**System Test Plan**

**For**

**STaTE**

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**Table of Contents**

[**1. Introduction**](#_8oqmak6px1ak) **3**

[1.1 Purpose](#_xon1593p1209) 3

[1.2 Objectives](#_lswsn8qadcp7) 3

[**2. Functional Scope**](#_avrlzznf1dyg) **3**

[**3. Overall Strategy and Approach**](#_n8h1dchqbg77) **3**

[3.1 Testing Strategy](#_xgm89ky6xya3) 3

[3.1.1 Usability Testing](#_vtac641at1wl) 4

[3.1.2 Functional Testing](#_nigl9cm1ed1q) 4

[3.1.3 Database Testing](#_suskt4j65ahi) 4

[3.1.4 Performance Testing](#_5ys6hbdaj94q) 4

[3.1.5 Documentation Testing](#_ux7y4k5z9bhs) 5

[3.2 System Testing Entrance Criteria](#_ijiwhfathrpm) 5

[3.3 Testing Types](#_xfkp55ex8zfn) 5

[3.3.1 Usability Testing](#_hfj7h3hfefha) 5

[3.3.2 Functional Testing](#_oijz5tx6sdqv) 6

[3.3.3 Database Testing](#_yt8y3wylp1og) 13

[3.3.4 Performance testing](#_u0xhadfg8rc0) 13

[3.3.5 Documentation Testing](#_b8a62nkpplg1) 14

[3.4 Suspension Criteria and Resumption Requirements](#_doeongyn74jn) 15

[3.4.1 Suspension Criteria](#_5h3ah95wa79f) 15

[3.4.2 Resumption Requirements](#_ds2ian5an6c7) 15

[**4. Execution Plan**](#_za1k2zvo2wkk) **15**

[4.1 Execution Plan](#_2g956iizngzo) 15

[**5. Traceability Matrix & Defect Tracking**](#_y6268uc7f443) **17**

[5.1 Traceability Matrix](#_em0ou14mqw85) 17

[5.2 Defect Severity Definitions](#_oh762xilwlgs) 18

[**6. Environment**](#_4zq06ccfzy2n) **18**

[6.1 Environment](#_9azex4ihq53v) 18

[**7. Assumptions**](#_u8tunhkub9jh) **19**

[**8. Risks and Contingencies**](#_xpqvvxgawi0s) **19**

[**9. Appendices**](#_7rd3uomq45rd) **20**

# **1.** **Introduction**

## **1.1** **Purpose**

This document is a test plan for STaTE System Testing, produced by the System Testing team. It describes the testing strategy and approach to testing the team will use to verify that the application meets the established requirements of the stakeholder and development team prior to release.

## **1.2** **Objectives**

§ Meets the requirements, specifications, and organizational rules.

§ Supports the intended organization functions and achieves the required standards.

§ Satisfies the entrance criteria for User Acceptance Testing.

# **2.** **Functional Scope**

The Modules in the scope of testing for the STaTE System Testing are mentioned in the document attached in the following path:

1. The System Requirements Specification document: <https://docs.google.com/document/d/156Tm2S6XeC7pAFM9EftQc5o40jnJkIaA/edit?usp=sharing&ouid=117820271301902277865&rtpof=true&sd=true>
2. Section 3.1 of this document.

# **3.** **Overall Strategy and Approach**

## **3.1** **Testing Strategy**

STaTE System Testing includes testing of system functionalities within the scope of the project (Refer to Section 2: Functional Scope). System testing activities include the testing of new functionalities, modified functionalities, screen level validations, workflows, functionality access, and testing of internal & external interfaces. Section 3.2 explains what needs to be tested, and the following subsections in 3.1 describe how tests of each type are executed and evaluated.

### 3.1.1 Usability Testing

**Test Objective:** To measure and evaluate ease of use of the STaTE system for end-users. Ensure that the system is effective, accurate, and accessible..

**Technique:** Start with screening and pre-test for a general user. Have general users (non-developers) perform use cases as described in the usability test plan as in-test questions. Record the tester's post-test answers.

**Completion Criteria**: When 5-12 prescreened general users have taken and responded to the usability test post-test questions.

### 3.1.2 Functional Testing

**Test Objective:** The STaTE’s navigation, data entry, data output, and processing according to the specific requirements in the SRS. Provides verification that the software is accurate according to definite inputs and expected outputs.

**Technique:** Execute use cases as described in the use case diagram. When valid data is entered, the corresponding successful result shall yield. When invalid data is entered, the corresponding error result shall yield.

**Completion Criteria:** When all use cases from the use case diagram have been tested and expected results are returned.

**Testing Assumption Consideration:** Access to the STaTe system and the corresponding SRS document.

### 3.1.3 Database Testing

**Test Objective:** Ensure the SQLite database has complete integration with SWA for the proper organizational structure and saving and retrieval of data.

**Technique:** Execute all instances of data saving and retrieval in the SWA, and check the SQLite for the test data equality.

**Completion Criteria:** When the data in the database matches the test data.

### 3.1.4 Performance Testing

**Test Objective:** Ensure the STaTe system can handle real-time scenarios and address issues to deliver an efficient product. Provides verification that the system behaves as expected for various conditions.

**Technique:** Execute condition cases as described in the condition case diagram. When conditions are met, the system shall perform to the standards described in the expected system behavior.

