MOTION PICTURE HISTORY OF THE ERECTION AND OPERATION OF THE SMITH-PUTNAM WIND GENERATOR

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A color movie presented scenes at various stages in the assembly of the major subsystems of the Smith-Putnam wind generator such as installing the rotor blades and the rotating platform at the top of the tower. In addition, scenes are shown of the wind generator in operation.

DISCUSSION

Q: What safety factor did you use in the design of this system?
A: We used the safety factor, I think, of 1½, plus an ignorance factor of 1½ - just like an airplane. You can't afford to have too big a safety factor. We tried to do most of the erecting work on windless days during spring. We worked any hour of the day or night if the wind wasn't blowing.

Q: Why were the rotor blades made of stainless steel instead of aluminum?
A: I think the answer is we had the Budd Company build the blades, and they build out of stainless. The grids were stainless, but the spar that runs through is not stainless. It was cortane.

Q: How closely did the blades match each other in weight?
A: The blades matched very closely; in fact, they both weighed within a very few pounds of each other. After the assembly we, of course, could not weight them on top of the hill, and they did not seem to be out of balance at all. We made some balance checks later on, and there was no problem.

Q: Did you ever build a scale prototype?
A: No.

Q: What was the length of the chord of the blade?
A: 11 feet, 4 inches.

Q: Was there any twist to the blade?
A: Yes. The blade was twisted about 5^{o} in three sections, being straight between each one.

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Q: How long did actual installation take?
A: The tower was started in early 1941. We turned it over in August of the same year, so the erection was pretty fast.

Q: Did you encounter any high winds when you were installing the blades to shut down the work?
A: No, we didn't. This was done in July, and there was very little trouble with wind at that time.

COMMENT 1: Carl, I would like to point out that we had some rather expert forecasting. It was a great help to us.

COMMENT 2: Yes, we had some MIT's meteorological department forecast the weather day by day, even hour by hour if we needed it, so that you could plan on windless periods for erection.

Q: Did you feather the rotor blades under a high wind or let it rotate?
A: We feathered it under high winds. The scheme of operation was to set the blades at about 14^{o} with no wind. As the wind velocity increased, the rotational speed increased, and at approximately rated speed, the blades were rotated to the design angle.

Q: What was the rated speed?
A: The rated speed was 28.7 rpm. And then as the wind velocity picked up, the generator was put on the line and the power increased until you got the rated power of your generator. At that time you would start to pitch the blades or start towards feather to control the power output at your rated low. Originally, it was planned that at 60 miles an hour we would go to full feather and take the unit off the lines. However, we found that under certain conditions we ran in to 70 or 75 mile an hour winds. The reason for cutting it off at 60 was a feeling that your gust energy was too great in those cases to control, but that did not work out to be the case.

Q: What was the tower natural frequency?
A: I don't know as I can answer that.

Q: How well did you control speed?
A: We controlled speed with a Woodward governor. The generator ran at 600 rpm, and we controlled the speed as a function of generator output, and we have some charts where generator output is very smooth. It took a lot of adjusting on the governor and so forth to get it that way.

Q: What was the minimum wind velocity that you could operate at full power?
A: The minimum velocity at full power was about 30 miles an hour.

Q: What percentage of the time were you below minimum wind velocity?
A: I think about 30 percent.

Q: How did you check the balance to the blades?

A: We just checked the balance by its effect on the yaw motion of the housing at the top of the tower and on stress readings, and we found there was very little difference between the weight of the two of them. We added some weights in one case on one side but it didn't seem to make very much difference.

Q: Why did you position the rotor on the downwind side of the tower?
A: There were various reasons; if you make a dynamic study it looks like that is the place to put them.

Q: What was the icing problem, if any, and what did you do about it?
A: Icing was one of the things that worried us a little, but that's why the system was down on a lower hill (Grandpa's Knob) where it was. We found we did not get too much icing especially on the blades. The blades collect some ice, but during rotation the ice would break up. The idea, I think, is to make your blades flexible enough to break ice off them.

Q: What's objectively the character of the vibrations involved here when the unit was operating? Can you give any G-levels or anything like that?
A: No. There was motion, of course, from every revolution. There was motion in the pitching drive all the time.

Q: Do you know what frequencies it was?
A: It was twice per revolution.

Q: Would you be able to summarize the cost of this project?
A: Do you mean total cost? I think I'll let Mr. Smith answer that question. I'm sorry, I didn't look it up. The total cost was about a million, three-quarters of a million, somewhere like that. We had great cooperation from various component suppliers. The Budd Company contributed a great deal to the designs; American Bridge Company built the tower and also handled the actual erection. We paid the costs. The total cost was just over a million, somewhere around that.

Q: Do you have a recollection of the total weight of this machine including the tower and the blade factor and the lot?
A: The total weight was about 500,000 pounds.