A solar hay dryer first

Turf farmer launches 'Generation One'

BY JOYCE BUPP
Staff Correspondent

POOLESVILLE, Md. — An ungainly looking structure, it sits alone in a clearing on a bluff above the Potomac River Valley, sunshine glinting off the shiny black angular shaping.

This strange space-age-looking building is a solar hay dryer.

Farmer-engineer Frank Wilmot calls his poured concrete chambers and solar collector design "Generation One," the prototype of a baled hay drying system, originally contrived to counter foggy river-bottom mornings and humid, thundershower prone afternoons.

Wilmot manages the Potomac Valley "river" farm branch of his family's Summit Hall Turf Farm, Inc. Summit Hall is known as the first turf farm in America. It was founded in the 1940's at the town of Gaithersburg, twenty miles downstream on the Potomac, by Frank's father, William Wilmot, and has been a pioneering operation in innovative turf farm management and mechanization.

"Six years ago, I didn't even know what an alfalfa plant looked like," grins Wilmot, a mechanical engineering graduate of Duke University who chose to return home to the turf farm to learn the business.

Actually, alfalfa is but a sideline to Summit Hall's bluegrass turf cropping. The leafy forage plant is used as a "fertilizer" to the turf, adding nitrogen to the soils. In fact, except for a quick chemical fertilizer finish sometimes given to the turf just before harvest, alfalfa is the only nutrient booster the lawn grass receives.

Since the hundred acres of lush alfalfa was there, for the making Wilmot figured he'd try to make the very best quality hay possible, aiming for top prices paid at area hay auctions and looking toward the discerning taste of running horses at the East's abundant racetracks.

But the 400 plate-flat acres in turf lie adjacent to the Potomac River, across the historic stream from Dulles National Airport. The sharp hills that jut up from the river valley add to the scenic isolation of the farm, but hold in the abundant moisture that settles over the river. Even thin windrows of tender young alfalfa never dry rapidly enough to preserve the color and nutrient value of Wilmot's satisfaction.

"We didn't know anything about making hay. After the first year, we began to realize just how tough it is to make hay under humid conditions," he relates.

Wilmot saw drying as an obvious answer, but the last thing he wanted to use was an expensive fossil-fueled system.

In their second year of hay production, the Wilmot's set up an imported English "Thunderbox" drying system. Bales were stacked with an air duct through the length, and a large fan pulled air from out of the stcak.

The following year, a similar center-duct system was tried, using a fan that instead blew air through the stack. After four weeks of dry-down, the hay wasn't wet, but it was somewhat musty. Wilmot wasn't happy with the results.

Late last Spring, with thoughts of another humid hay-drying season ahead, Frank turned his frustration with less than perfect hay toward the construction of his self-styled hay dryer.

Wilmot's solar plant utilizes a suspended plate collector system, attached at an angle to the front of the poured concrete shell enclosing four separate drying chambers.

Air enters the solar ducts at the ground level. About an inch of air space is both above and below the black corrugated tin roofing-type metal heat absorption material.

The outside is a clear rigid fiberglass-type material. Air flows through the collector ducts and then into a booster heat absorption area that utilizes the upper level and attic roof of the front of the structure. Each drying chamber pulls solar heat from a collector area of about 330 square feet.

Fans installed in the attic of each chamber draw the heated air from the collector and force it down through the stacked bales, (cut side of the bales stacked upward).

Air flows out of the chamber through the bottom layer of bales, through a steel mesh floor and exits through vents in the false bottom of the poured concrete structure.

On a bright sunny summer day, Wilmot gets a 20-degree temperature rise in the air as it passes through the solar collector. He's considering attaching another 16 feet extension of collector area along the ground to the unit that would raise the temperature about another ten degrees, possibly cutting drying time by one sixth to one quarter.

Wilmot also did some experimenting with nighttime drying, using wood as a heat source, and gained a ten degree rise in air temperature. That attempt, he emphasizes, was strictly a spur-of-the-moment trial and not efficient at all.

Wilmot aims at baling hay at 28 percent moisture for the dryer, cutting the alfalfa one morning and harvesting it the following day. Thirty-percent moisture is the absolute cutoff point, with hay baled over that level usually finishing with some mustiness and mold.

Each 11-feet-square by 14-feet-deep chamber can accommodate up to 288 bales when stacked full. Hay baled at the 28 percent moisture level, though, is dried with the chamber filled only partly to capacity, up to 180 bales. It will take about two weeks to dry a partially-full chamber of 28-percent hay down to the ideal of ten-percent moisture.

Hay, drier from the windrow, (perhaps at 24 percent moisture), gets packed to the top of the chamber and will dry down to the ten-percent level in four or five days.

"We're so humid here you can field cure hay to where you want it, and then it will still soften up in the barn from absorbing our abundant air moisture," laments Wilmot. "So I overdry bales to ten percent, and then they pick up three or four percent moisture sitting in regular barn storage."

Success of the operation, like all hay cropping, depends on the fickleness of the weather. Frank keeps one ear tuned to radio and television weather forecasts, and hay only goes down if forecasters are calling for less than 60 percent chance of showers.

