeof(msg_format);
 char *msg = (char *)malloc(len);
 if (msg == NULL) {
   /* Handle error */
 }
 ret = snprintf(msg, len, msg_format, user);
 if (ret < 0) {
   /* Handle error */
 } else if (ret >= len) {
   /* Handle truncated output */
 }
 fputs(msg, stderr);
 free(msg);
}
```

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

Principles(s): Validate Input Data. We need to exclude user input from format strings to avoid breaks or gaps in security.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Likely	Medium	P18	L1

Automation

Tool	Version	Checker	Description Tool
Astrée	22.04		Supported via stubbing/taint analysis
Axivion Bauhaus Suite	7.2.0	CertC-FIO30	Partially Implemented
CodeSonar	7.3p0	IOINJ.FMT MISC.FMT	Format string injection Format String
Coverity	2017.07	TAINTED_STRING	IMPLEMENTED

Coding Standard 3

Coding Standard	Label	Name of Standard
String Correctness	STR51-CPP	Do not attempt to create a std::string from 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): Heed Compiler warnings. Creating a std::string from a null pointer will throw a compiler warning and this should be addressed before pushing code to prod.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Likely	Medium	P18	L1

Automation

Tool	Version	Checker	Description Tool
Astrée	22.10	Assert_failure	
CodeSonar	7.3p0	LANG.MEM.NPD	Null Pointer Dereference
Helix QAC	2023.1	DF4770, DF4771, DF4772, DF4773, DF4774	
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	

Coding Standard 4

Coding Standard	Label	Name of Standard
SQL Injection	FIO39-C.	Do not alternately input and output from a stream without an intervening flush or positioning call

Noncompliant Code

This noncompliant code example appends data to a file and then reads from the same file:

```
#include <stdio.h>

enum { BUFFERSIZE = 32 };

extern void initialize_data(char *data, size_t size);

void func(const char *file_name) {
  char data[BUFFERSIZE];
  char append_data[BUFFERSIZE];
  FILE *file;

  file = fopen(file_name, "a+");
  if (file == NULL) {
    /* Handle error */
  }

  initialize_data(append_data, BUFFERSIZE);

  if (fwrite(append_data, 1, BUFFERSIZE, file) != BUFFERSIZE) {
    /* Handle error */
  }
  if (fread(data, 1, BUFFERSIZE, file) < BUFFERSIZE) {
    /* Handle there not being data */
  }

  if (fclose(file) == EOF) {
    /* Handle error */
  }
}
```

Compliant Code

In this compliant solution, fseek() is called between the output and input, eliminating the undefined behavior:

```
#include <stdio.h>

enum { BUFFERSIZE = 32 };
extern void initialize_data(char *data, size_t size);

void func(const char *file_name) {
  char data[BUFFERSIZE];
  char append_data[BUFFERSIZE];
  FILE *file;

  file = fopen(file_name, "a+");
  if (file == NULL) {
    /* Handle error */
  }

  initialize_data(append_data, BUFFERSIZE);
  if (fwrite(append_data, BUFFERSIZE, 1, file) != BUFFERSIZE) {
    /* Handle error */
  }

  if (fseek(file, 0L, SEEK_SET) != 0) {
    /* Handle error */
  }

  if (fread(data, BUFFERSIZE, 1, file) != 0) {
    /* Handle there not being data */
  }

  if (fclose(file) == EOF) {
    /* Handle error */
  }
}
```

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

Principles(s): Sanitize Data sent to Other Systems. Inputting and outputting data without intervening flush or positioning call can complicate data being sent to other systems.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
Low	Likely	Medium	P6	L2

Automation

Tool	Version	Checker	Description Tool
Astrée	22.04		Supported, but no explicit checker
Axivion Bauhaus Suite	7.2.0	CertC-FIO39	
CodeSonar	7.3p0	IO.IOWOP IO.OIWOP	Input After Output Without Positioning Output After Input Without Positioning
Compass/ROSE			Can detect simple violations of this rule

Coding Standard 5

Coding Standard	Label	Name of Standard
Memory Protection	MEM52-CPP	Detect and handle memory allocation errors

Noncompliant Code

In this noncompliant code example, an array of int is created using ::operator new[](std::size_t) and the results of the allocation are not checked. The function is marked as noexcept, so the caller assumes this function does not throw any exceptions. Because ::operator new[](std::size_t) can throw an exception if the allocation fails, it could lead to abnormal termination of the program.

