

The population problem has no technical solution; it requires a fundamental extension in morality.

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At the end of a thoughtful article on the future of nuclear war, Wiesner and York (1) concluded that: "Both sides in the arms race are . . . confronted by the dilemma of steadily increasing military power and steadily decreasing national security. *It is our considered professional judgment that this dilemma has no technical solution.* If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation."

I would like to focus your attention not on the subject of the article (national security in a nuclear world) but on the kind of conclusion they reached, namely, that there is no technical solution to the problem. An implicit and almost universal assumption of discussions published in professional and semipopular scientific journals is that the problem under discussion has a technical solution. A technical solution may be defined as one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality.

In our day (though not in earlier times) technical solutions are always welcome. Because of previous failures in prophecy, it takes courage to assert that a desired technical solution is not possible. Wiesner and York exhibited this courage; publishing in a science journal, they insisted that the solution to the problem was not to be found in the natural sciences. They cautiously qualified their statement with the phrase, "It is our considered profes-

sional judgment. . . ." Whether they were right or not is not the concern of the present article. Rather, the concern here is with the important concept of a class of human problems which can be called "no technical solution problems," and, more specifically, with the identification and discussion of one of these.

It is easy to show that the class is not a null class. Recall the game of tick-tack-toe. Consider the problem, "How can I win the game of tick-tack-toe?" It is well known that I cannot, if I assume (in keeping with the conventions of game theory) that my opponent understands the game perfectly. Put another way, there is no "technical solution" to the problem. I can win only by giving a radical meaning to the word "win." I can hit my opponent over the head; or I can drug him; or I can falsify the records. Every way in which I "win" involves, in some sense, an abandonment of the game, as we intuitively understand it. (I can also, of course, openly abandon the game—refuse to play it. This is what most adults do.)

The class of "No technical solution problems" has members. My thesis is that the "population problem," as conventionally conceived, is a member of this class. How it is conventionally conceived needs some comment. It is fair to say that most people who anguish over the population problem are trying to find a way to avoid the evils of overpopulation without relinquishing any of the privileges they now enjoy. They think that farming the seas or developing new strains of wheat will solve the problem—technologically. I try to show here that the solution they seek cannot be found. The population problem cannot be solved in a technical way, any more than can the problem of winning the game of tick-tack-toe.

Population, as Malthus said, naturally tends to grow "geometrically," or, as we would now say, exponentially. In a finite world this means that the per capita share of the world's goods must steadily decrease. Is ours a finite world?

A fair defense can be put forward for the view that the world is infinite; or that we do not know that it is not. But, in terms of the practical problems that we must face in the next few generations with the foreseeable technology, it is clear that we will greatly increase human misery if we do not, during the immediate future, assume that the world available to the terrestrial human population is finite. "Space" is no escape (2).

A finite world can support only a finite population; therefore, population growth must eventually equal zero. (The case of perpetual wide fluctuations above and below zero is a trivial variant that need not be discussed.) When this condition is met, what will be the situation of mankind? Specifically, can Bentham's goal of "the greatest good for the greatest number" be realized?

No—for two reasons, each sufficient by itself. The first is a theoretical one. It is not mathematically possible to maximize for two (or more) variables at the same time. This was clearly stated by von Neumann and Morgenstern (3), but the principle is implicit in the theory of partial differential equations, dating back at least to D'Alembert (1717-1783).

The second reason springs directly from biological facts. To live, any organism must have a source of energy (for example, food). This energy is utilized for two purposes: mere maintenance and work. For man, maintenance of life requires about 1600 kilocalories a day ("maintenance calories"). Anything that he does over and above merely staying alive will be defined as work, and is supported by "work calories" which he takes in. Work calories are used not only for what we call work in common speech; they are also required for all forms of enjoyment, from swimming and automobile racing to playing music and writing poetry. If our goal is to maximize population it is obvious what we must do: We must make the work calories per person approach as close to zero as possible. No gourmet meals, no vacations, no sports, no music, no literature, no art. . . . I think that everyone will grant, without

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argument of proof, that maximizing population does not maximize goods. Bentham's goal is impossible.

In reaching this conclusion I have made the usual assumption that it is the acquisition of energy that is the problem. The appearance of atomic energy has led some to question this assumption. However, given an infinite source of energy, population growth still produces an inescapable problem. The problem of the acquisition of energy is replaced by the problem of its dissipation, as J. H. Fremlin has so wittily shown (4). The arithmetic signs in the analysis are, as it were, reversed; but Bentham's goal is still unobtainable.

The optimum population is, then, less than the maximum. The difficulty of defining the optimum is enormous; so far as I know, no one has seriously tackled this problem. Reaching an acceptable and stable solution will surely require more than one generation of hard analytical work—and much persuasion.

We want the maximum good per person; but what is good? To one person it is wilderness, to another it is ski lodges for thousands. To one it is estuaries to nourish ducks for hunters to shoot; to another it is factory land. Comparing one good with another is, we usually say, impossible because goods are incommensurable. Incommensurables cannot be compared.

Theoretically this may be true; but in real life incommensurables are commensurable. Only a criterion of judgment and a system of weighting are needed. In nature the criterion is survival. Is it better for a species to be small and hideable, or large and powerful? Natural selection commensurates the incommensurables. The compromise achieved depends on a natural weighting of the values of the variables.

Man must imitate this process. There is no doubt that in fact he already does, but unconsciously. It is when the hidden decisions are made explicit that the arguments begin. The problem for the years ahead is to work out an acceptable theory of weighting. Synergistic effects, nonlinear variation, and difficulties in discounting the future make the intellectual problem difficult, but not (in principle) insoluble.

Has any cultural group solved this practical problem at the present time, even on an intuitive level? One simple fact proves that none has: there is no prosperous population in the world today that has, and has had for some

time, a growth rate of zero. Any people that has intuitively identified its optimum point will soon reach it, after which its growth rate becomes and remains zero.

Of course, a positive growth rate might be taken as evidence that a population is below its optimum. However, by any reasonable standards, the most rapidly growing populations on earth today are (in general) the most miserable. This association (which need not be invariable) casts doubt on the optimistic assumption that the positive growth rate of a population is evidence that it has yet to reach its optimum.

We can make little progress in working toward optimum population size until we explicitly exorcize the spirit of Adam Smith in the field of practical demography. In economic affairs, *The Wealth of Nations* (1776) popularized the "invisible hand," the idea that an individual who "intends only his own gain," is, as it were, "led by an invisible hand to promote . . . the public interest" (5). Adam Smith did not assert that this was invariably true, and perhaps neither did any of his followers. But he contributed to a dominant tendency of thought that has ever since interfered with positive action based on rational analysis, namely, the tendency to assume that decisions reached individually will, in fact, be the best decisions for an entire society. If this assumption is correct it justifies the continuance of our present policy of laissez-faire in reproduction. If it is correct we can assume that men will control their individual fecundity so as to produce the optimum population. If the assumption is not correct, we need to reexamine our individual freedoms to see which ones are defensible.

Tragedy of Freedom in a Commons

The rebuttal to the invisible hand in population control is to be found in a scenario first sketched in a little-known pamphlet (6) in 1833 by a mathematical amateur named William Forster Lloyd (1794-1852). We may well call it "the tragedy of the commons," using the word "tragedy" as the philosopher Whitehead used it (7): "The essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless working of things." He then goes on to say, "This inevitableness of destiny can only be illustrated in terms of human life by incidents which in fact in-

volve unhappiness. For it is only by them that the futility of escape can be made evident in the drama."

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsman, the negative utility for any particular decision-making herdsman is only a fraction of -1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another. . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

Some would say that this is a platitude. Would that it were! In a sense, it was learned thousands of years ago, but natural selection favors the forces of psychological denial (8). The individual benefits as an individual from his ability to deny the truth even though society as a whole, of which he is a part, suffers.

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Education can counteract the natural tendency to do the wrong thing, but the inexorable succession of generations requires that the basis for this knowledge be constantly refreshed.