**Completion Criteria:** When all condition cases from the condition case diagram have been tested and expected system behavior has been achieved.

### 3.1.5 Documentation Testing

**Test Objective:** Ensure that the information explained in the documentation, properly matches what is available in the software. Also, checks that the explanation is sufficient and clearly explained.

**Technique:** Similar to usability testing, when a general user would attempt to use documentation as described in the test plan, the user would give feedback and results.

**Completion Criteria:** When 5-12 prescreened general users have taken and responded to the post-test questions.

## **3.2** **System Testing Entrance Criteria**

In order to start system testing, certain requirements must be met for testing readiness. The readiness can be classified into usability testing, functional testing, and data and documentation testing.

STEC-1: Availability of testable code

STEC-2: Defined requirements

STEC-3: Access to necessary test data

STEC-4: Readiness of test cases

STEC-5: Availability of a prepared test environment with the needed tools and resources

STEC-6: Ensure preconditions are met and eradicate defects when not met.

## **3.3** **Testing Types**

### 3.3.1 Usability Testing

User interface attributes, cosmetic presentation, and the content will be tested for accuracy and general usability. The goal of Usability Testing is to ensure that the User Interface is comfortable to use and provides the user with consistent and appropriate access and navigation through the functions of the application (e.g., access keys, consistent tab order, readable fonts, etc.) as outlined in the:

· Software Quality Attributes, Usability

System Requirements Specification, 5.4.1 SQA-1: “The program shall be intuitive for the user to interact with, requiring little to no explanation for interacting with the program excluding a physical script provided by a TC.”

System Requirements Specification, 5.4.1 SQA-2: “After login, both user interfaces shall have a locatable navigation pane on each page.”

System Requirements Specification, 5.4.1 SQA-3: “After login, both user interfaces shall have a locatable “Logout” button on each page.“

System Requirements Specification, 5.4.1 SQA-4: “On the login page, the username vs password text box must be clearly marked and locatable.”

System Requirements Specification, 5.4.1 SQA-5: “On the login page, there must be a marked and locatable “Login” button.”

System Requirements Specification, 5.4.1 SQA-6: “The program shall be intuitive for teachers to set up a mission in 7 clicks.”

System Requirements Specification, 5.4.1 SQA-7: “The program shall be intuitive for teachers to deploy a SimCraft after creating a mission in 10 clicks.”

System Requirements Specification, 5.4.2 SQA-8: “The program shall be cross-platform compatible with chromium-based web browsers.”

System Requirements Specification, 5.4.3 SQA-9: “The program shall be reusable, so that it may act as a teaching tool long after the project’s development.”

System Requirements Specification, 5.4.4 SQA-10 “The program shall be reliable so that the department using this program will not have to (a) go through the code, or (b) employ further senior design groups to attempt to fix the program once developed to the scope of the remainder of the semester.”

### 3.3.2 Functional Testing

The objective of this test is to ensure that each element of the component meets the functional requirements of the organization as outlined in the:

· Organizational / Functional Requirements

· Organization rules or conditions

Other functional documents produced during the course of the project i.e. resolution to issues/change requests/feedback

Note: IP and Port numbers are dependent on the device running the current server the user is accessing until a proper domain name is acquired.

System Requirements Specification, SWA-FR-1: “SWA shall maintain a hosted web application at (URL TBD).”

System Requirements Specification, SWA-FR-2: “SWA shall maintain an About Page at (URL TBD)/About.”

System Requirements Specification, SWA-FR-3: “SWA shall maintain a Contact Page at (URL TBD)/Contact.”

System Requirements Specification, SWA-FR-4: “SWA shall maintain a Flight Operator Django app at (URL TBD)/fo/home.”

System Requirements Specification, SWA-FR-5: “SWA shall maintain a Test Conductor Django app at (URL TBD)/tc/home.”

System Requirements Specification, SWA-FR-6: “SWA shall navigate to (URL TBD) when a user enters (URL TBD) in their browser.”

System Requirements Specification, SWA-FR-7: “SWA shall display the About Page when a user enters (URL TBD)/About in their browser.”

System Requirements Specification, SWA-FR-8: “SWA shall display the Contact Page when a user enters (URL TBD)/Contact in their browser.”

System Requirements Specification, SWA-FR-9: “The home page shall display a “Login” button.”

System Requirements Specification, SWA-FR-10: “The “Login” button displayed on Home Page shall navigate the user’s browser to (URL TBD)/login when selected.”

System Requirements Specification, SWA-FR-11: “The home page shall display an “About” button.”

System Requirements Specification, SWA-FR-12: “The “About” button displayed on Home Page shall navigate the user’s browser to (URL TBD)/About when selected.”

System Requirements Specification, SWA-FR-13: “The home page shall display a “Contact” button.”

System Requirements Specification, SWA-FR-14: “The “Contact” button displayed on Home Page shall navigate the user’s browser to (URL TBD)/Contact when selected.”

System Requirements Specification, SWA-FR-15: “The home page shall display a welcome message and a short description of the STaTE project.”

System Requirements Specification, SWA-FR-16: “About page shall display a “Home” button.”

System Requirements Specification, SWA-FR-17: “The “Home” button displayed on About Page shall navigate the user’s browser to (URL TBD) when selected.”

