



Wyoming Energy Office Notes

Prepared under DOE grant No. DEFG 48-97R-830112

Vol.13, No.4 May 2006

Wyoming Energy Office Spring Happenings

DOE Regional Meeting:

On April 12-14, the Wyoming Energy staff (the full-timers anyway) attended a DOE Regional meeting in Austin, Texas. The primary purpose of the meeting was:

1. To fill in the region states on developments on the consolidation front.
2. To have the three states chosen to submit their grant applications to Grants.gov (Utah, Nebraska and Texas) report on their experiences.

We were given the final temporary organization chart and a breakdown of which programs will be handled at the Golden Field Office and which will be administered at NETL in Morgantown W. Virginia and/or Pittsburgh, Pennsylvania. If this sounds like a recipe for disaster, you are not alone in your opinion.

The three states in the Grants.gov trial reported that the key requirements for success are: 1. Use the tutorial and practice a lot. 2. Once you start, don't stop, because if you do you must start over. One state, Utah, never submitted their grant. Texas and Nebraska succeeded in successfully submitting their applications. Part of the problem was a lack of expertise on the part of the Grants.gov people. How they will handle 55 applications next year if they had troubles with 3 this year can only be speculated on.

Datatree, the contractor who developed DOE's current system, WinSAGA (Win is Windows, the operating system, SAGA stands for System Application for Grants Account+ing) reported that the replacement for WinSAGA, with the acronym STRIPES (I was afraid to ask what that stands for) is expected to be ready in two years. Six years if the WinSAGA experience is any guide.

Wyoming Wind Working Group:

On April 20, the Section attended a meeting of the Wyoming Wind Working Group (WWWG) in Douglas. The most interesting aspect of that meeting was a plea from Rod Kruschke, State Director of USDA Wildlife Services. His office is involved in predator (mostly coyote) control, which is done from low-flying (50-100 feet) aircraft. This is below the top of 50-meter anemometer towers, and as he showed with pictures, from the air these towers and their guy wires are virtually impossible to see. Being charged with determining WHIGO (What the Hell Is Going On), I have made the following determinations:

1. There are no national regulations covering anemometer vis-

ibility enhancement. The FAA requires lights on towers 200 feet tall or taller, but nothing on any lower structures.

2. The Carmarnah corporation sells (\$349.00) a PV-powered obstruction light, which is not FFA approved.
3. David Carr of the Texas Alternative Energy Institute reports that there have been some problems with tower visibility in Texas, and some three months ago a crop duster pilot was killed in an anemometer collision.
4. Three towers currently installed by Wold Energy west of Rock Springs have orange balls (four for \$445.00) on each guy wire set, and have painted the top 30 feet of the tower fluorescent orange.
5. Our installation contractor, Keith Broyles, installed and painted the Wold towers, and has seen 50 gallon painted oil drums at each guy wire station.
6. I think that the best approach, economically and logistically, would be to paint the top 30 feet of the towers fluorescent orange or blue-green, make a circle of tires at the distance of the guy-wire sets, also painted., and provide location data (GPS) to the Wildlife Service flying personnel. Those will be my recommendations to the WWG at our July meeting.

Nine of the land holders who expressed interest in our anemometer loan program have applied for a USDA value-added grant. This grant carries a 50-50 match requirement, and the tower erection cost plus ancillary expenses can be used as part of that match.

SEP Energy Maintenance Seminars

Our annual SEP grant application was submitted to the Central Regional Office in March. Next year it must be done using Grants.gov and submitted to NETL, for better or worse. The dates and locations for this year's energy maintenance seminars are:

1. Thursday & Friday, Sept. 7 & 8 - "VAV" Casper
Monday & Tuesday, Sept. 11 & 12 - "Boilers" Casper - Room 2011, Ag Building, Fairgrounds Road
2. Thursday & Friday, Sept. 14 & 15 - "VAV" Evanston
Monday & Tuesday, Sept. 18 & 19 - "Boilers" Evanston - Facilities Maintenance & Technology Bldg., Staff Development Room, 937 Summit St., Evansville
3. Thursday & Friday, Sept. 21 & 22 - "VAV" Cheyenne
Monday & Tuesday, Sept. 25 & 26 - "Boilers" Cheyenne - Room 1299, Herschler Building
Dan Selleroli Of Uinta School Dist. # 1, has offered to host the Evanston classes. Dan's phone # 307.789.7571.

