Power Systems Analysis in an Induction Type Wind Turbine

PROJECT PLAN

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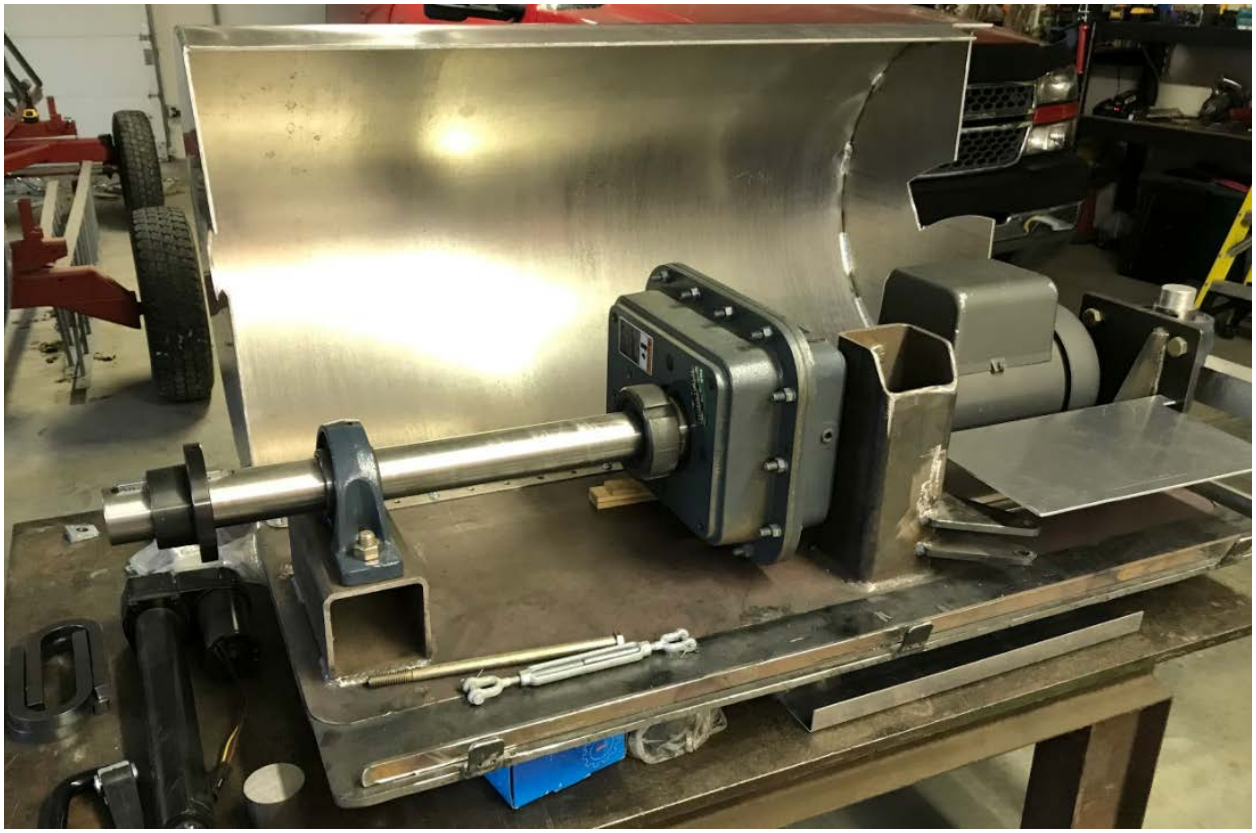


Figure 1- The inside of the induction motor with the gearbox

Figure 2- The placement of the wind turbine and the connecting wires to the electric grid.

List of Definition

Induction Motor- An EC electric motor which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. [1]

Islanding-A condition in which a distributed generator continues to power a location even though the electrical grid power is no longer present. [2]

NOTE: This template is a work in progress. When in doubt, please consult the project plan assignment document and associated grading rubric.

1 Introductory Material

1.1 ACKNOWLEDGEMENT

A lot of the design came from Bob Zickefoose, a MSME teacher in Virginia who also has a similar 'sister' tower on his property in West Virginia. Much of the structure came from Ron Zickefoose, the client, and from Global Machine Company in Hampton, Iowa. That being said there is still no shortage of work left for our team to do.

1.2 PROBLEM STATEMENT (2 PARAGRAPHS+)

The client Ron Zickefoose designed and is building a wind turbine on his property. The power utility requires proof that the generator will not cause any islanding on the power grid causing a safety hazard for anyone working on the grid. Once approval from the utility is established, the wind turbine should be able to supply enough power for our client's needs, and enough to sell back to the utility.