System Requirements Specification, SWA-FR-18: “About Page shall display information about the STaTE project including intended usage and copyrights.”

System Requirements Specification, SWA-FR-19: “The contact Page shall display a “Home” button.”

System Requirements Specification, SWA-FR-20: “The “Home” button displayed on Contact Page shall navigate the user’s browser to (URL TBD) when selected.”

System Requirements Specification, SWA-FR-21: “The contact Page shall display contact information for the developers and the administrators of STaTE.”

System Requirements Specification, FOP-FR-1: “The FOP shall enact a visual change of a subsystem when a student changes a value in an input terminal.”

System Requirements Specification, FOP-FR-2: “The FOP shall accurately pass user inputs to the control console via commands.”

System Requirements Specification, FOP-FR-3: “The FOP shall display all subsystems on the SimCraft to which the Flight Operator is assigned.”

System Requirements Specification, FOP-FR-4: “The FOP shall contain a button on a navigation bar to access the Attitude and Control Subsystem (ACS) webpage at (URL TBD)/FO/[SimCraft]/ACS.”

System Requirements Specification, FOP-FR-5: “The FOP shall contain a button on a navigation bar to access the Electrical Power Subsystem (EPS) webpage at (URL TBD)/FO/[SimCraft]/EPS.”

System Requirements Specification, FOP-FR-6: “The FOP shall contain a button on a navigation bar to access the Thermal Control Subsystem (TCS) webpage at (URL TBD)/FO/[SimCraft]/TCS.”

System Requirements Specification, FOP-FR-7: “The FOP shall contain a button on a navigation bar to access the Communications Subsystem (Comms) webpage at (URL TBD)/FO/[SimCraft]/Comms.”

System Requirements Specification, FOP-FR-8: “The FOP shall contain a button on a navigation bar to access the Payload Subsystem webpage at (URL TBD)/FO/[SimCraft]/Payload.”

System Requirements Specification, FOP-FR-9: “The FOP shall display a map of the current SimCraft’s position in the atmosphere.”

System Requirements Specification, “FOP-FR-10: “The FOP shall display notifications for off-nominal SimCraft behavior.”

System Requirements Specification, TCP-FR-1: “TCP shall maintain a hosted web application at (URL TBD).”

System Requirements Specification, TCP-FR-2: “TCP shall maintain a TC Home Page at (URL TBD)/TC/Home.”

System Requirements Specification, TCP-FR-3: “TCP shall maintain a Class Management Page at (URL TBD)/TC/Home/[ClassName].”

System Requirements Specification, TCP-FR-4: “TCP shall maintain a Simulation Management Page at (URL TBD)/TC/Home/[ClassName]/[SimName].“

System Requirements Specification, TCP-FR-5: “TCP shall maintain a New Mission page at (URL TBD)/TC/Home/[ClassName]/newMission.“

System Requirements Specification, TCP-FR-6: “TCP shall maintain a New Simulation page at (URL TBD)/TC/Home/[ClassName]/newSim.“

System Requirements Specification, TCP-FR-7: “TCP shall maintain a simulation interaction page at (URL TBD)/TC/Home/[ClassName]/[SimName]/FDView“

System Requirements Specification, TCP-FR-8: “SWA shall navigate to (URL TBD)/TC when a user clicks a button to log in as TC.“

System Requirements Specification, TCP-FR-9: “TCP shall navigate to (URL TBD)/TC/Home when a user enters the correct login credentials.“

System Requirements Specification, TCP-FR-10: “TCP shall navigate to (URL TBD)/TC/home/[ClassName] when a class is selected on the TC homepage“.

System Requirements Specification, TCP-FR-11: “TCP shall navigate to (URL TBD)/TC/Home/[ClassName]/newSim when the new simulation button is pressed on the TC Class Management page.“

System Requirements Specification, TCP-FR-12:“ TCP shall navigate to (URL TBD)/TC/Home/[ClassName] when the new simulation submission button is pressed on the New Simulations Page.“

System Requirements Specification, TCP-FR-13: “TCP shall navigate to (URL TBD)/TC/Home/[ClassName]/newMission when the new mission button is pressed on the TC homepage.“

System Requirements Specification, TCP-FR-14: “TCP shall navigate to (URL TBD)/TC/Home/[ClassName] when the new mission submission button is pressed on the New Missions page.“

System Requirements Specification, TCP-FR-15: “TCP shall navigate to (URL TBD)/TC/Home/[ClassName]/[SimName]/FDView when the Simulation name (button/link) is pressed on the simulation management table on the Class management page.“

System Requirements Specification, TCP-FR-16: “TCP shall navigate to (URL TBD)/TC/Home from any TC Page “Home” button.“

System Requirements Specification, TCP-FR-17: “The login page shall display 2 text boxes: 1 for username, and 1 for password.“

System Requirements Specification, TCP-FR-18: “The login Page shall display a “Login” button.“

System Requirements Specification, TCP-FR-19: “TC Home Page shall display a “Add New Class” button.“

System Requirements Specification, TCP-FR-20: “The “Add New Class” button displayed on TC Home Page shall open a popup window to define a class name and status.“

System Requirements Specification, TCP-FR-21: “TC Home Page shall display a table with all active and inactive classes.“

System Requirements Specification, TCP-FR-22: “The “Settings” button displayed next to every class on TC Home Page shall open a popup window to change the class name, status, and code.“