```
#include <cstring>

void f(const int *array, std::size_t size) noexcept {
  int *copy = new int[size];
  std::memcpy(copy, array, size * sizeof(*copy));
  // ...
  delete [] copy;
}
```

Compliant Code

When using std::nothrow, the new operator returns either a null pointer or a pointer to the allocated space. Always test the returned pointer to ensure it is not nullptr before referencing the pointer. This compliant solution handles the error condition appropriately when the returned pointer is nullptr.

```
#include <cstring>
#include <new>

void f(const int *array, std::size_t size) noexcept {
  int *copy = new (std::nothrow) int[size];
  if (!copy) {
    // Handle error
    return;
  }
  std::memcpy(copy, array, size * sizeof(*copy));
  // ...
  delete [] copy;
}
```

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

Principles(s): Use effective quality Assurance. Memory allocation errors can lead to poor performing code so by ensuring we take care of these early we will maintain high QA.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Likely	Medium	P18	L1

Automation

Tool	Version	Checker	Description Tool
Compass/ROSE			
Coverity	7.5	CHECKED_RETURN	Finds Inconsistencies in how function call return values are handled
Helix QAC	2023.1	C++3225, C++3226, C++3227, C++3228, C++3229, C++4632	
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	

Coding Standard 6

Coding Standard	Label	Name of Standard
Assertions	EXP53-CPP.	Do not read uninitialized memory

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): Default Deny. By default we should deny or not read any memory that isn't initialized as we can't be sure it is secure.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Probable	Medium	P12	L1

Automation

Tool	Version	Checker	Description Tool

Tool	Version	Checker	Description Tool
Astrée	22.10	Uninitialized-read	Partially checked
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	7.3p0	LANG.STRUCT.RPL LANG.MEM.UVAR	Return pointer to local Uninitialized variable
Helix QAC	2023.1	DF726, DF2727, DF2728, DF2961, DF2962, DF2963, DF2966, DF2967, DF2968, DF2971, DF2972, DF2973, DF2976, DF2977, DF978	

Coding Standard 7

Coding Standard	Label	Name of Standard
Exceptions	ERR51-CPP.	Handle all exceptions

Noncompliant Code

In this noncompliant code example, neither f() nor main() catch exceptions thrown by throwing_func(). Because no matching handler can be found for the exception thrown, std::terminate() is called.

```
void throwing_func() noexcept(false);

void f() {
  throwing_func();
}

int main() {
  f();
}
```

Compliant Code

In this compliant solution, the main entry point handles all exceptions, which ensures that the stack is unwound up to the main() function and allows for graceful management of external resources.

```
void throwing_func() noexcept(false);

void f() {
  throwing_func();
}

int main() {
  try {
    f();
  } catch (...) {
    // Handle error
  }
}
```

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

Principles(s): Use Effective Quality Assurance. Handling all exceptions ensures the highest quality of code we can output.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
Low	Probable	Medium	P4	L3

Automation

Tool	Version	Checker	Description Tool
Astrée	22.10	Main-function-catch-all Early-catch-all	Partially checked
Axivion Bauhaus Suite	7.2.0	CertC++-ERR51	
CodeSonar	7.3p0	LANG.STRUCT.UCTCH	Unreachable Catch
Helix QAC	2023.1	C++4035, C++4036, C++4037	

Coding Standard 8

Coding Standard	Label	Name of Standard
Object Oriented Programming	OOP56-CPP.	Honor replacement handler requirements

Noncompliant Code

In this noncompliant code example, a replacement new_handler is written to attempt to release salvageable resources when the dynamic memory manager runs out of memory. However, this example does not take into account the situation in which all salvageable resources have been recovered and there is still insufficient memory to satisfy the allocation request. Instead of terminating the replacement handler with an exception of type std::bad_alloc or terminating the execution of the program without returning to the caller, the replacement handler returns as normal. Under low memory conditions, an infinite loop will occur with the default implementation of ::operator new(). Because such conditions are rare in practice, it is likely for this bug to go undiscovered under typical testing scenarios.

```
#include <new>

void custom_new_handler() {
  // Returns number of bytes freed.
  extern std::size_t reclaim_resources();
  reclaim_resources();
}

int main() {
  std::set_new_handler(custom_new_handler);

  // ...
}
```

Compliant Code

In this compliant solution, custom_new_handler() uses the return value from reclaim_resources(). If it returns 0, then there will be insufficient memory for operator new to succeed. Hence, an exception of type std::bad_alloc is thrown, meeting the requirements for the replacement handler.