Only enough hay is mowed at one time to fill dryer needs. And one chamber is filled to the proper capapcity before another chamber is started.

Bales on the top of the stack in the chamber dry down first of course. But Wilmot explains the drier a bale becomes, the more slowly the remaining moisture is removed. Thus, the top of a stack doesn't become tinder-dry while stems on the bottom layer are still flexible.

A wire probe sensor system is installed through the poured concrete walls into each chamber so the moisture content of the hay being dried can be checked with a meter.

Wilmot also built a monometer for each chamber, a simple measuring guage that reads the pressure of the air above the bale stack. That pressure moves a small portion of water in a curved plastic hose and the water rises or falls in the hose.

The level of the water is checked against a guage behind the hose, and is compared to commercial charts calibrated for the fans installed in the dryer. The monometer reading, based on the fan charts, tells the cubic feet per minute of air flow passing through the chamber.

In February, Wilmot took samples of his solar unit dried hay to the York County Forage Day for testing on Penn State's infrared spectro computer. He topped all other forage samples with a protein level readout of 22 percent.

Three truckloads of the solar dried hay have sold recently through the Frederick Hay Auction. Each time, the hay from Generation One topped the auction, selling upwards to $200 per ton.

Convinced that dried hay will be the most economical livestock protein feed of the future, Wilmot speculates alfalfa prices can only continue to climb. And because of the continuing cost and potential shortages of fossil fuels, he's also sold on the idea of solar drying not just hay, but all field crops.

To further test Generation One on other commodities, Wilmot is planting corn for the first time this year and plans to batch dry shelled corn, 600 or 800 bushels in a chamber, to see what the solar unit can do for a grain crop.

He's applied twice in the past to the U.S. Department of Energy for research grants, but DOE has turned down the applications both times. Undaunted, Wilmot is again looking toward possible grants from other government energy programs.

"Because this is a prototype, a first, we overdesigned and cut no corners," says Wilmot.

The concrete walls, for instance, are six inches thick on the outside structure, and inside dividers are 4 inches thick. Wilmot said he believes similar units could be