System Requirements Specification, TCP-FR-23: “TC Class Management Page shall display a “New Sim” button.“

System Requirements Specification, TCP-FR-24: “TC Class Management Page shall display a “New Mission” button.“

System Requirements Specification, TCP-FR-25: “TC Class Management Page shall display a “Manage” (settings) button for each mission and simulation.“

System Requirements Specification, TCP-FR-26: “TC Class Manage Page shall display a “Operators” button for each simulation.“

System Requirements Specification, TCP-FR-27: “The “Home” button displayed on the Class Management Page shall navigate the TC user’s browser to (URL TBD)/TC/Home when selected.“

System Requirements Specification, TCP-FR-28: “The Simulation Interaction Page shall display information about the active simulations.“

System Requirements Specification, TCP-FR-29: “The Simulation Interaction Page shall show what the simulation Fight Director sees.“

System Requirements Specification, TCP-FR-30: “The “Home” button displayed on the Simulation Interaction Page shall navigate the TC user’s browser to (URL TBD)/TC/Home/[ClassName]/[SimName]/FDView when selected.”

System Requirements Specification, Control Console-FR-1: “The Control Console shall present the indicators given by SimCraft.”

System Requirements Specification, Control Console-FR-2: “The Control Console shall allow commands for the control moment gyroscope (CMG) roll, pitch, and yaw angle ranges.”

System Requirements Specification, Control Console-FR-3: “The Control Console shall allow commands for XYZ stabilization.”

System Requirements Specification, Control Console-FR-4: “The Control Console shall allow commands for the telemetry transfer.”

System Requirements Specification, Control Console-FR-5: “The Control Console shall allow commands to verify the signal status.”

System Requirements Specification, Control Console-FR-6: “The Control Console shall provide monitoring capabilities for the Electrical Power Subsystem.”

System Requirements Specification, Control Console-FR-7: “The Control Console shall allow commands for Standby mode for the ACS, EPS, TCS, and payload power systems.”

System Requirements Specification, Control Console-FR-8: “The Control Console shall allow commands for the solar panel electrical charge and dissipation.”

System Requirements Specification, Control Console-FR-9: “The Control Console shall allow commands for the telemetry transfer.”

System Requirements Specification, Control Console-FR-10: “The Control Console shall provide monitoring capabilities for the Thermal Control Subsystem.”

System Requirements Specification, Control Console-FR-11: “The Control Console shall allow commands for heating and cooling of the Comm’s transceiver, antenna, and amplifier attributes.”

System Requirements Specification, Control Console-FR-12: “The Control Console shall allow commands for heating and cooling of the ACS’s CMGs and sensor attributes.”

System Requirements Specification, Control Console-FR-13: “The Control Console shall allow commands for heating and cooling of the payload's camera attribute.”

System Requirements Specification, Control Console-FR-14: “The Control Console shall allow commands for heating and cooling of the EPS’s solar panel and battery temperature attributes.”

System Requirements Specification, Control Console-FR-15: “The Control Console shall allow commands for the telemetry transfer.”

System Requirements Specification, Control Console-FR-16: “The Control Console shall provide monitoring capabilities for the Communications Control Subsystem.”

System Requirements Specification, Control Console-FR-17: “The Control Console shall provide monitoring capabilities for the payloads.”

System Requirements Specification, Control Console-FR-18: “The Control Console shall allow commands for the camera zoom range.”

System Requirements Specification, Control Console-FR-19: “The Control Console shall allow a command to capture a photo.”

System Requirements Specification, Simulation Engine-FR-1: “The Simulation Engine Attitude and Control console shall control the SimCraft in a Low Earth Orbit (LEO).”

System Requirements Specification, Simulation Engine-FR-2: “The Simulation Engine Attitude and Control console shall control the SimCraft's exposure to sunlight for ½ of the SimCrafts orbit.”

System Requirements Specification, Simulation Engine-FR-3: “The Simulation Engine Attitude and Control console shall control sensors related to the Attitude and Control Subsystem, with nominal and off-nominal values.”

System Requirements Specification, Simulation Engine-FR-4: “The Simulation Engine Electrical Power console shall provide power to SimCraft via power stored in the system’s batteries.”

System Requirements Specification, Simulation Engine-FR-5: “The Simulation Engine Electrical Power console shall distribute power as needed to the payload.”

System Requirements Specification, Simulation Engine-FR-6: “The Simulation Engine Electrical Power console shall have the ability to distribute power to the payload as needed, with excess power stored in the system’s batteries.”

System Requirements Specification, Simulation Engine-FR-7: “The Simulation Engine Electrical Power console shall have the ability to distribute power in the batteries to the SimCraft when the object is within Earth’s shadow.”

System Requirements Specification, Simulation Engine-FR-8: “The Simulation Engine Electrical Power console shall monitor solar panel power production, related to the angle of incidence with the sun, where the angle of incidence is defined as the angle between a line normal to the surface of the solar panel and the line pointing to the SimCraft to the sun.”

System Requirements Specification, Simulation Engine-FR-9: “The Simulation Engine Electrical Power console shall have the ability to control the angle of incidence of the SimCraft only to one degree of rotational freedom.”

