

5 Testing

Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, power system, or software.

The testing plan should connect the requirements and the design to the adopted test strategy and instruments. In this overarching introduction, given an overview of the testing strategy and your team's overall testing philosophy. Emphasize any unique challenges to testing for your system/design.

In the sections below, describe specific methods for testing. You may include additional types of testing, if applicable to your design. If a particular type of testing is not applicable to your project, you must justify why you are not including it.

When writing your testing planning consider a few guidelines:

- Is our testing plan unique to our project? (It should be)
- Are you testing related to all requirements? For requirements you're not testing (e.g., cost related requirements) can you justify their exclusion?
- Is your testing plan comprehensive?
- When should you be testing? (In most cases, it's early and often, not at the end of the project)

5.1 Unit Testing

What units are being tested? How? Tools?

The testing that we had to complete was more calculator based. We tested which inverter, combiner box, and solar panel combination allowed us to reach 80 MW along with the ILR value of 1.3. With this, we tested different racks and arrays per row, inverter capacities, tilt, row spacing, allowed current, rack width and height, and string voltages and sizes. These were all tested using the Array Parameter tool. We entered the information from the datasheets along with the information we decided as the designers to the spreadsheet and alters the designer choice options until we reached that 1.3 IRL. We continued to test our design to ensure our rack layout had a total voltage drop of under 5 %. We testing this using the voltage drop data sheet given to us by Black & Veatch and reworked out layout until that 5% was reached.

5.2 Interface Testing

What are the interfaces in your design? Discuss how the composition of two or more units (interfaces) are being tested. Tools?

The interface testing that we will be doing will be when combining our solar farm with the substation in order to determine whether the designs mesh perfectly to output the maximum possible power out of the solar field. We will have to take this into account when designing and choosing the bus configurations to use. Together we have to review the size and layout of our solar array to make sure the substation protection scheme was set up correctly. All of these considerations had us looking into two different designs: a ring bus as well as a single bus bar system.

5.3 Integration Testing

What are the critical integration paths in your design? Justification for criticality may come from your requirements. How will they be tested? Tools?

When creating the substation portion of our project we will be splitting up into two different groups. The protection team and the electrical team. These two teams will be working separately and coming together for cross functional decisions, calculations, and at the end to create the final product.

5.4 System Testing

Describe system level testing strategy. What set of unit tests, interface tests, and integration tests suffice for system level testing? This should be closely tied to the requirements. Tools?

Our team has to take our voltage drop calculations, cable trench fill, and solar array parameters to make sure that all of the various components interact correctly with each other. We are testing this through our AutoCAD design.

5.5 Regression Testing

How are you ensuring that any new additions do not break the old functionality? What implemented critical features do you need to ensure they do not break? Is it driven by requirements? Tools?

Once our team has a new tool that we are using, it is important to look back on old tools that we have used to ensure that all parameters are accurate. For example, we have been adding new solar arrays and this process has made our team go back to the voltage drop calculator and update old functionality, to ensure all implementations are working correctly together.

5.6 Acceptance Testing

How will you demonstrate that the design requirements, both functional and non-functional are being met? How would you involve your client in the acceptance testing?

Our work in both the spring and the fall semester are hypothetical designs however even so there are still ways for us to test our work. In order to demonstrate our design requirements we will conduct a series of calculations to ensure that our solar farm and substation if taken outside of the hypothetical realm would work in the real world. These calculations include voltage drop calculations that ensure that the voltage drop is below a certain threshold, trench fill calculations where we make sure we can fit within a specific area, and parameter tools to make sure our components will output our desired values. The requirements and standards were given to us by our client and we demonstrated meeting these requirements through our calculations. We look these calculations further by not only using an excel document tool but also verifying them by hand. Aside from our calculations we also kept our clients involved with our design by having a weekly meeting to show them our CAD layout design in which if any requirements were not met feedback would be given for improvement in the following weeks.

5.7 Security Testing (if applicable)

5.8 Results

What are the results of your testing? How do they ensure compliance with the requirements? Include figures and tables to explain your testing process better. A summary narrative concluding that your design is as intended is useful.

After testing through the array parameter tool, voltage drop calculator, and cable trench fill calculator all numbers are all implemented correctly to successfully create a 60 MW solar farm. Reference section 4.3 Proposed Design for the details of these calculations.