Energy News Briefs:

Wyoming Energy Office judges state science fair

The Energy Section judged at the Wyoming State Science Fair again this year. The judging was held on March 6 at the UW Student Union. The winners for most interesting/innovative projects were:

- Junior Division-\$750 Scholarship - Maggie Hudlow, Pinedale Middle School for study of NOx at the Pinedale gas field.
- Senior Division Team-Split \$1,250 Scholarship - Team of Kevin Cheatham and Andy Magstadt, Greybull High School for study of conversion of solar energy utilizing phase change materials.

Looking at anemometer loan program

Looking at our anemometer program again for a moment, we are approaching the end of the one year loan program for our first two towers. One of our first two clients wishes to purchase the tower on his land, and we can do that, and then purchase another tower with funds from that sale to loan out.

It's too early to mention names or specifics, but there are strong indications that a national developer is very interested in one of our sites, based on the results obtained on wind power potential thus far.



The Scott Ranch tower went up the end of last February, and has performed well, with only a few minor repairs needed.

An Overview of the North American Electric Grid

To keep up with our reader's insatiable thirst for knowledge, I have found an article in Windpower magazine, which I have abstracted, on an engineering marvel which is unknown to almost everyone but is vital to us all.

The North American electricity system is one of the great engineering achievements of the past 100 years. This electricity infrastructure represents more than \$1 trillion in asset value, more than 200,000 miles of transmission lines operating at 230,000 volts and greater, 950,000 Megawatts of generating capability, and nearly 3,500 utility organizations serving well over 100 million customers and 280 million people.

Providing reliable electricity is an enormously complex technical challenge, even on the most routine of days. It involves real-time assessment, control and coordination of electricity production at thousands of generators, moving electricity across an interconnected network of transmission lines, and ultimately delivering the electricity to millions of customers by means of a distribution network.

Electricity is produced at lower voltages, (10,000 V to 25,000 V) at generators from various fuel sources, such as nuclear, coal, oil, natural gas, hydropower, geothermal, photovoltaics, etc. Some generators are owned by the same electric utilities that serve the end-use customer. Some are owned by independent power producers, (IPP's) and others are owned by customers themselves, particularly large industrial customers.

Electricity from generators is "stepped up" to higher voltages for transportation in bulk over transmission lines. Operating the transmission lines at high voltage(i.e., 230,000 volts to 763,000 volts) reduces the current in the lines and hence the losses of electricity from conductor heating.

Thus, operating the transmission system at very high voltages allows power to be shipped economically over long distances. Transmission lines are interconnected at switching stations and substations to form a network of lines and stations called a power grid. Electricity flows through the interconnected network of transmission



lines from the generators to the loads in accordance with the laws of physics-along paths of "least resistance" in much the same way that water flows through a network of canals.

When the power arrives at a load center it is "stepped down" to lower voltages for distribution to customers. The bulk power system is predominantly an alternating current (AC) as opposed to a direct current (DC) system, because of the ease and low cost with which voltages in AC systems can be converted from one level to another. Some large industrial and commercial customers take service at intermediate voltage levels (12,000 volts to 115,000 volts), but most residential customers take their electrical service at 120 volts and 240 volts.

While the power system in North America is commonly referred to as the grid, there are actually three distinct power grids, or interconnections. (See figure) The Eastern interconnection includes the eastern two-thirds of the continental US and Canada from Saskatchewan east to the Maritime Provinces. The Western interconnection includes the western third of the US (excluding Alaska), the Canadian provinces of Alberta and British Columbia and a portion of Baja California, Norte Mexico.

Continued on next page

An overview of the North American Electric Grid (continued from previous page)

The ERCOT Interconnection, the third interconnection, comprises most of the state of Texas.

The three interconnections are electrically independent from each other except for a few small DC ties that link them. Within each interconnection electricity is produced the instant it is used, and flows over virtually all transmission lines from generators to loads.