A simple incident that occurred a few years ago in Leominster, Massachusetts, shows how perishable the knowledge is. During the Christmas shopping season the parking meters downtown were covered with plastic bags that bore tags reading: "Do not open until after Christmas. Free parking courtesy of the mayor and city council." In other words, facing the prospect of an increased demand for already scarce space, the city fathers reinstated the system of the commons. (Cynically, we suspect that they gained more votes than they lost by this retrogressive act.)

In an approximate way, the logic of the commons has been understood for a long time, perhaps since the discovery of agriculture or the invention of private property in real estate. But it is understood mostly only in special cases which are not sufficiently generalized. Even at this late date, cattlemen leasing national land on the western ranges demonstrate no more than an ambivalent understanding, in constantly pressuring federal authorities to increase the head count to the point where overgrazing produces erosion and weed-dominance. Likewise, the oceans of the world continue to suffer from the survival of the philosophy of the commons. Maritime nations still respond automatically to the shibboleth of the "freedom of the seas." Professing to believe in the "inexhaustible resources of the oceans," they bring species after species of fish and whales closer to extinction (9).

The National Parks present another instance of the working out of the tragedy of the commons. At present, they are open to all, without limit. The parks themselves are limited in extent—there is only one Yosemite Valley—whereas population seems to grow without limit. The values that visitors seek in the parks are steadily eroded. Plainly, we must soon cease to treat the parks as commons or they will be of no value to anyone.

What shall we do? We have several options. We might sell them off as private property. We might keep them as public property, but allocate the right to enter them. The allocation might be on the basis of wealth, by the use of an auction system. It might be on the basis of merit, as defined by some agreed-

upon standards. It might be by lottery. Or it might be on a first-come, first-served basis, administered to long queues. These, I think, are all the reasonable possibilities. They are all objectionable. But we must choose—or acquiesce in the destruction of the commons that we call our National Parks.

Pollution

In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of the commons; but of putting something in—sewage, or chemical, radioactive, and heat wastes into water; noxious and dangerous fumes into the air; and distracting and unpleasant advertising signs into the line of sight. The calculations of utility are much the same as before. The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest," so long as we behave only as independent, rational, free-enterprisers.

The tragedy of the commons as a food basket is averted by private property, or something formally like it. But the air and waters surrounding us cannot readily be fenced, and so the tragedy of the commons as a cesspool must be prevented by different means, by coercive laws or taxing devices that make it cheaper for the polluter to treat his pollutants than to discharge them untreated. We have not progressed as far with the solution of this problem as we have with the first. Indeed, our particular concept of private property, which deters us from exhausting the positive resources of the earth, favors pollution. The owner of a factory on the bank of a stream—whose property extends to the middle of the stream—often has difficulty seeing why it is not his natural right to muddy the waters flowing past his door. The law, always behind the times, requires elaborate stitching and fitting to adapt it to this newly perceived aspect of the commons.

The pollution problem is a consequence of population. It did not much matter how a lonely American frontiersman disposed of his waste. "Flowing water purifies itself every 10 miles," my grandfather used to say, and the myth was near enough to the truth when he

was a boy, for there were not too many people. But as population became denser, the natural chemical and biological recycling processes became overloaded, calling for a redefinition of property rights.

How To Legislate Temperance?

Analysis of the pollution problem as a function of population density uncovers a not generally recognized principle of morality, namely: *the morality of an act is a function of the state of the system at the time it is performed* (10). Using the commons as a cesspool does not harm the general public under frontier conditions, because there is no public; the same behavior in a metropolis is unbearable. A hundred and fifty years ago a plainsman could kill an American bison, cut out only the tongue for his dinner, and discard the rest of the animal. He was not in any important sense being wasteful. Today, with only a few thousand bison left, we would be appalled at such behavior.

In passing, it is worth noting that the morality of an act cannot be determined from a photograph. One does not know whether a man killing an elephant or setting fire to the grassland is harming others until one knows the total system in which his act appears. "One picture is worth a thousand words," said an ancient Chinese; but it may take 10,000 words to validate it. It is as tempting to ecologists as it is to reformers in general to try to persuade others by way of the photographic shortcut. But the essence of an argument cannot be photographed; it must be presented rationally—in words.

That morality is system-sensitive escaped the attention of most codifiers of ethics in the past. "Thou shalt not . . ." is the form of traditional ethical directives which make no allowance for particular circumstances. The laws of our society follow the pattern of ancient ethics, and therefore are poorly suited to governing a complex, crowded, changeable world. Our epicyclic solution is to augment statutory law with administrative law. Since it is practically impossible to spell out all the conditions under which it is safe to burn trash in the back yard or to run an automobile without smog-control, by law we delegate the details to bureaus. The result is administrative law, which is rightly feared for an ancient reason—*Quis custodiet ipsos custodes?*—"Who shall

watch the watchers themselves?" John Adams said that we must have "a government of laws and not men." Bureau administrators, trying to evaluate the morality of acts in the total system, are singularly liable to corruption, producing a government by men, not laws.

Prohibition is easy to legislate (though not necessarily to enforce); but how do we legislate temperance? Experience indicates that it can be accomplished best through the mediation of administrative law. We limit possibilities unnecessarily if we suppose that the sentiment of *Quis custodiet* denies us the use of administrative law. We should rather retain the phrase as a perpetual reminder of fearful dangers we cannot avoid. The great challenge facing us now is to invent the corrective feedbacks that are needed to keep custodians honest. We must find ways to legitimate the needed authority of both the custodians and the corrective feedbacks.

Freedom To Breed Is Intolerable

The tragedy of the commons is involved in population problems in another way. In a world governed solely by the principle of "dog eat dog"—if indeed there ever was such a world—how many children a family had would not be a matter of public concern. Parents who bred too exuberantly would leave fewer descendants, not more, because they would be unable to care adequately for their children. David Lack and others have found that such a negative feedback demonstrably controls the fecundity of birds (11). But men are not birds, and have not acted like them for millenniums, at least.

If each human family were dependent only on its own resources; if the children of improvident parents starved to death; if, thus, overbreeding brought its own "punishment" to the germ line—then there would be no public interest in controlling the breeding of families. But our society is deeply committed to the welfare state (12), and hence is confronted with another aspect of the tragedy of the commons.

In a welfare state, how shall we deal with the family, the religion, the race, or the class (or indeed any distinguishable and cohesive group) that adopts overbreeding as a policy to secure its own aggrandizement (13)? To couple the concept of freedom to breed with the belief that everyone born has an

equal right to the commons is to lock the world into a tragic course of action.

Unfortunately this is just the course of action that is being pursued by the United Nations. In late 1967, some 30 nations agreed to the following (14):

The Universal Declaration of Human Rights describes the family as the natural and fundamental unit of society. It follows that any choice and decision with regard to the size of the family must irrevocably rest with the family itself, and cannot be made by anyone else.

It is painful to have to deny categorically the validity of this right; denying it, one feels as uncomfortable as a resident of Salem, Massachusetts, who denied the reality of witches in the 17th century. At the present time, in liberal quarters, something like a taboo acts to inhibit criticism of the United Nations. There is a feeling that the United Nations is "our last and best hope," that we shouldn't find fault with it; we shouldn't play into the hands of the archconservatives. However, let us not forget what Robert Louis Stevenson said: "The truth that is suppressed by friends is the readiest weapon of the enemy." If we love the truth we must openly deny the validity of the Universal Declaration of Human Rights, even though it is promoted by the United Nations. We should also join with Kingsley Davis (15) in attempting to get Planned Parenthood-World Population to see the error of its ways in embracing the same tragic ideal.

Conscience Is Self-Eliminating

It is a mistake to think that we can control the breeding of mankind in the long run by an appeal to conscience. Charles Galton Darwin made this point when he spoke on the centennial of the publication of his grandfather's great book. The argument is straightforward and Darwinian.