System Requirements Specification, Simulation Engine-FR-10: “The Simulation Engine Electrical Power console shall monitor the ACS, presumed to maintain an incidence angle of +/- 5 Degrees when operating normally, allowing for maximal energy capture during the daylight portion of the SimCraft orbit.”

System Requirements Specification, Simulation Engine-FR-11: “The Simulation Engine Thermal Control console shall control SimCraft's internal temperature.”

System Requirements Specification, Simulation Engine-FR-12: “The Simulation Engine Thermal Control console shall control thermal exposure in a new attitude position.”

System Requirements Specification, Simulation Engine-FR-13: “The Simulation Engine Communications console shall control SimCraft's communication between the Ku-Band satellite antenna and a group station antenna.”

System Requirements Specification, Simulation Engine-FR-14: “The Simulation Engine Thermal Control console shall control transmission frequencies and gain values to process and transmit images.”

System Requirements Specification, Simulation Engine-FR-15: “The Simulation Engine Payload console shall control SimCraft's ability to capture the imagery of a target during a flyover period based on GPS coordinates.”

System Requirements Specification, SimCraft-FR-1: “The Attitude and Contol Subsystem shall monitor the spacecraft's angle of incidence toward the sun and earth using GPS coordinates.”

System Requirements Specification, SimCraft-FR-2: “The Attitude and Contol Subsystem shall monitor the spacecraft's degrees of freedom as roll, pitch, and yaw degree values.”

System Requirements Specification, SimCraft-FR-3: “The Attitude and Contol Subsystem shall monitor the spacecraft’s CMG roll, pitch, and yaw values to determine the spacecraft’s angular acceleration.”

System Requirements Specification, SimCraft-FR-4: “The Electrical Power Subsystem shall monitor the spacecraft orbit and solar arrays alignment showing energy-gathering efficiency.”

System Requirements Specification, SimCraft-FR-5: “The Electrical Power Subsystem shall monitor the spacecraft’s electrical status and command full power to the satellite in preparation for the payload power needs to capture a System Requirements Specification, image.”

System Requirements Specification, SimCraft-FR-6: “The Electrical Power Subsystem shall monitor the spacecraft’s state in order to delegate additional power for a mission for any unforeseen anomalies.”

System Requirements Specification, SimCraft-FR-7: “The Electrical Power Subsystem shall monitor the spacecraft’s signal status and stability between the Ku-Band satellite antenna and a ground station.”

System Requirements Specification, SimCraft-FR-8: “The Thermal Control Subsystem shall monitor the spacecraft’s internal temperature to prevent overheating or over-cooling in a new attitude position.”

System Requirements Specification, SimCraft-FR-9: “The Communication Control Subsystem shall monitor the spacecraft’s wireless connection with ground stations.”

System Requirements Specification, SimCraft-FR-10: “The Communication Subsystem shall monitor the spacecraft’s signal status and stability between the Ku-Band satellite antenna and a ground station.”

System Requirements Specification, SimCraft-FR-11: “The Payload Control Subsystem shall monitor the spacecraft’s geological position above the earth given by GPS coordinates.”

### 3.3.3 Database Testing

The objective of this test is to ensure that the database meets the needs of the STaTE system and functions correctly as outlined in the:

· Database Requirements (SRS: 6.1)

System requirements Specification, 6.1 DR-1: “The database shall store simulation states, which consist of all information of each simulation at a given time.“

System requirements Specification, 6.1 DR-2: “The database shall be able to send and receive data sets from the program.”

System requirements Specification, 6.1 DR-3: “The database shall be able to store text communications from users after a simulation has concluded.”

### 3.3.4 Performance testing

The objective of this test is to ensure that the system meets the required performance behavior at various load conditions as outlined in the:

· Performance Requirements

· Business conditions

System Requirements specification, 5.1 PR-1: “The program shall not exceed a response time of 10 ms from connections made in the United States unless the current number of users exceeds the maximum number of users.”

System Requirements specification, 5.1 PR-2: “The program shall not exceed a response time of 20 ms from the connections made in the United States unless the current number of users exceeds double the maximum number of users.”

System Requirements specification, 5.1 PR-3: “The program shall be capable of running 15 simulated missions in tandem while connected with the maximum number of users.”

System Requirements specification, 5.1 PR-4: “Local spacecraft data written regarding a simulated spacecraft shall not exceed 2 GB in size per simulated mission.”

System Requirements specification, 5.1 PR-5: “The program shall update data transmitted to the connected user no less than every 5 seconds.”

System Requirements specification, 5.1 PR-6: “The program shall save the simulated spacecraft data every 15 minutes..”

System Requirements specification, 5.1 PR-7: “The program shall save all flight conductor and flight operator inputs entered through the terminal.”

System Requirements specification, 5.1 PR-8: “In the event that the program suffers an error that ceases runtime, the program shall not lose any local data regarding conductor inputs.”

System Requirements specification, 5.1 PR-9: “In the event that the program suffers an error that ceases runtime, the program shall not lose any local data regarding a simulated spacecraft.”

System Requirements specification, 5.1 PR-10: “In the event that the program suffers an error that ceases runtime, the program shall attempt to restart the corresponding simulation using the latest version of the save data.”

System Requirements specification, 5.1 PR-11: “In the event that the program suffers an error that ceases runtime, the program shall alert all Test Conductor users.”