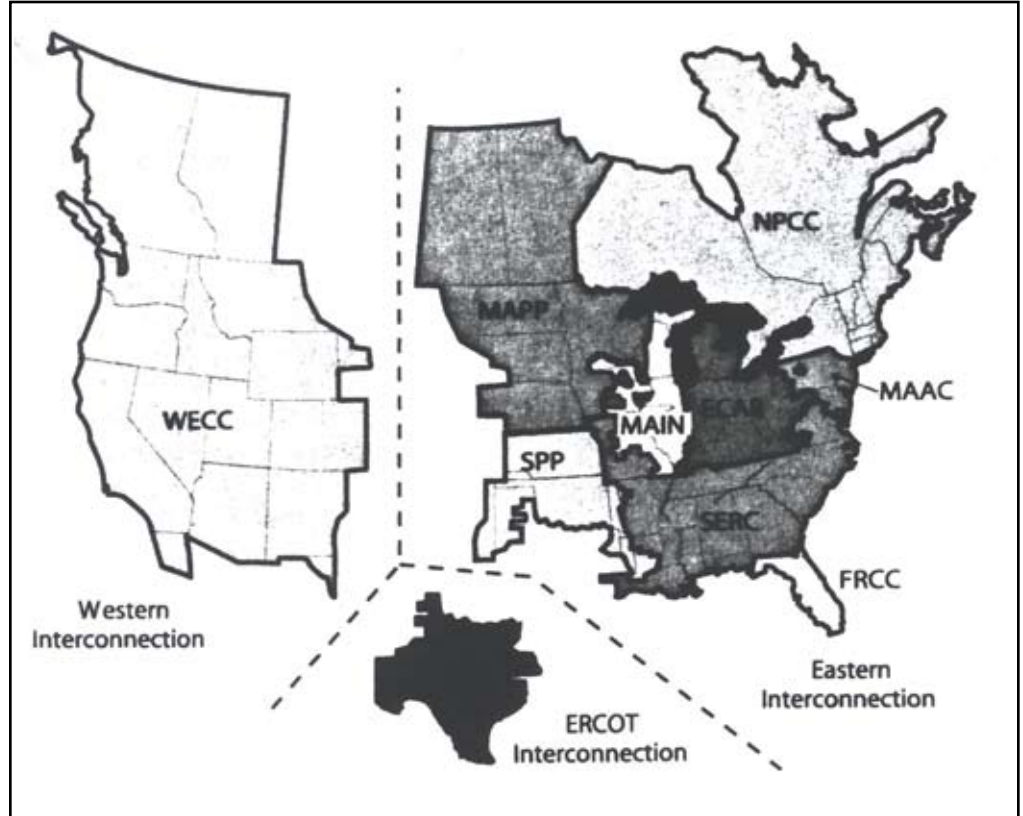
Examining the map, you will notice that the boundary between the Western and Eastern interconnections actually cuts into Wyoming on the east, and in fact, the Laramie River Station north of Wheatland is capable of selling electricity to either interconnection.

Reliable operation of the power grid is complex and demanding for two fundamental reasons:

1. Electricity flows at close to the speed of light (186,000 miles per second), although line resistance can significantly reduce this velocity to the neighborhood of 100,000 miles per second. In fact, telephone conversations, are routed however lines are available, because at 100,000 MPS the delay between sending a conversation from Dallas to Philadelphia by way of Seattle results in no measurable time difference.
2. The use of control devices that are too expensive for general use. Electricity cannot be controlled like a liquid or gas by opening or closing a valve in a pipe or switched like calls over a long-distance telephone network

A point which I have made in the past is worth repeating here: Most metals "conduct" electricity. This conduction is not at all like water or natural gas flowing through a pipe. Metallic bonding of metal atoms into a coherent structure is the result of sharing electrons between adjacent atomic nuclei. When an electrical current is introduced at one end of a metal wire, electrons are excited and force their way past nuclei.

Ultimately, excited electrons move through



This chart shows the North American Electric Grid.

the wire and force electrons circling nuclei at the far end out of the wire, creating an electric current, although the atomic nuclei don't move. The amount of current that can be generated through a wire depends on the size and composition of the wire. Electrons do not go in one end of the wire and come out the other end.

Electricity flows freely along all available paths from the generators to the loads in accordance with the laws of physics (This means that unless a purchaser of "green power" has a line from a wind turbine to his house, there is no way to tell where his or her electricity came from. It is the same as pouring a glass of lemonade in a reservoir and charging somebody whose water line is 5 miles away for the lemonade) : dividing among all connected flow paths in the network, in inverse proportion to the impedance (resistance plus reactance) on each path.

Maintaining reliability is a complex enterprise that requires trained and skilled operators, sophisticated computers and communications, and careful planning and design.

The North American Electric Reliability Council (NERC) and its eight regional reliability councils have developed system operating and planning standards for ensuring the reliability of a transmission grid that are based on seven key concepts:

1. Balance power generation and demand continuously.
2. Balance reactive power supply and demand to maintain scheduled voltages,
3. Monitor flows over transmission lines and other facilities to ensure that thermal limits are not exceeded.
4. Keep the system in a stable condition.
5. Operate the system so that it remains in a reliable condition even if a contingency occurs, such as the loss of a key generator or transmission Facility (the "N minus 1 criterion").
6. Plan, design and maintain the system to operate reliably.
7. Prepare for emergencies.