People vary. Confronted with appeals to limit breeding, some people will undoubtedly respond to the plea more than others. Those who have more children will produce a larger fraction of the next generation than those with more susceptible consciences. The difference will be accentuated, generation by generation.

In C. G. Darwin's words: "It may well be that it would take hundreds of generations for the progenitive instinct to develop in this way, but if it should do so, nature would have taken her revenge, and the variety *Homo contra-*

ciens would become extinct and would be replaced by the variety *Homo progenitivus*" (16).

The argument assumes that conscience or the desire for children (no matter which) is hereditary—but hereditary only in the most general formal sense. The result will be the same whether the attitude is transmitted through germ cells, or exosomatically, to use A. J. Lotka's term. (If one denies the latter possibility as well as the former, then what's the point of education?) The argument has here been stated in the context of the population problem; but it applies equally well to any instance in which society appeals to an individual exploiting a commons to restrain himself for the general good—by means of his conscience. To make such an appeal is to set up a selective system that works toward the elimination of conscience from the race.

WEAKEST POINT

Pathogenic Effects of Conscience

The long-term disadvantage of an appeal to conscience should be enough to condemn it; but it has serious short-term disadvantages as well. If we ask a man who is exploiting a commons to desist "in the name of conscience," what are we saying to him? What does he hear?—not only at the moment but also in the wee small hours of the night when, half asleep, he remembers not merely the words we used but also the nonverbal communication cues we gave him unawares? Sooner or later, consciously or subconsciously, he senses that he has received two communications, and that they are contradictory: (i) (intended communication) "If you don't do as we ask, we will openly condemn you for not acting like a responsible citizen"; (ii) (the unintended communication) "If you *do* behave as we ask, we will secretly condemn you for a simpleton who can be shamed into standing aside while the rest of us exploit the commons."

Everyman then is caught in what Bateson has called a "double bind." Bateson and his co-workers have made a plausible case for viewing the double bind as an important causative factor in the genesis of schizophrenia (17). The double bind may not always be so damaging, but it always endangers the mental health of anyone to whom it is applied. "A bad conscience," said Nietzsche, "is a kind of illness."

To conjure up a conscience in others

of welfare state.

is tempting to anyone who wishes to extend his control beyond the legal limits. Leaders at the highest level succumb to this temptation. Has any President during the past generation failed to call on labor unions to moderate voluntarily their demands for higher wages, or to steel companies to honor voluntary guidelines on prices? I can recall none. The rhetoric used on such occasions is designed to produce feelings of guilt in noncooperators.

For centuries it was assumed without proof that guilt was a valuable, perhaps even an indispensable, ingredient of the civilized life. Now, in this post-Freudian world, we doubt it.

Paul Goodman speaks from the modern point of view when he says: "No good has ever come from feeling guilty, neither intelligence, policy, nor compassion. The guilty do not pay attention to the object but only to themselves, and not even to their own interests, which might make sense, but to their anxieties" (18).

One does not have to be a professional psychiatrist to see the consequences of anxiety. We in the Western world are just emerging from a dreadful two-centuries-long Dark Ages of Eros that was sustained partly by prohibition laws, but perhaps more effectively by the anxiety-generating mechanisms of education. Alex Comfort has told the story well in *The Anxiety Makers* (19); it is not a pretty one.

Since proof is difficult, we may even concede that the results of anxiety may sometimes, from certain points of view, be desirable. The larger question we should ask is whether, as a matter of policy, we should ever encourage the use of a technique the tendency (if not the intention) of which is psychologically pathogenic. We hear much talk these days of responsible parenthood; the coupled words are incorporated into the titles of some organizations devoted to birth control. Some people have proposed massive propaganda campaigns to instill responsibility into the nation's (or the world's) breeders. But what is the meaning of the word responsibility in this context? Is it not merely a synonym for the word conscience? When we use the word responsibility in the absence of substantial sanctions are we not trying to browbeat a free man in a commons into acting against his own interest? Responsibility is a verbal counterfeit for a substantial *quid pro quo*. It is an attempt to get something for nothing.

If the word responsibility is to be used at all, I suggest that it be in the sense Charles Frankel uses it (?). "Responsibility," says this philosopher, "is the product of definite social arrangements." Notice that Frankel calls for social arrangements—not propaganda.

Mutual Coercion

Mutually Agreed upon

The social arrangements that produce responsibility are arrangements that create coercion, of some sort. Consider bank-robbing. The man who takes money from a bank acts as if the bank were a commons. How do we prevent such action? Certainly not by trying to control his behavior solely by a verbal appeal to his sense of responsibility. Rather than rely on propaganda we follow Frankel's lead and insist that a bank is not a commons; we seek the definite social arrangements that will keep it from becoming a commons. That we thereby infringe on the freedom of would-be robbers we neither deny nor regret.

The morality of bank-robbing is particularly easy to understand because we accept complete prohibition of this activity. We are willing to say "Thou shalt not rob banks," without providing for exceptions. But temperance also can be created by coercion. Taxing is a good coercive device. To keep downtown shoppers temperate in their use of parking space we introduce parking meters for short periods, and traffic fines for longer ones. We need not actually forbid a citizen to park as long as he wants to; we need merely make it increasingly expensive for him to do so. Not prohibition, but carefully biased options are what we offer him. A Madison Avenue man might call this persuasion; I prefer the greater candor of the word coercion.

Coercion is a dirty word to most liberals now, but it need not forever be so. As with the four-letter words, its dirtiness can be cleansed away by exposure to the light, by saying it over and over without apology or embarrassment. To many, the word coercion implies arbitrary decisions of distant and irresponsible bureaucrats; but this is not a necessary part of its meaning. The only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected.

To say that we mutually agree to

coercion is not to say that we are required to enjoy it, or even to pretend we enjoy it. Who enjoys taxes? We all grumble about them. But we accept compulsory taxes because we recognize that voluntary taxes would favor the conscienceless. We institute and (grumblingly) support taxes and other coercive devices to escape the horror of the commons.

An alternative to the commons need not be perfectly just to be preferable. With real estate and other material goods, the alternative we have chosen is the institution of private property coupled with legal inheritance. Is this system perfectly just? As a genetically trained biologist I deny that it is. It seems to me that, if there are to be differences in individual inheritance, legal possession should be perfectly correlated with biological inheritance—that those who are biologically more fit to be the custodians of property and power should legally inherit more. But genetic recombination continually makes a mockery of the doctrine of "like father, like son" implicit in our laws of legal inheritance. An idiot can inherit millions, and a trust fund can keep his estate intact. We must admit that our legal system of private property plus inheritance is unjust—but we put up with it because we are not convinced, at the moment, that anyone has invented a better system. The alternative of the commons is too horrifying to contemplate. Injustice is preferable to total ruin.

It is one of the peculiarities of the warfare between reform and the status quo that it is thoughtlessly governed by a double standard. Whenever a reform measure is proposed it is often defeated when its opponents triumphantly discover a flaw in it. As Kingsley Davis has pointed out (21), worshippers of the status quo sometimes imply that no reform is possible without unanimous agreement, an implication contrary to historical fact. As nearly as I can make out, automatic rejection of proposed reforms is based on one of two unconscious assumptions: (i) that the status quo is perfect; or (ii) that the choice we face is between reform and no action; if the proposed reform is imperfect, we presumably should take no action at all, while we wait for a perfect proposal.

But we can never do nothing. That which we have done for thousands of years is also action. It also produces evils. Once we are aware that the

BANK ROBBER

status quo is action, we can then compare its discoverable advantages and disadvantages with the predicted advantages and disadvantages of the proposed reform, discounting as best we can for our lack of experience. On the basis of such a comparison, we can make a rational decision which will not involve the unworkable assumption that only perfect systems are tolerable.

Recognition of Necessity

Perhaps the simplest summary of this analysis of man's population problems is this: the commons, if justifiable at all, is justifiable only under conditions of low-population density. As the human population has increased, the commons has had to be abandoned in one aspect after another.