```
#include <new>

void custom_new_handler() noexcept(false) {
  // Returns number of bytes freed.
  extern std::size_t reclaim_resources();
  if (0 == reclaim_resources()) {
    throw std::bad_alloc();
  }
}

int main() {
  std::set_new_handler(custom_new_handler);

  // ...
}
```

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

Principles(s): Keep it Simple. By honoring replacement handler requirements we make sure our code doesn't get over complicated by having to perform extra tasks.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
Low	Probable	High	P2	L3

Automation

Tool	Version	Checker	Description Tool
Helix QAC	2023.1	DF4776, DF4777, DF4778, DF4779	
Parasoft C/C++ test	2022.2	CERT_CPP-OOP56-a CERT_CPP-OOP56-b CERT_CPP-OOP56-c	Properly define terminate handlers Properly define unexpected handlers Properly define new handlers
[Insert text.]	[Insert text.]	[Insert text.]	[Insert text.]
[Insert text.]	[Insert text.]	[Insert text.]	[Insert text.]

Coding Standard 9

Coding Standard	Label	Name of Standard
Thread Safety	CON55-CPP	Preserve thread safety and liveness when using condition variables

Noncompliant Code

This noncompliant code example uses five threads that are intended to execute sequentially according to the step level assigned to each thread when it is created (serialized processing). The currentStep variable holds the current step level and is incremented when the respective thread completes. Finally, another thread is signaled so that the next step can be executed. Each thread waits until its step level is ready, and the wait() call is wrapped inside a while loop, in compliance with CON54-CPP. Wrap functions that can spuriously wake up in a loop.

```
#include <condition_variable>
#include <iostream>
#include <mutex>
#include <thread>

std::mutex mutex;
std::condition_variable cond;

void run_step(size_t myStep) {
  static size_t currentStep = 0;
  std::unique_lock<std::mutex> lk(mutex);

  std::cout << "Thread " << myStep << " has the lock" << std::endl;

  while (currentStep != myStep) {
    std::cout << "Thread " << myStep << " is sleeping..." << std::endl;
    cond.wait(lk);
    std::cout << "Thread " << myStep << " woke up" << std::endl;
  }

  // Do processing...
  std::cout << "Thread " << myStep << " is processing..." << std::endl;
  currentStep++;

  // Signal awaiting task.
  cond.notify_one();

  std::cout << "Thread " << myStep << " is exiting..." << std::endl;
}

int main() {
  constexpr size_t numThreads = 5;
```

Noncompliant Code

```
  std::thread threads[numThreads];

  // Create threads.
  for (size_t i = 0; i < numThreads; ++i) {
    threads[i] = std::thread(run_step, i);
  }

  // Wait for all threads to complete.
  for (size_t i = numThreads; i != 0; --i) {
    threads[i - 1].join();
  }
}
```

Compliant Code

This compliant solution uses notify_all() to signal all waiting threads instead of a single random thread. Only the run_step() thread code from the noncompliant code example is modified.

```
#include <condition_variable>
#include <iostream>
#include <mutex>
#include <thread>

std::mutex mutex;
std::condition_variable cond;

void run_step(size_t myStep) {
  static size_t currentStep = 0;
  std::unique_lock<std::mutex> lk(mutex);

  std::cout << "Thread " << myStep << " has the lock" << std::endl;

  while (currentStep != myStep) {
    std::cout << "Thread " << myStep << " is sleeping..." << std::endl;
    cond.wait(lk);
    std::cout << "Thread " << myStep << " woke up" << std::endl;
  }

  // Do processing ...
  std::cout << "Thread " << myStep << " is processing..." << std::endl;
  currentStep++;

  // Signal ALL waiting tasks.
  cond.notify_all();

  std::cout << "Thread " << myStep << " is exiting..." << std::endl;
```

Compliant Code

```
}

// ... main() unchanged ...
```

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

Principles(s): Practice Defense in Depth. Thread safety is key and we must be sure we have a level of defense in place to keep threads clean.

Threat Level

Severity	Likelihood	Remediation Cost	Priority	Level
Low	Unlikely	Medium	P2	L3

Automation

Tool	Version	Checker	Description Tool
CodeSonar	7.3p0	CONCURRENCY.BADFUNC.CNDSIGNAL	Use of Condition Variable Signal
Helix QAC	2023.1	C++1778, C++1779	
Klocwork	2023.1	CERT.CONC.UNSAFE_COND_VAR	
Parasoft C/C++test	2022.2	CERT_CPP-CON55-a	Do not use the 'notify_one()' function when multiple threads are waiting on the same condition variable

Coding Standard 10

Coding Standard	Label	Name of Standard
Containers	CTR51-CPP	Use valid references, pointers, and iterators to reference elements of a container

Noncompliant Code

In this noncompliant code example, pos is invalidated after the first call to insert(), and subsequent loop iterations have undefined behavior.