### 3.3.5 Documentation Testing

Documentation describes all of the user guides, readme files, and system manuals that are provided with the software in order for the user to understand the STaTE system. The objective of this testing is to ensure that what is explained in the documentation, properly matches what is available in the software as outlined in

· User Documentation (SRS 2.6)

System Requirements Specification, 2.6 UD-STANDARD-1: “The documentation will be provided online through the web application.”

System Requirements Specification, 2.6 UD-STANDARD-2: “The documentation can be downloaded, sent, or given in the physical form to users.”

System Requirements Specification, 2.6 UD-STANDARD-3: “The intended audience of the documentation are the teachers conducting spacecraft control center training and the students in training. “

## **3.4** **Suspension Criteria and Resumption Requirements**

This section specifies the criteria that are used to suspend all or a portion of the testing activities on the items associated with this test plan.

### 3.4.1 Suspension Criteria

Testing will be suspended if the following incidents found do not allow further testing of the system/application under-test:

* Discovery that one of the System Testing Entrance Criteria (refer to 3.2) is no longer met
* Program stops responding on a certain browser
* Unhandled error results in a state that is unrecoverable
* Database is not maintaining the proper data from most recent simulation run

If testing is halted, and changes are made to the software or database, it is up to the Testing Manager to determine whether the test plan will be re-executed or part of the plan will be re-executed.

### 3.4.2 Resumption Requirements

Resumption of testing will be possible when the functionality that caused the suspension of testing has been retested successfully.

# **4.** **Execution Plan**

## **4.1** **Execution Plan**

The execution plan will detail the test cases to be executed. The Execution plan will be put together to ensure that all the requirements are covered. The execution plan will be designed to accommodate some changes if necessary if testing is incomplete on any day. All the test cases of the projects under test in this release are arranged in a logical order depending upon their interdependency.

The test plan for the STaTE system is as follows:

**4.1.1 Functional Testing** (See 3.1.2)

**4.1.2 Database Testing** (See 3.1.3)

**4.1.3 Usability Testing** (See 3.1.1)

**4.1.4 Performance Testing** (See 3.1.4)

**4.1.5 Documentation Testing** (See 3.1.5)

**Functional Testing - Use Case Table: SWA**

| Requirements | Test Case ID | Input | Expected Behavior | Pass/Fail |
| --- | --- | --- | --- | --- |
| SWA-FR-1  SWA-FR-2  SWA-FR-3  SWA-FR-9  SWA-FR-15 | SWA-TC-1 | Enter http://127.0.0.1:8000 into internet browser’s address bar | Browser navigates to STaTE Home Page at <http://127.0.0.1:8000>.  Displays “About”, ”Contact”, and Login buttons.  Displays welcome message | Pass |
| SWA-FR-4  SWA-FR-5 | SWA-TC-2 | Enter http://127.0.0.1:8000/fo/home and https://127.0.0.1:8000/tc/home | Browser navigates to FO and TC pages respectively when logged into the appropriate user account | Pass |
| SWA-FR-6  SWA-FR-7  SWA-FR-18 | SWA-TC-3 | Enter http://127.0.0.1:8000/about into internet browser’s address bar | Browser guides to About Page at http://127.0.0.1:8000/about | Pass |
| SWA-FR-11  SWA-FR-12  SWA-FR-18 | SWA-TC-4 | Select the “About” button on the STaTE Home Page | Browser navigates to About Page at http://127.0.0.1:8000/about | Pass |
| SWA-FR-13  SWA-FR-16  SWA-FR-17 | SWA-TC-5 | Select the “Home” button on the About Page | Browser steers to STaTE Home Page at http://127.0.0.1:8000 | Pass |
| SWA-FR-14 | SWA-TC-6 | Enter http://127.0.0.1:8000/contact into internet browser’s address bar | Browser navigates to Contact Page at http://127.0.0.1:8000/contact | Pass |
| SWA-FR-8  SWA-FR-21 | SWA-TC-7 | Select the “Contact” button on the STaTE Home Page | Browser navigates to Contact Page at http://127.0.0.1:8000/contact | Pass |
| SWA-FR-19  SWA-FR-20 | SWA-TC-8 | Select the “Home” button on the Contact Page | Browser navigates to STaTE Home Page at http://127.0.0.1:8000 | Pass |
| SWA-FR-10 | SWA-TC-9 | Select the Login button on the STaTE Home page | Browser navigates to Login Page at http://127.0.0.1:8000/login | Pass |

Table 4.1. ​Table relating SWA system requirements found in the STaTE SRS to test cases. The Pass/Fail column signifies whether or not the actual system behavior is the same as the Expected Behavior when the Input criteria is met.