First we abandoned the commons in food gathering, enclosing farm land and restricting pastures and hunting and fishing areas. These restrictions are still not complete throughout the world.

Somewhat later we saw that the commons as a place for waste disposal would also have to be abandoned. Restrictions on the disposal of domestic sewage are widely accepted in the Western world; we are still struggling to close the commons to pollution by automobiles, factories, insecticide sprayers, fertilizing operations, and atomic energy installations.

In a still more embryonic state is our recognition of the evils of the commons in matters of pleasure. There is almost no restriction on the propagation of sound waves in the public medium. The shopping public is assaulted with mindless music, without its consent. Our

government is paying out billions of dollars to create supersonic transport which will disturb 50,000 people for every one person who is whisked from coast to coast 3 hours faster. Advertisers muddy the airwaves of radio and television and pollute the view of travelers. We are a long way from outlawing the commons in matters of pleasure. Is this because our Puritan inheritance makes us view pleasure as something of a sin, and pain (that is, the pollution of advertising) as the sign of virtue?

Every new enclosure of the commons involves the infringement of somebody's personal liberty. Infringements made in the distant past are accepted because no contemporary complaints of a loss. It is the newly proposed infringements that we vigorously oppose; cries of "rights" and "freedom" fill the air. But what does "freedom" mean? When men mutually agreed to pass laws against robbing, mankind became more free, not less so. Individuals locked into the logic of the commons are free only to bring on universal ruin; once they see the necessity of mutual coercion, they become free to pursue other goals. I believe it was Hegel who said, "Freedom is the recognition of necessity."

The most important aspect of necessity that we must now recognize, is the necessity of abandoning the commons in breeding. No technical solution can rescue us from the misery of overpopulation. Freedom to breed will bring ruin to all. At the moment, to avoid hard decisions many of us are tempted to propagandize for conscience and responsible parenthood. The temptation must be resisted, because an appeal to independently acting con-

science selects for the disappearance of all conscience in the long run, and an increase in anxiety in the short.

The only way we can preserve and nurture other and more precious freedoms is by relinquishing the freedom to breed, and that very soon. "Freedom is the recognition of necessity"—and it is the role of education to reveal to all the necessity of abandoning the freedom to breed. Only so, can we put an end to this aspect of the tragedy of the commons.

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WRIGHT

An Induced Thigmotropic Response In Coryphs undulata And Its Implications.

by

RALPH LESLIE SEILER

A Paper Submitted to Dr. D. Weins of the Department of Biology
in Partial Fulfillment of the Requirements for the Removal of an
Incomplete.

Introduction

It has long been claimed in certain circles that chanting and projecting good vibes at plants causes them to grow better and look prettier. This study was a preliminary attempt to determine if 1), psychic emanations can effect plant response and 2), if so can these psychic emanations be characterized. It was first necessary to find a response that could easily be measured. A search of the lore revealed that the cauliflower cactus, Coryphys undulata, has normally non-thigmotropic stamens but when the subject of psychic emanations has an induced thigmotropic response.

Preliminary Studies

To determine if there was any truth to the lore I removed a potted cactus from the greenhouse and by touching the stamens with the tip of my pen determined there was no thigmotropic response. To test for the effects of psychic emanations I then took the cactus to the Sublimed Temple of Ethereal Condensate and saw his Holiness, the Ultimate Cause. I explained my purpose and he agreed to assist. He took the cactus and placed it on the floor and sat about one and a half feet away in the full lotus. He then chanted "Hare Krishna, rejoice thou lovely plant." After chanting for five minutes he nodded at me and I touched the tip of my pen to the stamens and there was a marked thigmotropic response.

Materials

Small clumps of cauliflower cactus were found growing about two miles north of the airport. Clumps having from 6-8 flowers were chosen and screened off so no flying or crepuscular pollinators could enter. As a source of psychic emanations a work study person was chosen. Originally it had been intended to use members of the Sublimed Temple of Ethereal

Condensate but it was against the moral code of these people to think bad vibes at plants, and this was a vital part of one of the experiments, however; they were gracious enough to help me calibrate my work study person.

Experiment 1

Four variations of vibes were projected at the plants, good, neutral, bad, and the control, ie none. Initially care was taken so the work study psychic emanator was in a mood corresponding to that to be projected. However it was found that five minutes of chanting invariably caused the proper mood to develop, so before all experiments the psychic emanator was warmed up for five minutes.

The work study person chanted the appropriate chant from a distance of one foot at a frequency of 8chants/minute. The chants employed are listed below according to the vibes they were to induce:

Good. Hare Krishna, rejoice thou lovely plant

Neutral. Harvey Koschmann, grow you gahdam plant

Bad. Adolf Eichman, croak you fuggin plant

In part A of this experiment the actual movement of the stamens were measured. One stamen from each flower had a recording motionometer attached which measured extent of movement away from the zero point. In addition a small bee sized object was manipulated so it could be lowered into the stamens near the wired stamen. The results of this experiment are shown in Figure 1.

 Insert Fig. 1. About Here

In part B of this experiment the effect of psychic emanations on the attractiveness of the flower to pollinators was measure. The experiments

were done at the same time each morning for four consecutive days, during which time temperature, wind velocity, cloud cover, humidity and presumably the number of pollinating bees in the area remained constant. The appropriate vibes were induced in the same manner as previously described. The number of bees at each flower were counted at 10 minute intervals, time 0 being the time psychic emanations were initiated. The results are shown in Figure 2.

 Insert Fig. 2. About Here

Experiment 2

It was noticed in the course of the previous experiment that those inflorescences nearest the psychic emanator reacted more strongly than those further away. It was therefore decided to measure the strength of the staminal response as a function of distance. Good vibes were projected at the plant and the response at a distance of 1 foot was given an arbitrary value of 100. The results of this experiment are shown in Figure 3.

 Insert Fig. 3. About Here

The response of the flower at a distance of 0.5 foot was interesting. A real bee was accidentally used instead of the simulacrum used previously. The bee was rather leery of landing because of the closeness of the psychic emanator. The bee would dart close to the flower then fly off. On the fifth such approach one of the stamens whipped up and around one of the bees legs and pulled it down into the flower. Other stamens quickly enclosed the bee and held it relatively immobile. The other stamens not holding the bee were waving wildly. The stamens holding the bee then proceeded to pass it around the flower, those not holding the struggling bee slapped

its back dusting it with pollen. After $2\frac{1}{2}$ circuits around the flower the stamens tossed the now yellow straight up into the air about seven inches. If a flying insect may be said to stagger, this bee staggered off. Direct correlation of such a powerful response with the response from one foot was impossible so it was given a rating of infinity.

The type of response shown in Fig. 3. is characteristic of an exponential curve so it was attempted to discover the order of the exponent. The sign of the exponent is obviously negative. The following equation is postulated:

$$(1) F = K r^{-x}$$

where F is the strength of response, K is the constant of proportionality and, r the distance between the psychic emanator and the flower. F/K is given the value of 100 when $r = 1$, therefore;

$$(2) \frac{(F/K)_r}{(F/K)_{r=1}} = \frac{r^{-x}}{1^{-x}}$$

$$(3) (F/K)_r = 100r^{-x}$$

$$(4) \log (F/K)_r = 2 - x \log r$$

Therefore a plot of $\log (F/K)_r$ vs $\log r$ will be linear and have a slope of -x and an intercept of 2. $(F/K)_r$ vs r is plotted logarithmically in Fig. 4.

The method of least squares gives a slope of -5.93 and a correlation coefficient of 0.962. The significance of a value of approximately 6 as the order will be discussed.

Discussion

It is seen that psychic emanations can have a profound effect on a plant. The good vibes projected at the plant caused several 'adaptive' responses to occur. First, the thigmotropic response insures the insect is covered with pollen. The adaptive value of this is obvious, however; if the response is too strong this behavior may become non-adaptive, i.e. the bee may have been injured.