Wyoming's Minerals: the County Mineral Story

The term mineral, although it is generally applied to all extractive products, has a very specific definition, namely, an inorganic solid with a definite atomic structure and a chemical composition which can vary within limits. Given that, petroleum, natural gas and coal are not minerals. In fact, neither is Uranium as it is produced in Wyoming, although Uranium initially exists as minerals. All Uranium in Wyoming is produced by underground leaching, so it is not a solid, and even after purification and drying it still has no structure. Nonetheless, while a mineral is a very specific thing, the term is always applied to all commodities.

Economic minerals, as is almost always the case in nature, with almost every resource, are not evenly distributed. There are regions (the Sahara), nations (New Zealand), and States (Maine, Tennessee, Iowa), with very sparse mineral resources. Even within a state as richly endowed as Wyoming, there are counties essentially lacking in mineral production (Teton, Goshen, Platte) in contrast to the rich counties (Campbell, Sweetwater, Sublette).

The three most important economic sectors in Wyoming are agriculture, tourism, and the minerals industry. Total import to the economy of any economic sector is difficult to measure, and in the case of Wyoming's "Big Three" the task is complicated by the fact that what is counted in one is ignored in one or both others. Given that, the most straight-forward figure is from agriculture, where the value of production of crops plus livestock and products (honey, eggs, and milk) in 2004 was \$912,671,000.

Tourism is more difficult. That industry adds spending by tourists (A tough number to tease out), hotel/motel room rentals, and a factor that neither of the other two add, wages. The total estimated for 2004 from tourism was about \$2 billion. Total valuation of minerals produced in Wyoming in 2004 as shown in the above chart, was a little less than \$11 billion. Income to the state from severance taxes, sales and use taxes, U.S. Royalty returns, and income to state land was a little over \$2.3 billion. The problem in reporting equivalent value numbers to the Big Three lies in the difference in what they do. Agriculture produces and markets products. Tourism collects revenue from visitors partly, from marketing products, but more importantly from providing services, either in the form of entertainment/distraction or maintenance, i.e. food and lodging. The minerals industry extracts, processes, and markets mineral products. While assessed valuation approximates market value, it does not mirror it. Actual mineral sales are not counted as income to Wyoming because in most cases the seller is not a Wyoming entity. Real property taxes paid by the minerals industry are not counted as income, primarily because of the difficulty in extracting this data from county tax records.

Selected '04 County Production Numbers by Commodity

These figures are compiled by the Department of Revenue and are available on their web site. They also appear in our 2005 Wyoming Minerals and Energy Yearbook.

Petroleum (Barrels)

Campbell-9,152,595; Park-8,427,576; Hot Springs-3,417,913

Natural Gas (MCF)

Sublette-603,172,194; Campbell-337,011,602; Sweetwater-183,772,115

Coal (Tons)

Campbell-360,149,115; Converse-21,452,900, Sweetwater-183,722,115

Trona (Tons)

Sweetwater- 18,736,464

Bentonite (Tons)

Big Horn-2,001,241; Crook-1,159,004; Johnson-411,540

Uranium (Pounds)

Converse-1,224,356; Campbell-25,441; Sweetwater-17,394

Gypsum (Tons)

Big Horn-309,806; Niobrara-188,320; Albany-4,141

Wyoming leads the nation in coal, uranium and bentonite production. The second contributor to valuation is unit value. An increase in county valuation may be due to increases in production, or valuation, or both. In some cases, a drop in production may be offset by an increase in unit value, or vice versa. Here are '05 unit valuations with changes from '04.

Commodity	'05 Unit Value	Change from '01
Petroleum	\$32.91	Plus \$8.11
Natural Gas	\$4.02	Plus \$.82
Coal	\$5.15	Plus \$.25
Uranium	\$7.36	Plus \$.76
Trona	\$10.62	Plus \$.37
Bentonite	\$9.73	Plus \$.53
Gypsum	\$5.21	Plus \$.04

Note that the only large increase in Unit Valuation was in Petroleum. The large increases in valuation seen in natural gas in the past several years have been due to production increases. Given demand projections, no downturn in mineral income to the state seems likely anytime soon. If clean fuels from coal reaches the development stage, Wyoming income from minerals may change in nature in the future, but not in importance.