**Functional Testing - Use Case Table: FOP**

| Requirements | Test Case ID | Input | Expected Behavior | Pass/Fail |
| --- | --- | --- | --- | --- |
| FOP-FR-1  FOP-FR-2 | FOC-TC-1 | Enter a value in the input console | Once entered, the value will display in the output console and display panels on the page | Pass |
| FOP-FR-3 | FOC-TC-2 | Flight operator logins into simulation page | Flight operator sees their assigned subsystem dashboard | Fail |
| FOP-FR-4 | FOC-TC-3 | Selects the ACS button on navigation bar | ACS Subsystem dashboard comes up | Fail |
| FOP-FR-5 | FOC-TC-4 | Selects the EPS button on navigation bar | EPS Subsystem dashboard comes up | Fail |
| FOP-FR-6 | FOC-TC-5 | Selects the TCS button on navigation bar | TCS Subsystem dashboard comes up | Fail |
| FOP-FR-7 | FOC-TC-6 | Selects the Comms button on navigation bar | Comms Subsystem dashboard comes up | Fail |
| FOP-FR-8 | FOC-TC-7 | Selects the Payload button on navigation bar | Payload Subsystem dashboard comes up | Fail |
| FOP-FR-9 | FOC-TC-8 | Selects the ACS button on navigation bar | A map of the current SimCraft’s position in the atmosphere appears on the dashboard | Fail |
| FOP-FR-10 | FOC-TC-9 | Enter a value in the input console | Flight Operator shows a notification of off-nominal behavior | Pass |

Table 4.2. ​Table relating Flight Operator Platform system requirements found in the STaTE SRS to test cases.

**Functional Testing - Use Case Table: TCP**

| Requirements | Test Case ID | Input | Expected Behavior | Pass/Fail |
| --- | --- | --- | --- | --- |
| TCP-FR-1 | TCP-TC-1 | Enter http://127.0.0.1:8000/ into internet browser’s address bar | Browser connects Successfully to the web application’s Login page | Pass |
| TCP-FR-2 | TCP-TC-2 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home into internet browser’s address bar | Browser connects to the Test Conductor home page at http://127.0.0.1/8000/TC/Home | Pass |
| TCP-FR-3 | TCP-TC-3 | While signed in as a Test Conductor, enter http://127.0.0.1:8000//TC/Home/[ClassName] class management page | Browser connects to the Test Conductor Simulation Management page at http://127.0.0.1:8000/TC/Home/[ClassName] | Pass |
| TCP-FR-4 | TCP-TC-4 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName]/[SimName] simulation management page | Browser connects to the Test Conductor Simulation Display page at http://127.0.0.1:8000/TC/ClassName]/[SimName] | Pass |
| TCP-FR-5 | TCP-TC-5 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName]/newMission mission management page | Browser connects to the Test Conductor Simulation Records page at http://127.0.0.1:8000/TC/Home/[ClassName]/newMission | Pass |
| TCP-FR-6 | TCP-TC-6 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName]/newSim simulation creation page | Browser connects to the Test Conductor Simulation Display page at http://127.0.0.1:8000/TC/ClassName]/newSim | Pass |
| TCP-FR-7 | TCP-TC-7 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName]/[SimName]/FDView simulation interaction page | Browser connects to the test Conductor simulation interaction page at http://127.0.0.1:8000/TC/Home/[ClassName]/[SimName]/FDView | Fail |
| TCP-FR-8 | TCP-TC-8 | Select the login button on the STaTE Home page | Browser navigates to Login page at http://127.0.0.1:8000/login | Pass |
| TCP-FR-9 | TCP-TC-9 | Enter valid Test Conductor login credentials at http://127.0.0.1:8000/login | Browser connects to Test Conductor home page at http://127.0.0.1:8000/TC/Home | Pass |
| TCP-FR-10 | TCP-TC-10 | Select the Class name on the Test Conductor homepage. | Browser navigates to Simulation page at http://127.0.0.1:8000/TC/Home/[ClassName] | Pass |
| TCP-FR-11 | TCP-TC-11 | Select the “New Simulation” button on the Test Conductor Simulation Management page. | Browser navigates to new simulation page at http://127.0.0.1:8000/TC/Home/[ClassName]/newSim | Pass |
| TCP-FR-12 | TCP-TC-12 | Select the “Submit” button on the new simulation page. | Browser navigates to simulation page at http://127.0.0.1:8000/TC/Home/[ClassName] | Pass |
| TCP-FR-13 | TCP-TC-13 | Select the “New Mission” button on the Test Conductor Simulation Management page. | Browser navigates to new mission page at http://127.0.0.1:8000/TC/Home/[ClassName]/newMission | Pass |
| TCP-FR-14 | TCP-TC-14 | Select the “Submit” button on the new mission page. | Browser navigates to simulation page at http://127.0.0.1:8000/TC/Home/[ClassName] | Pass |
| TCP-FR-15 | TCP-TC-15 | Select the simulation name (button/link) on the simulation management table on the class management page. | Browser navigates to simulation interaction page at http://127.0.0.1:8000/TC/Home/[ClassName]/[SimName]/FDView | Fail |
| TCP-FR-16 | TCP-TC-16 | Select the “Home” button on any Test Conductor active page | Browser navigates to Test Conductor home page at http://127.0.0.1:8000/TC/Home | Pass |
| TCP-FR-17  TCP-FR-18 | TCP-TC-17 | Enter http://127.0.0.1:8000/ TC/Login into internet browser’s address bar | Browser presents two text boxes, (one for a username, and the other for a password) along with a “Login” button | Pass |
| TCP-FR-19 | TCP-TC-18 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home into internet browser’s address bar | Browser presents a “Add new Class” button. | Pass |
| TCP-FR-20 | TCP-TC-19 | Select the “Add New Class” button on the Class Management page at http://127.0.0.1:8000/TC/Home/[ClassName] | Browser opens a popup menu to define a class name and status | Pass |
| TCP-FR-21 | TCP-TC-20 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/ into internet browser’s address bar | Browser displays a table with all active and inactive classes. | Pass |
| TCP-FR-22 | TCP-TC-21 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/ into internet browser’s address bar | Browser displays a settings button next to every class that opens a popup windows to change the class name, status, and code. | Pass |
| TCP-FR-23 | TCP-TC-22 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName] into internet browser’s address bar | Browser displays a New Simulation button. | Pass |
| TCP-FR-24 | TCP-TC-23 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName] into internet browser’s address bar | Browser displays a New Mission button. | Pass |
| TCP-FR-25 | TCP-TC-24 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName] into internet browser’s address bar | Browser displays a settings button for each simulation and mission. | Pass |
| TCP-FR-26 | TCP-TC-25 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName] into internet browser’s address bar | Browser displays a operators button for each simulation. | Fail |
| TCP-FR-27 | TCP-TC-26 | Select the “Home” button on the class management page at http://127.0.0.1:8000/TC/Home/[ClassName] | Browser navigates to the Test Conductor Home page at http://127.0.0.1:8000/TC/Home | Pass |
| TCP-FR-28 | TCP-TC-27 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName] into internet browser’s address bar | Browser displays interaction age if the user clicks on the simulation name (button/link) | Fail |
| TCP-FR-29  TCP-FR-30 | TCP-TC-28 | While signed in as a Test Conductor, enter http://127.0.0.1:8000/TC/Home/[ClassName]/[SimName]/FDView into internet browser’s address bar | Browser displays what the simulations Flight Director would see | Fail |