Secondly, in some manner the flower becomes more attractive and bees literally swarm over the plant. The reason for this increased attractiveness is by no means clear. Three possibilities present themselves and should be the subject of further research.

1: The projecting of good vibes at the plant in and of itself sets up a 'cloud cover' of good vibes which attracts the bees.

2: The flowers natural attracting mechanisms are intensified to a great extent.

3: The plant collects the psychic emanations and then begins to radiate itself, in effect setting up a new attracting mechanism.

The neutral vibes were very similar to the control, though a slightly enhanced attractiveness and a possible thigmotropic response were noted. It is uncertain why this should be, however; if an anthropomorphic explanation may be tendered, the plant may have been aware that somebody 'cares'.

The control reacted as expected, there was no thigmotropic response and a constant level of attractiveness to bees. The bad vibes directed towards the plant had the interesting effect of causing non-adaptive behavior only after a certain resistance had been overcome. The plant reacted normally for a period of about 30 minutes and only then began to show non-adaptive responses such as drawing the stamens away from and becoming unattractive to the bees.

The discovery of the relation between force and distance is in the authors opinion the most important result of this study. Hitherto the only other force known to follow such a $F \propto r^{-6}$ relationship has been the forces binding the nucleons of atoms together. The implications of this are staggering, the forces bonding matter may be the same as those bonding mind and matter. Further research is called for.

His Holiness, the Ultimate Cause of the Sublimed Temple of Ethereal Condensate came to the field early in the study and observed our work. He graciously allowed the strength of his psychic emanations to be tested. Using good vibes at a distance of 1 foot the stamens reacted about 18 times stronger than when my work study person projected. His Holiness, the Ultimate Cause claimed the strength of my work study persons emanations are about normal for a sophisticated non scientist. Indeed my personal attempts to project good vibes caused only a weak staminal response at $\frac{1}{2}$ foot. His Holiness the Ultimate Cause claims this is about average for a scientist, he had no acceptable reasons why this should be however.

Conclusion

Mind has been shown to effect matter in such a manner consistant with the hypothesis that the forces involved are one of the fundamental forces of nature. It is hoped that these studies will generate further research and a revaluation of previous psychic research now that the relationship between force and distance has been discovered.

FIGURE ONE

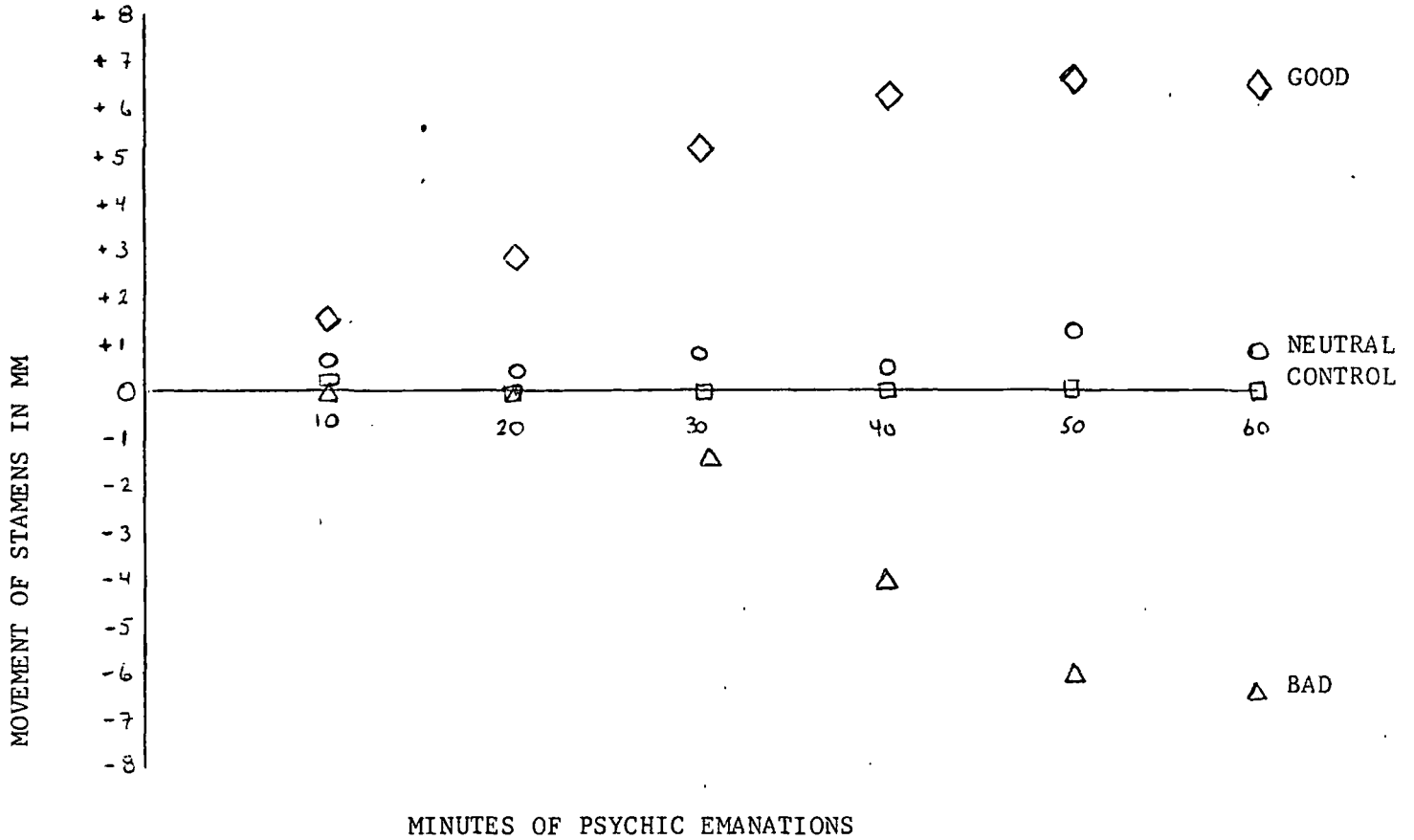


Fig. 1. The Thigmotropic response of *C. undulata* stamens as a function of time at varying vibes as induced by Psychic Emanations. A '+' value denotes movement towards the artificial pollinator, a '-' value away.