```
#include <deque>

void f(const double *items, std::size_t count) {
  std::deque<double> d;
  auto pos = d.begin();
  for (std::size_t i = 0; i < count; ++i, ++pos) {
    d.insert(pos, items[i] + 41.0);
  }
}
```

Compliant Code

In this compliant solution, pos is assigned a valid iterator on each insertion, preventing undefined behavior.

```
#include <deque>

void f(const double *items, std::size_t count) {
  std::deque<double> d;
  auto pos = d.begin();
  for (std::size_t i = 0; i < count; ++i, ++pos) {
    pos = d.insert(pos, items[i] + 41.0);
  }
}
```

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

Principles(s): Keep it simple. Using valid pointers, references, and iterators keeps our code simplified, clean and effective.

Threat Level

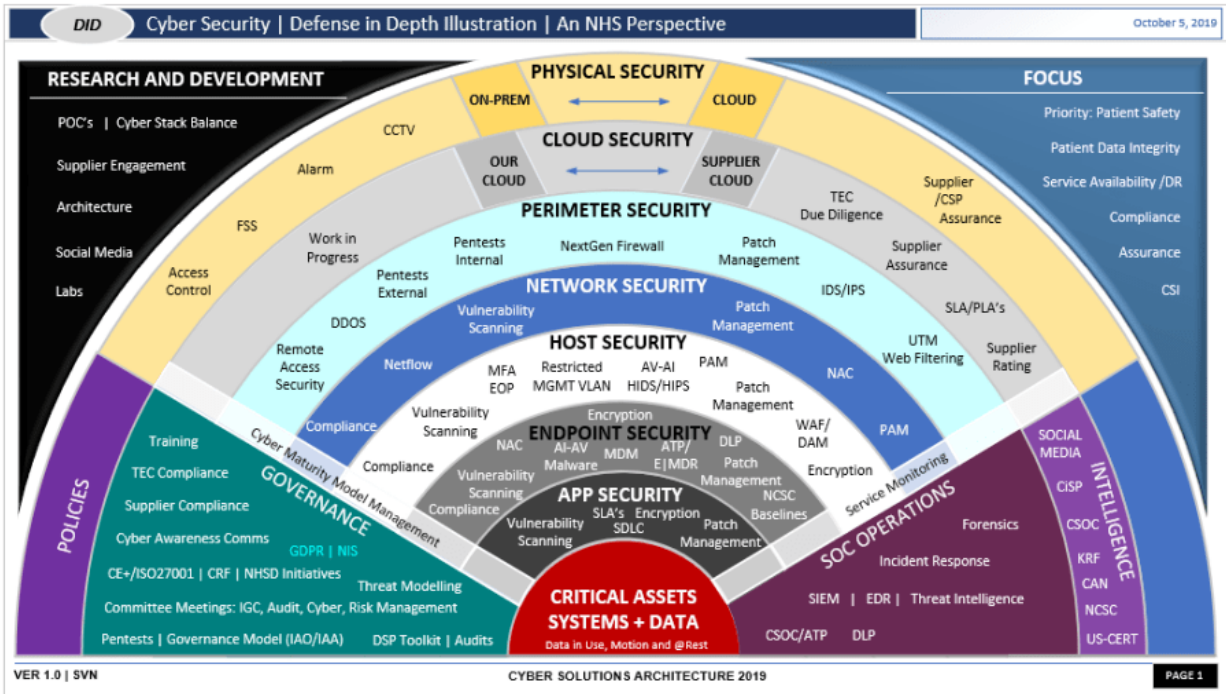
Severity	Likelihood	Remediation Cost	Priority	Level

Severity	Likelihood	Remediation Cost	Priority	Level
High	Probable	High	P6	L2

Automation

Tool	Version	Checker	Description Tool
Astrée	22.10	overflow_upon_dereference	
CodeSonar	7.3p0	ALLOC.UAF	Use After Free
Helix QAC	2023.1	DF4746, DF4747, DF4748, DF4749	
Klocwork	2023.1	ITER.CONTAINER.MODIFIED	

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

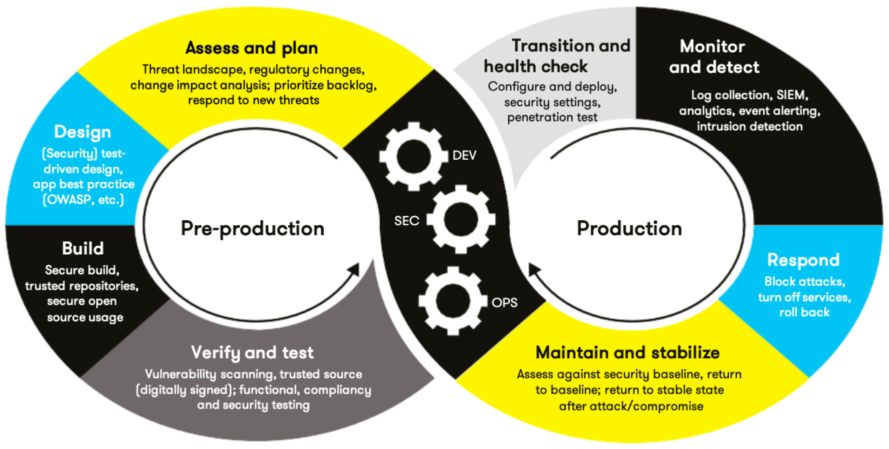
Complete this section on the coding standards tables. Enter high, medium, or low for each of the headers, then rate it overall using a scale from 1 to 5, 5 being the greatest threat. You will address each of the seven policy standards. Fill in the columns of severity, likelihood, remediation cost, priority,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


Assess and plan
Threat landscape, regulatory changes, change impact analysis; prioritize backlog, respond to new threats
Design
(Security) test-driven design, app best practice (OWASP, etc.)
Build
Secure build, trusted repositories, secure open source usage
Verify and test
Vulnerability scanning, trusted source (digitally signed); functional, compliancy and security testing
Pre-production
DEV
SEC
OPS
Transition and health check
Configure and deploy, security settings, penetration test
Monitor and detect
Log collection, SIEM, analytics, event alerting, intrusion detection
Production
Respond
Block attacks, turn off services, roll back
Maintain and stabilize
Assess against security baseline, return to baseline; return to stable state after attack/compromise

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.