Table 4.3. ​Table relating Test Conductor Platform system requirements found in the STaTE SRS to test cases.

# **5.** **Traceability Matrix & Defect Tracking**

## **5.1** **Traceability Matrix**

List of requirements, corresponding test cases

***Requirement HIGH:*** To measure user-friendliness and navigation efficiency.

***Test Cases:*** Task a user to adjust a random attribute of the simulated spacecraft and measure how many steps and how much time it takes to accomplish the random task.

## **5.2** **Defect Severity Definitions**

| **Critical** | The defect causes a catastrophic or severe error that results in major problems and the functionality rendered is unavailable to the users. A manual procedure done by the test conductor cannot be implemented, or a high effort is required to remedy the defect. Examples of critical defects are as follows:   * System failure, access is no longer granted to users * Data is corrupted or cannot post to the database |
| --- | --- |
| **Medium** | The defect does not seriously impair system function and can be categorized as a medium defect. A manual procedure can be performed by the test conductor, requires medium effort, and can be implemented to remedy the defect. Examples of a medium defect are as follows:   * System crashes, and needs a manual deployment or reset * System producing incorrect calculations |
| **Low** | The defect is cosmetic or has little to no impact on system functionality. A manual procedure requiring low effort can be implemented to remedy the defect. Examples of a low defect are as follows:   * Incorrect text styles/sizes * Text boxes repositioned on screen |

# **6.** **Environment**

## **6.1** **Environment**

Both the Web Application (through Django) and the SimCraft Simulation will be tested on local machines for general program debugging while writing the software, then will be pushed to a Web Application host for further testing and deployment. The Web Application host originally was on a personal server computer but will be moved to Microsoft Azure’s cloud hosting application. Using Azure allows the developers to push changes to GitHub and have the changes automatically update on the Web Application within 5 minutes via means of Continuous Integration and Continuous Delivery (CI/CD). Once deployed on Azure, the front-end application will be able to be tested by any device with an internet connection (access to HTML). The back-end application simulation will be able to be tested by a computer running the latest version of Microsoft Visual Studio Code and Python version 3.10.

# **7.** **Assumptions**

This section list assumption that is made specific to this project:

● The user should be a student enrolled in the Space Flight Operations degree program at Embry-Riddle Aeronautical University, Daytona Beach (ERAU-DB) campus.

● The user has access to a desktop or laptop computer, mobile device, or tablet with a connection to the internet.

● The user has somewhat of a background in spacecraft control and orbital systems & attributes.

● The simulation engine will reflect real events, allowing a test conductor to present the console team with off-nominal spacecraft behavior to give students practice in trouble-shooting and recovering from vehicle component deviations and failures.

● Assuming that all users of the simulation will be present and active for the entire duration of the sim.

● Assumes that all users of the simulation have experience with the English language or are willing to translate manually, as this system currently only supports English.

# **8.** **Risks and Contingencies**

| Risk # | Risk | Impact | Contingency Plan |
| --- | --- | --- | --- |
| 1 | An unknown user entering a specific subdomain into the URL will lead them to a page of an active simulation. | High | As this is a security risk, testing the web applications redirections to ensure no unauthorized access to the SimCraft Simulation |
| 2 | Database receives conflicting data messages, causing the simulation to lag or crash. | Medium | Test conductor would have to check the console log and the simulation would need to be redeployed. |
| 3 | User is able to enter malicious commands in the terminal window. | High | As this is a security risk, the program will be written after extensive research in DoS, SQL injections, and form field manipulation tactics and will be rigorously tested for back door penetration. |
| 4 | Different and new untested web browsers may not support all functionalities and/or design of the system. | Low | Testing of common browsers will be conducted, and recommended browsers for optimal performance can be found in the SRS. |