FIGURE TWO

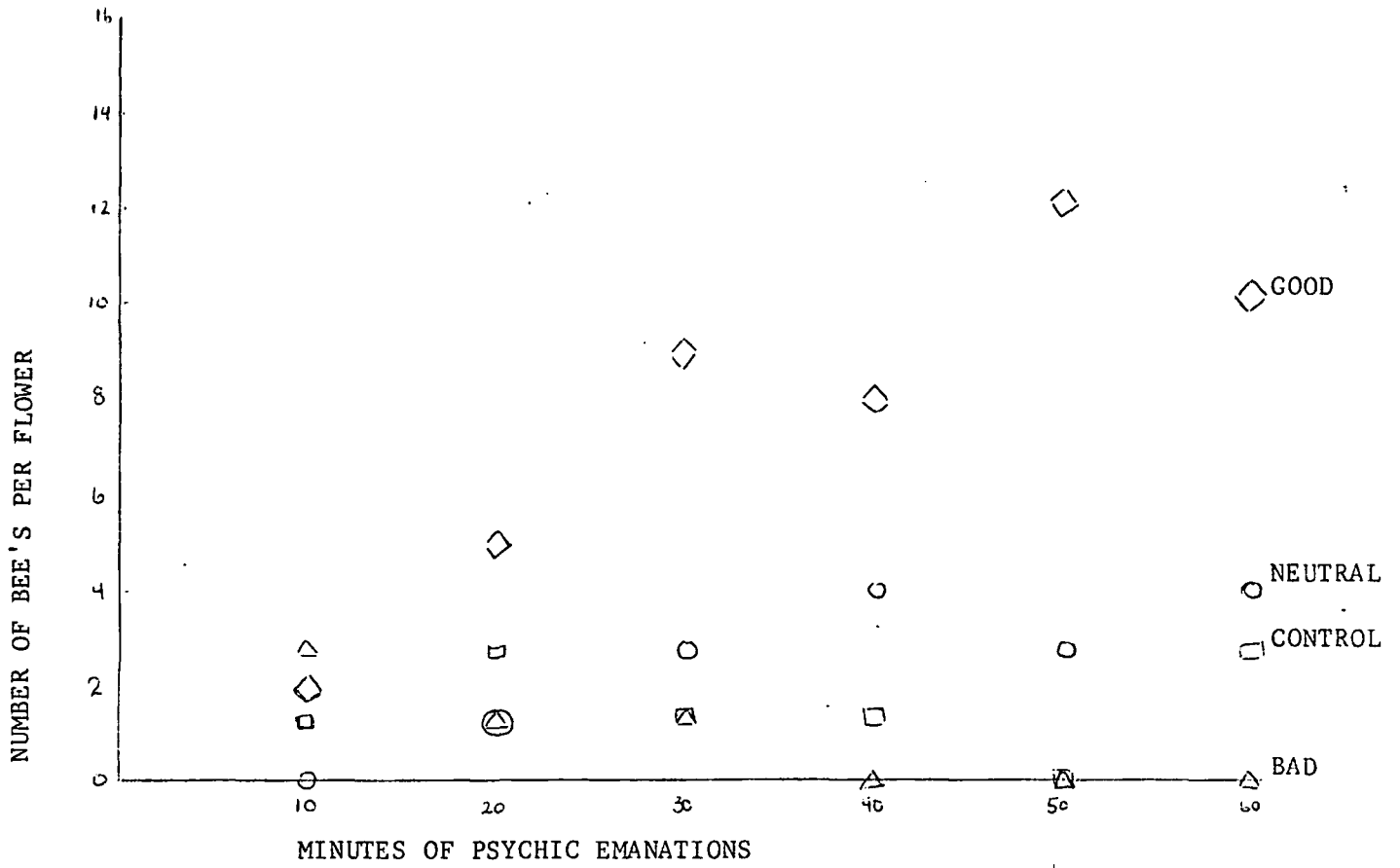


Fig. 2. The Number of pollinating bee's at an inflorescence as a function of time at varying vibes as induced by Psychic Emanations.

FIGURE THREE

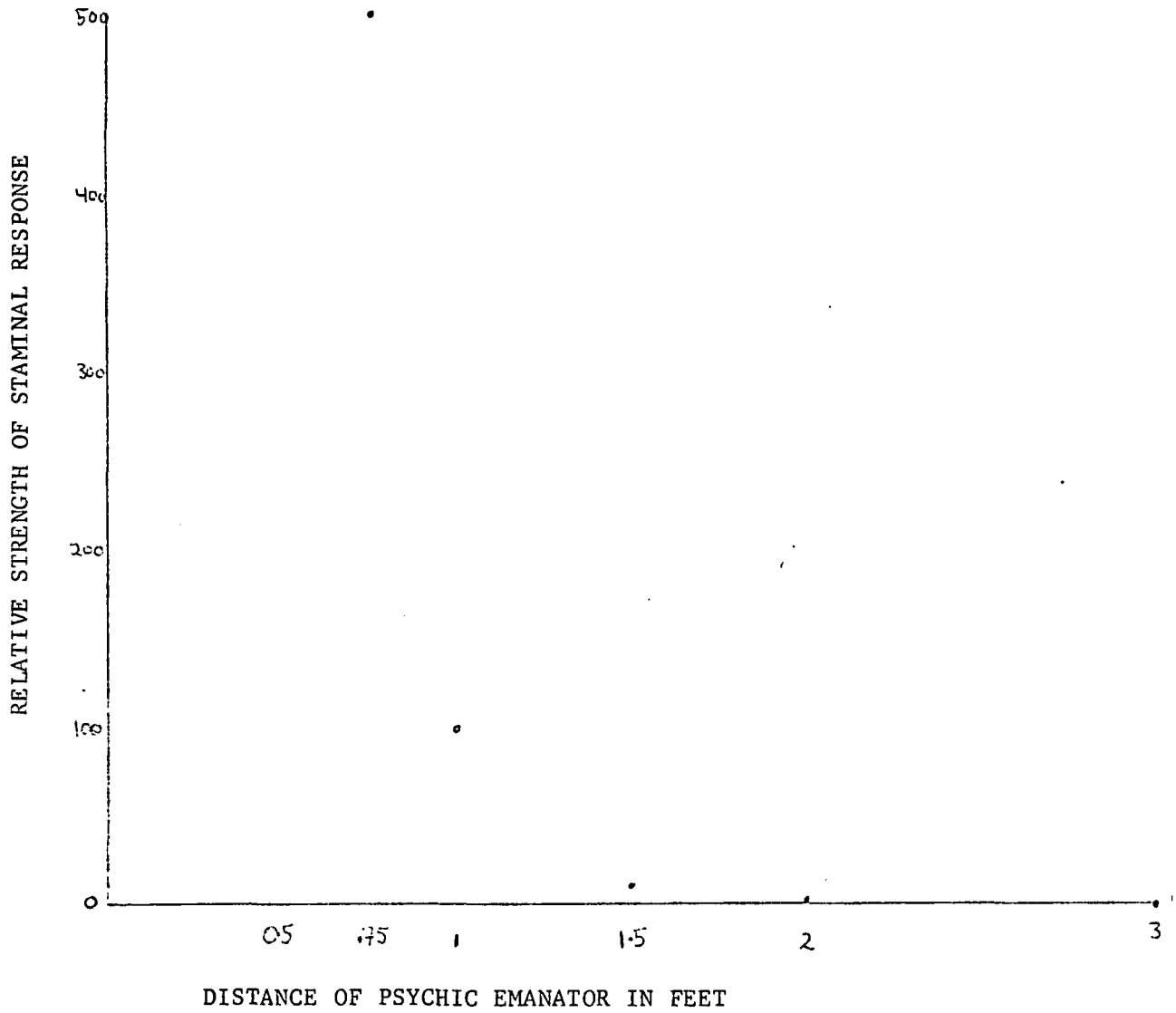


Fig. 3. The Relative strength of staminal response as a function of the distance of the Psychic Emanator. The response at one foot is given an arbitrary value of 100