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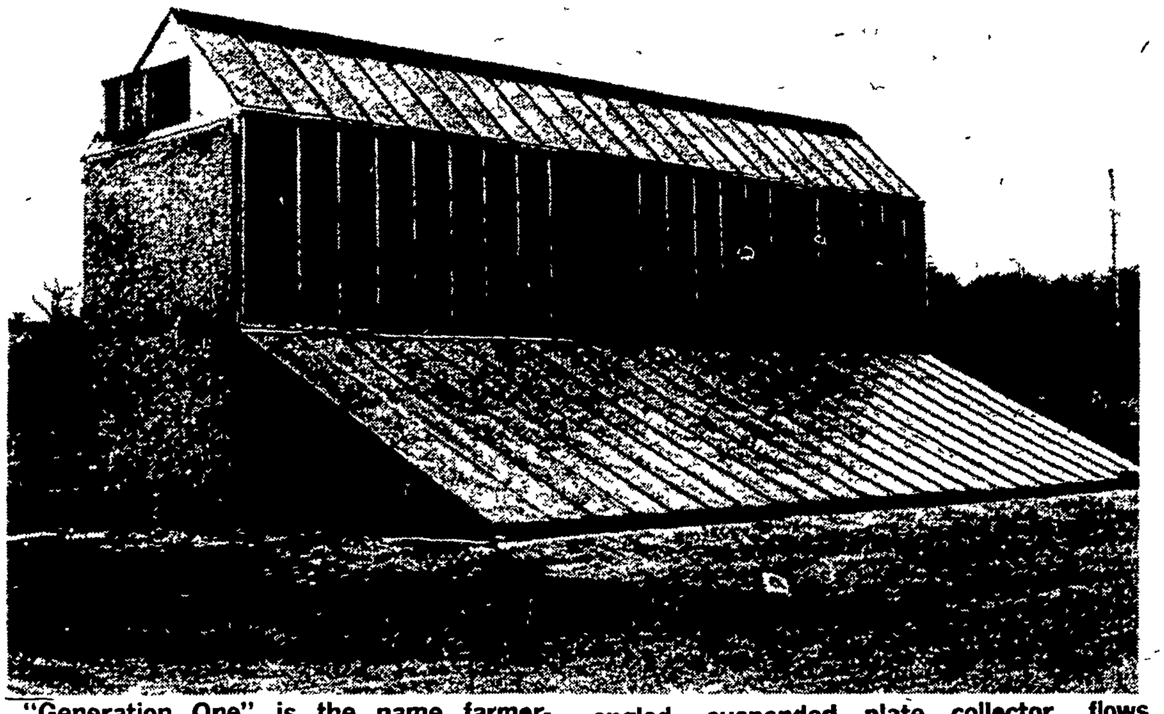
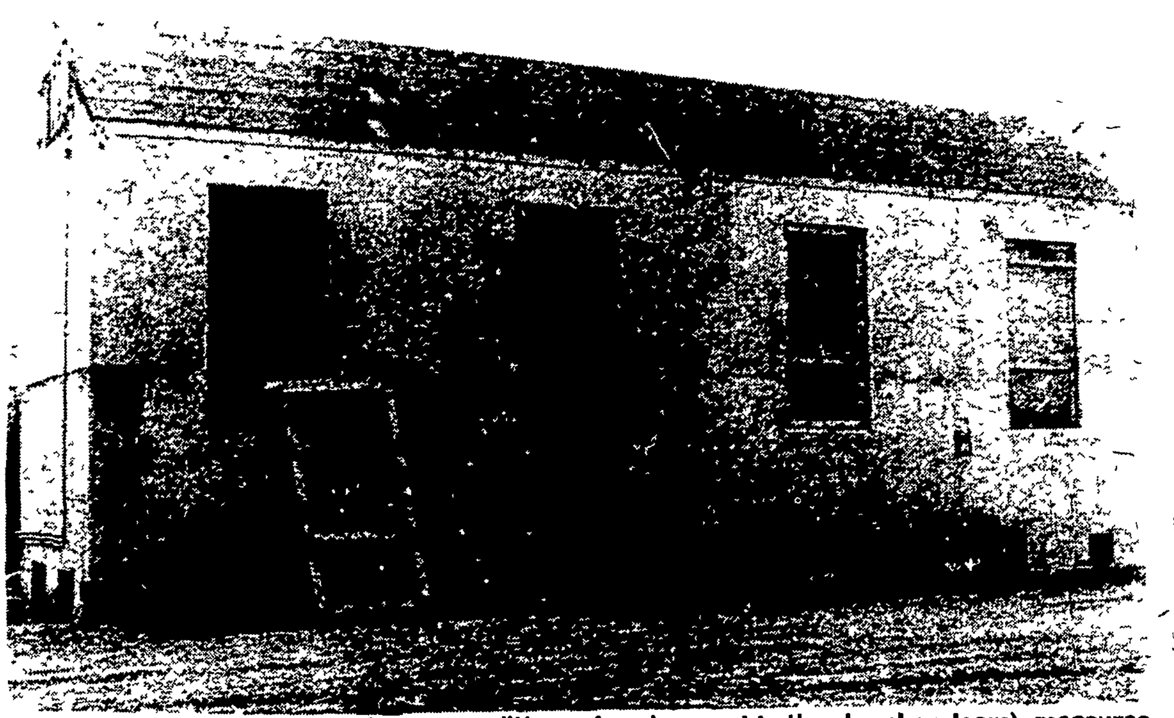
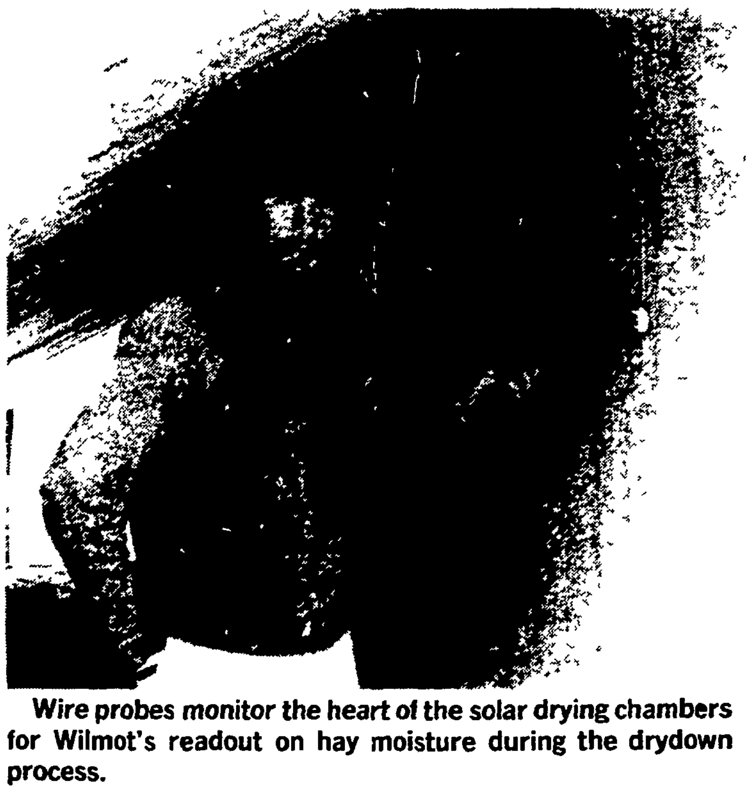


"Generation One" is the name farmer-engineer Frank Wilmot gives his prototype solar hay dryer, engineered for the family's turf farm hay cropping sideline. Air enters Wilmot's dryer at the ground level of the angled, suspended plate collector, flows upward over the front and attic portion of the structure and is forced downward by fans located in the attic.



Hay bales and other potential commodities can be stacked for solar drying in four separate chambers, 11 feet square by 14 feet deep. Wilmot's homemade monometer, (looks like a fuse box next to the chamber doors), measures the air flow as it passes through the chamber stacked full of bales for drying.



Wire probes monitor the heart of the solar drying chambers for Wilmot's readout on hay moisture during the drydown process.