*We should begin implementing automation from the pre-production all the way through the production cycles. Asses and Plan is one step where automation should not take place as we need all hands on deck to plan and prepare for any new threats and where security should be implemented or improved. Verification and testing can be automated through several of the automations tools listed in this policy document above. As it moves from pre-production to production, we should look to automate the transition and health check, as well as the monitoring and detecting stage. However, response, and maintenance should be left to manual processes.

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	P7	2
INT30-C	High	Likely	High	P1	L2
FIO30-C	High	Likely	Medium	P3	L1
STR51-CPP	High	Likely	Medium	P3	L1
FIO39-C	Low	Likely	Medium	P8	L2
MEM52-CPP	High	Likely	Medium	P3	L1
EXP53-CPP	High	Probable	Medium	P6	L1
ERR51-CPP	Low	Probable	Medium	P10	L3
OOP56-CPP	Low	Probable	High	P9	L3
CON55-CPP	Low	Unlikely	Medium	P11	L4
CTR51-CPP	High	Probable	High	P2	L2

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**.**

a. Explain each type of encryption, how it is used, and why and when the policy applies.

b. 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.

a. **Encryption**	**Explain what it is and how and why the policy applies.**
Encryption in rest	This is encrypting data even when it's not being used or transferred. Data resting on a hard drive for example should be encrypted in case it were to be stolen then the hacker would have to decrypt the data without a decryption key.
Encryption at flight	This is referring to any data moving over a Network or Cloud based organization. Encrypting this is vital as these networks can be hacked and monitored by attackers so any non-encrypted data could easily be stolen.
Encryption in use	This is essentially the policy that is ensuring any data no matter what stage it's in is encrypted so that it cannot be stolen or decrypted at any point by an unauthorized individual.

b. **Triple-A Framework***	**Explain what it is and how and why the policy applies.**
Authentication	This refers to having users use valid log in credentials, preferably even 2 factor authentication so that we can validate that only authorized individuals can log in and access our data.
Authorization	Authorization refers to maintaining authorized personnel who only have permissions that are accurate to their needs in our systems.
Accounting	Reference to needing to continuously audit our users credentials, permissions and authorizations so that security passwords change frequently and that no users are given access that don't need it or are no longer with the organization.

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	3/17/2023	Milestone 1	Sam Dayball	
1.1.1	4/4/2023	Project 1	Sam Dayball	
1.1.2	7/12/2023	CS499 Enhancement	Sam Dayball	

Appendix A Lookups

Approved C/C++ Language Acronyms

Language	Acronym
C++	CPP
C	CLG
Java	JAV