FIGURE FOUR

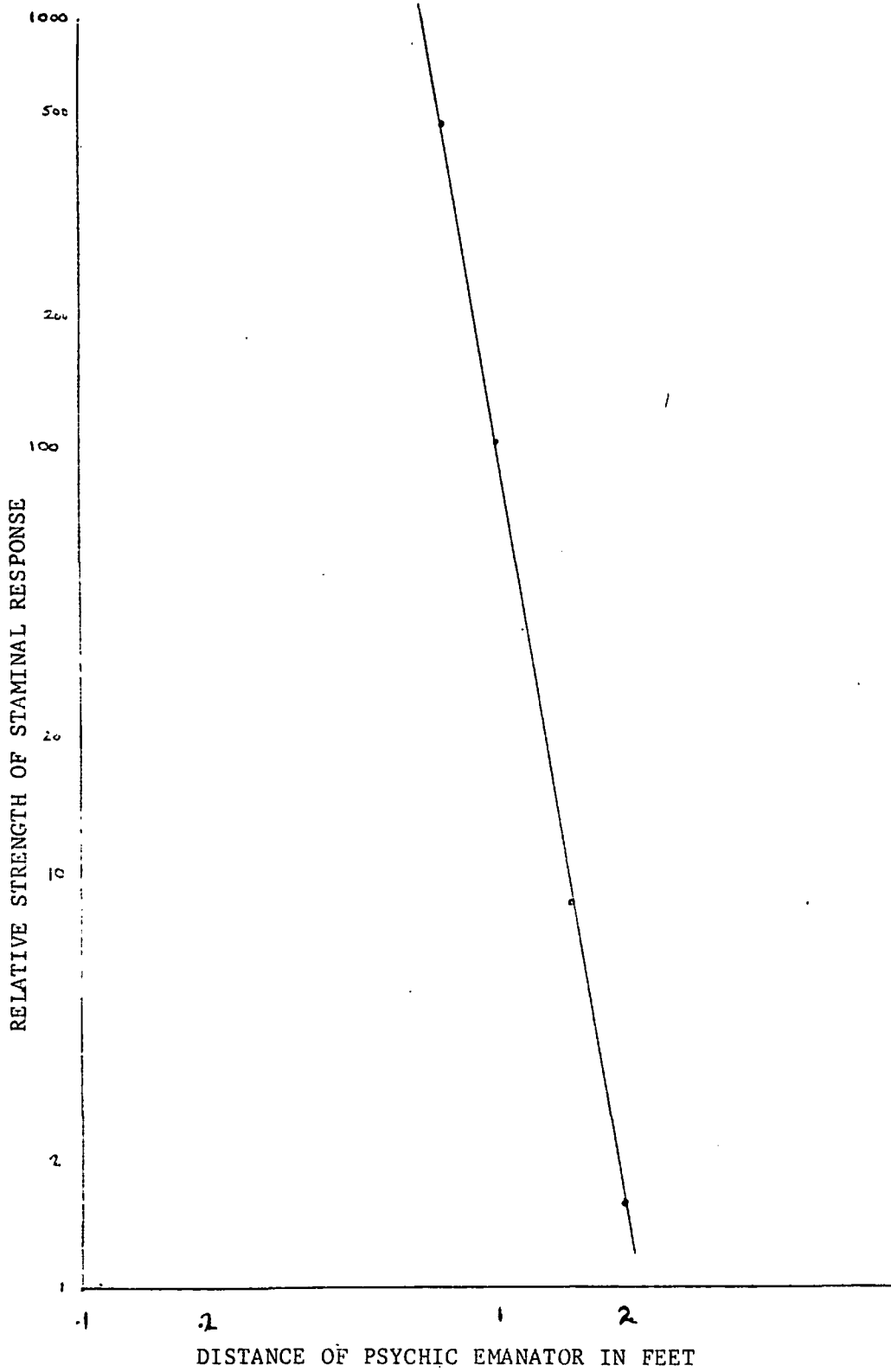
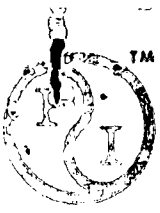


Fig. 4. A Log plot of the relative strength of staminal response as a function of the distance of the Psychic Emanator. The response at one foot is given an arbitrary value of 100.





NATIONAL GEOTHERMAL REPORT

920⁰⁰/spz.

Completion credit
120⁰⁰/spz

month 1 start date.

FIRST TEXAS GEOTHERMAL/GEOPRESSURE WELL BEING DRILLED IN BRAZORIA COUNTY

Following five years of study performed by the University of Texas' Center for Energy Studies, Austin, with the cooperation of the Department of Energy and others, the first Texas geothermal/geopressure well is being drilled. Operator on the well is General Crude.

While drilling at 15,675 ft at Pleasant Bayou, 45 miles south of Houston, General Crude encountered mechanical problems and skidded its rig 500 ft to the southeast. Drilling at the new site began this week with the well scheduled to go to 16,500 ft. According to the Center for Energy Studies, total depth should be reached in approximately 120 days and the well will be tested for two years.

This geothermal/geopressure program, and similar studies in Louisiana and elsewhere in the Southeast, is to be ongoing as four to five wells will be drilled annually. The first wells in the program are scheduled in areas having subsurface temperatures of 300 degrees Fahrenheit and above...more than likely putting those wells in the geopressure category. Later wells will explore thermal areas with somewhat lower subsurface temperatures. Areas scheduled for future drilling include the Armstrong Ranch area in southern Texas and locations in DeWitt and Harris counties. Although other wells drilled in the state may have found geothermal/ geopressure resources, no previous program has attempted to locate and produce Texas' water resource.

In delineating geopressure resources from geothermal, pressure and temperature gradients in specific areas must be reviewed. Both geopressure and geothermal wells are involved in the exploration of water-bearing sands; however, gradients encountered differ dramatically. The average pressure gradient in geothermal exploration is about .4-.5 psi per ft. Pressure gradients encountered during geopressure drilling range from .7-.8 psi per ft and up. Temperature gradients on geopressure wells are higher than those encountered during geothermal drilling...ranging from 300 degrees Fahrenheit up.

Geopressure wells drilled in Texas will normally be drilled to depths below 15,000 ft where such high temperature/pressure gradients are found.

While geothermal development will result in the conversion of temperature and pressure into energy, studies indicate that saline fluids found during geopressure drilling may contain natural gas in saturation. Therefore, development of geopressure resources may involve the conversion of temperature and pressure, as well as natural gas, to energy.

GEOHERMAL GENERATOR PLANNED FOR NEW MEXICO

The nation's first commercial-scale hot water geothermal generator will be built by Public Service Co of New Mexico (PNM) in cooperation with Union Oil Co of California, in the Redondo Creek Canyon of the Jemez Mountains, New Mexico. The 50-megawatt generating plant is expected to be a "showcase project" from a technological, environmental and aesthetic standpoint.

Union and PNM expect to begin construction in the spring, with the facility's operation slated for 1982. The Department of Energy will provide 50 per cent funding of the total project cost, estimated at \$100 million.

The proposed area is a former volcanic cone with water trapped under pressure and heated to roughly 550 degrees Fahrenheit. A "double flash" generating system will be used to pipe water to the earth's surface, whereupon steam will be separated as pressure is reduced. The steam will drive the turbine. Existing wells at the site will be used for the injection of brine left after the fluid has been converted into steam.

When the project is completed, the plant will supply approximately five per cent of PNM's total power load, or enough electricity to meet the needs of a city about the size of Santa Fe.

TEMPERATURE GRADIENT STUDY COMPLETED ON EAST COAST...DEEP TEST SCHEDULED

The final shallow hole in an eight-month temperature gradient study conducted by the Department of Energy along the East Coast was completed last week. As a result of study findings, a 5000 ft geothermal well will be drilled for the DOE in Crisfield, Maryland in March.

Gruy Federal Inc, Houston, under contract to the DOE, drilled more than 40 shallow, 1000 ft holes on locations in New Jersey, Delaware, Maryland, Virginia and North Carolina between June and mid-January, 1979 to measure temperature gradients in designated areas. Areas were picked with the aid of Dr. John Costain and his staff at the Virginia Polytechnic Institute.

The program provided a preliminary assessment of geothermal resources in the East. Because of the shallow depth of the holes, no accurate estimation of geothermal reserves in the area could be obtained. Information obtained from the drilling program, however, was used by the DOE in determining the deep well location.

According to the DOE, site of the deep test is on a geophysical anomaly in the central portion of the Del Mar Peninsula, Bottom hole temperature of the well is expected to be approximately 185 degrees Fahrenheit...suitable for low to moderate heat generation.

Other sites have been selected for possible future drilling on a potential geothermal reserve which, according to the DOE, may extend from New Jersey to southern Georgia. Several granite masses acting as heat generators are believed to underlie parts of the East Coast. This heat, officials say, is apparently trapped beneath wet sand and clay which cover the area.

CONTRACTOR SOUGHT FOR GEOTHERMAL WELL IN EASTERN OREGON

A geothermal resource well will be drilled in eastern Oregon's Malheur County by ORE-IDA Inc, a subsidiary of the Heinz Corp, to replace a part of its natural gas requirement for the processing of food products. The food company is seeking a drilling contractor for the one, and possibly three geothermal wells, which are receiving partial support (less than 50 per cent) from the Department of Energy, Idaho Falls, Idaho.

The initial well in the program is located in 3-18s-47e, ORE-IDA property in Ontario, Oregon. The well is projected to 7000 ft but may go to 10,000 ft to Cretaceous if higher subsurface temperatures are required. If a geothermal reservoir is established a second well will be drilled in the same section. A third well will then be needed to reinject the water after usage. Nearest geothermal drilling in the area is Phillips Petroleum's 1 Chrestesen in 29-11n-3w, Washington County, Idaho, 15 miles to the north.