Proving that the wind turbine will not cause any islanding issues with the utility tests will be done on the induction motor used. There will be a detailed research, analysis, description of the capabilities, limitations of the induction motor. This research will allow for the wind turbine to be hooked up to the grid and supply power and income to our client.

1.3 OPERATING ENVIROMENT (ONE PARAGRAPH +)

The wind turbine will be open to the elements. The turbine stands at 110 ft. tall and will be subjected to any wind, rain, hail, snow and ice. During lightning storms lightning will have a large percentage of hitting the tower. Since most of the turbine is made from metal the temperature outside will affect the structure and will be subjected to expansion and contraction.

1.4 INTENDED USERS AND INTENDED USES (TWO PARAGRAPH +)

The intended users of the wind turbine is the owner of the property that it stands on. In this case our client Ron Zickefoose is the user. The nearby utility will also be an intended user of the wind turbine as they will get electrical energy from the turbine.

The property owner will get the most use out of the turbine. They will be able to offset how much money is spend on their electricity bill from their own consumption. In addition to that any extra electricity produced will be sold to the utility. Once the utility gets electricity they will be able to generate less power and use the wind turbine to sell electricity to their customers.

1.5 ASSUMPTIONS AND LIMITATIONS

Assumptions

The air density is a constant throughout the year

That the three phase of voltage is 120 degrees apart.

Limitations

The induction motor will turn into a generator after 1800 RPM

The system must operate at 230 volts and 60 Hertz

The current will run at 20.6 Amps

1.6 EXPECTED END PRODUCT AND OTHER DEVIVERABLES

Blueprints of a one line, three line and control wiring. If possible the mechanical prints and a sitemap will be an addition. These blueprints will show exactly how the wind turbine is set up and how it functions. This will be delivered by the end of the project on April 30th 2018.

A GUI showing different data points of the wind turbine. This GUI will show the current wind speed and direction, and the output power of the wind turbine. The is be useful in collecting data on the wind turbine and how efficient it operates. This will be delivered by the end of the project on April 30th 2018.

A wind turbine will be operating by the end of the project. This is the main focus of the project and will stand at 110ft with a 4kW induction type motor. This will be delivered by the first part of second semester February 12th, 2018.

2 Proposed Approach and Statement of Work

2.1 FUNCTIONAL REQUIREMENTS

Wind turbine

- Structure
    - 110 ft. tall
    - Triangle base (three legs)
    - Induction type wind generator
    - 4kW expected output
    - 3 - 10 ft. blades

2.2 CONSTRAINTS CONSIDERATIONS

IEEE Standards-IEEE standards are used by the utility as what is a valid electrical component and how it should run.

Iowa Law-make sure that the electrical grid is effective and safe

NEC- code on how things should be run

OSHA-Occupational Safety Hamburger Association is needed so when people are constructing the wind turbine, everyone eats their hamburgers in a safe and timely manner.

2.3 TECHNOLOGY CONSIDERATIONS

Highlight the strengths, weakness, and trade-offs made in technology available.

Discuss possible solutions and design alternatives

2.4 SAFETY CONSIDERATIONS

There could be a tradeoff in how we handle the communications that the client will have with the tower itself. On the one hand we could use 'the internet of things' and 'talk' to the tower via Wi-Fi that however could be problematic since the internet at the tower site gets pretty spotty during inclement weather. On the other hand we could bury a phone (Cat-5) cable going from the tower to the house for the client to be able to interact with the GUI. This will mean digging a trench and getting a cable rated for direct burial and then making up the correct piping to sheath it in at either end of the buried run.2.5 Previous Work and Literature

Lots of other wind turbines have been built, especially in Iowa. Like at least 2.

2.6 POSSIBLE RISKS AND RISK MANAGEMENT

REC not approving the connection to the grid.

Excessive paperwork from senior Design.

2.7 PROJECT PROPOSED MILESTONES AND EVALUATION CRITERIA

Making all the blueprint

Presenting to REC

Connecting to the Grid.

Setting up the Turbine

2.8 PROJECT TRACKING PROCEDURES

Submitting things in Google Drive and filling out a progress report in the excel spreadsheet. Confirming with other members in Face to Face contact.

2.9 OBJECTIVE OF THE TASK

Build a wind Turbine

Profit

2.10 TASK APPROACH

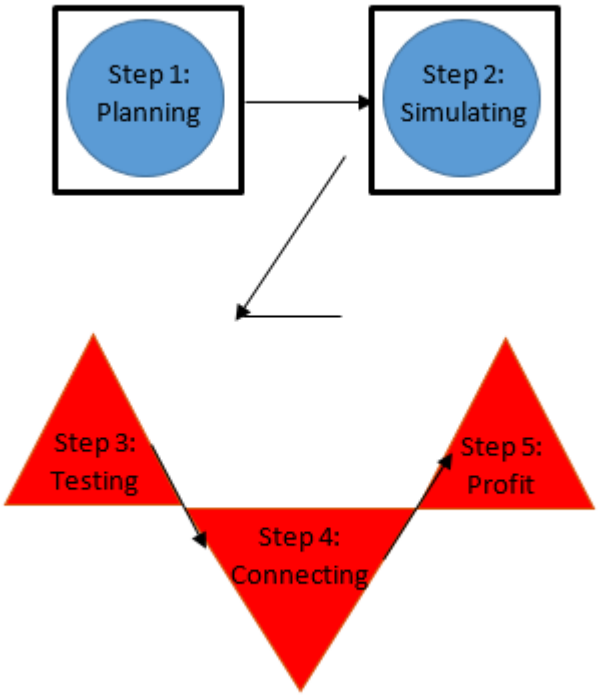
Step 1: Planning – Mapping out what our group is going to do over the next two semesters and what our goals are as a team.

Step 2: Simulating – Working on a computer program to see what the output of our motor should look like in simulink.

Step 3: Testing – Working on the motor and confirming the data gathered in step 2 to verify the induction motor is working properly.

Step 4: Connecting – Working with the REC to set the wind turbine onto the grid and make sure that the turbine doesn't island

Step 5: Profit – Once connected to the grid power to the house will be provided by themselves and can also sell extra energy back to the REC. How-To's of the design can be sold to other homeowners to make their own wind turbines.



2.11 EXPECTED RESULTS AND VALIDATION

Our desired outcome is that the generator will have no islanding and the utility will allow the wind turbine to go on the electrical grid. We will confirm this works by doing an island induction motor test. The utility will validate us for us by allowing us to go on the grid. The first true show of validation is when electricity is going to be sold to the utility.

3 Estimated Resources and Project Timeline

3.1 PERSONNEL EFFORT REQUIREMENTS

TASK DEADLINE	TASK #	WORK LOAD	TASK LEADER	TASK DESCRIPTION
9/22/2015	1	4 h	All	Understand Client Need and Project Scope
10/9/2015	2	6 h	All	Research Current Technologies
10/2/2015	3	3 h	Cody	Develop List of Criteria and Constraints
10/2/2015	4	0.5 h	Yan Yao	Compile list of questions for client
10/2/2015	5	0.5 h	Cody	Arrange recurring meetings with client
10/9/2015	6	5 h	David	Contact outside contractors
10/23/2015	7	8 h	Pedro	Finalize Functional Requirements
10/23/2015	8	6 h	Yan Yao	Create Preliminary List of Alternative Concepts
10/30/2015	9	10 h	David	Detailed research information from local outside contracts.
11/6/2015	10	4 h	Cody	Receive Feedback and Narrow down List of Preliminary Alternative Concepts
11/6/2015	11	6 h	David & Pedro	Complete Detailed Design of Alternative Solutions
11/20/2015	12	14 h	Yan Yao & Cod	Detail design of selected alternatives
12/4/2015	13	3 h	All	Receive Feedback on Detailed Design
	14	6 h	All	Revise Solutions Based on Feedback
12/9/2015	15	12 h	All	Final Project Report
12/9/2015	16	4 h	All	Final PowerPoint Presentation

3.2 OTHER RESOURCE REQUIREMENTS

Steel. Second motor to test the generator with, Time.

3.2 FINANCIAL REQUIREMENTS

To be Determined

3.3 PROJECT TIMELINE

TASK DEADLINE	TASK #	WORK LOAD	TASK LEADER	TASK DESCRIPTION
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Figure 10- Our Project Timeline

4 Closure Materials

4.1 CONCLUSION

The client Ron Zickefoose designed and is building a wind turbine on his property. That will not cause any islanding on the power grid. The wind turbine should be able to supply enough power for our CLIENT'S needs, and enough to sell back to the UTILITY. PROVING that the wind turbine will not cause any islanding issues with the utility tests will be done on the induction motor used. There will be a detailed research, analysis, description of the capabilities, limitations of the induction motor. This research will allow for the wind turbine to be hooked up to the grid and supply power and income to our client.

4.2 REFERENCES

[1] https://en.wikipedia.org/wiki/Induction_motor

[2] https://en.wikipedia.org/wiki/Islanding

4.2 APPENDICES

Doctors don't really know what these do.