ORE-IDA hopes to establish water production of at least 800 gallons per minute at a temperature of at least 150 degrees centigrade (about 310 degrees Fahrenheit) for its food processing.

ORE-IDA has retained two firms to assist in the program: CH2M will retrofit the food plant for use of the geothermal energy, and GeothermEx Inc will handle the geothermal exploration management.

A SYMPOSIUM ON GEOTHERMAL ENERGY AND ITS DIRECT USES IN THE EASTERN U.S. will be held April 5-7, at The Homestead, Hot Springs, Virginia. The symposium will emphasize the direct use (non-electric) aspects of geothermal energy, and is designed to bring together those parties who will ultimately be involved in development of geothermal resources in the East. Two concurrent optional field trips will be held following two days of technical sessions. For details, contact: Beverly Hall, Geothermal Resources Council, P. O. Box 98, Davis, CA 95616, (916)-758-2360.

GEOTHERMAL COMPLETIONS

FINAL CLASS: GTM - Producing Geothermal; GT - Unsuccessful Geothermal; GTD - Unsuccessful Geothermal Deepening; GTR - Unsuccessful Geothermal Redrill; IW - Injection Well; GEOP - Unsuccessful Geothermal Pressure.

CALIFORNIA

IMPERIAL COUNTY

5-12s-13e SB WILDCAT: 6000. (9-6-78 BK). EI: -185 (approx) KB. GTM
 UNION OIL OF CALIF 15 Sinclair SW/c 200n 299e.
 API 04-025-90196 Contr: Loffland. Spud 10-22-78, 30 @ 110, 20 @ 1000, drld to 6000, ran ES, TMPL-"survey", PB & KO @ 3800, redrld to 5950, ran logs, TD 6000 (OH) (Miocene), TD 5950 (RD #1) (Miocene). ...Comp as geothermal well 1-4-79.

16-13s-14e SB BRAWLEY: EI: 141 KB. IW
 UNION OIL OF CALIF 7 Veysey SE/c 499 N & 2598 W.
 API 04-025-90181 Contr: Bawden #22. Spud 7/3/78, 13 3/8 @ 1000, 9 5/8 @ 3910, ran ES, TD 5688 (Pliocene), wtr inj well, Comp 8/24/78.

17-13s-14e SB BRAWLEY: 10,000. (6-2-78 BK). EI: -141 KB. GTM
 CHEVRON USA 1 Brandt SW/c 90n 997e.
 API 04-025-90187 Contr: Peter Bawden #27. Spud 8-7-78, 13 3/8 @ 1025, drld & cored to 4850, 8 5/8 @ 4850, drld to 10,010, ran logs, 6 5/8 Inr @ 10,000 (T/Inr NR) w/pre-perfs 4850-10,000, TD 10,010. ...Comp as geothermal well 11-6-78.

28-14s-14e SB WILDCAT: EI: 128 KB. GT
 MCCULLOCH 1-28 Mercer NW/c 659 S & 2041 E. SUS
 GEOTHERMAL API 04-025-90165 Spud 7/11/78, 13 3/8 @ 1201, drld to 8959, ran DI, CDM, FDC-CNL, GRL, TMPL, 9 5/8 @ 5645/2100 sx, drld to 11,021, ran ES, TMPL, 7 @ 11,020, perfd & tstd unrptd int, TD 11,021 (Miocene), Susp oper 10/11/78.

30-15s-17e SB MESA, EAST: 7500. (7-6-78 BK). EI: 58 KB. GTM
 REPUBLIC GEOTHERMAL58-30 East Mesa SW/c
 175n 2740e. API 04-025-90192 Contr: Kenai Camrich #7. Spud 7-9-78, 16 @ 2000, drld to 5500, ran logs, 10 3/4 @ 5490, WSOK on lap, drld to 7340, ran logs, PB & KO 5610, drld to 7305, ran ES, TMPL-"survey", 7 5/8 @ 7305, perf & tested unrptd int, TD 7340 (OH) (Miocene), TD 7305 (RD #1) (Miocene). ...Comp as geothermal well 11-8-78.

30-15s-17e SB MESA, EAST: 8000 Miocene. (8-29-78 BK). EI: 59 KB. GTR
 REPUBLIC GEOTHERMAL78-30 SW/c
 175n 4081e. Contr: Camrich #7.
 Old Well Info: OTD 7440, 8 5/8 @ 5275, 6 5/8 @ 7218.
 New Info: Resumed 8-29-78, milled a window @ 5000 (approx), PB & KO @ 5000 (approx), redrld to 7440, ran ES, TMPL-"survey", PB to 7220, set csg @ unrptd depth, tested, TD 7440 (OH) (Miocene), TD 7440 (RD #1) (Miocene), PBTD 7220. ...Comp as geothermal well, date NR, no other info released by oper.

7-16s-17e SB MESA, EAST: (12-20-78 BK). EI: 21 (approx) KB. GT
 MAGMA POWER 46B-7 SW/c 1749n 2500e.
 API 04-025-90201 Contr: Coastal. Spud 10-11-78, 13 3/8 @ 2255, drld to 3530, ran ES, TMPL-"survey", 10 3/4 @ 3530, perf 2255-3530, TD 3530 (Miocene). ...Comp as geothermal water disposal well 11-14-78.

7-16s-17e SB EAST MESA: EI: 30 KB. GTM
 MAGMA POWER CO 44B-7 NW/c 2500S 2549E.
 API 04-025-90119 Contr: Coastal #2. Spud 7/31/78, drld to 5150, ran DI, 9 5/8 @ 5150, dr to 6821, ran DI, TMPL, 7 Inr 5067-6821 w/pre-perfs 5788-6818, TD 6821 (Miocene), Comp 9/26/78. Prod int: 5788-6818, Pot'l Geothermal Producer.

7-16s-17e SB EAST MESA: EI: 30 KB. GTM
 MAGMA POWER CO 44A-7 NW/c 2499S 2451E.
 API 04-025-90188 Contr: Coastal #2. Spud 6/3/78, 13 3/8 @ 1254, drld to 5150, ran DI, TMPL, 9 5/8 @ 5150, drld to 7080, ran ES, TMPL, 7 Inr 5130-7080 (all pre-perfd), TD 7080 (Miocene), SI, Comp 7/26/78 Prod Int: 5105-7080. Pot'l Geothermal Producer.

30-15s-17e SB EAST MESA: EI: 62 KB. GTM
 REPUBLIC 78-30 SW/c 174N 4058E.
 GEOTHERMAL API 04-025-90175 Spud 7/1/78 (est), TD 7741 (Miocene), Comp 7/30/78 (est). Pot'l Geothermal Producer.

LAKE SONOMA COUNTY

7-13n-7w MD BORAX LAKE: Franciscan. (2-15-78 BK). EI: 1401 KB. GT
 PHILLIPS PETROLEUM 7-1 Borax Lake NE/c 2559s 1197w.
 API 04-033-90162 Contr: Camay Montgomery. Spud 2-15-78, 20 @ 210, 13 3/8 @ 9-20-78, TD 5850 (approx). ...Comp 11-78, temperature observation well.

GEOTHERMAL COMPLETIONSLAKE SONOMA COUNTY Contd34-11n-8w MD
AMINOIL USA37-34 CA-956
API 04-097-90394GEYSERS: 6500 Franciscan. (11-16-78 BK). EI: 2914 (approx) GTM
SW/c 870n 1650e.Contr: Montgomery. Spud 11-16-78, 16 @ 400, drld to 1740, lost
circ, regained circ, 11 3/4 @ 2400, 8 5/8 @ 1100, drld to 3930,ran ES, TMPL, TD 3930 (Franciscan). ...Comp 1-2-79.NEVADALYON COUNTY24-20n-25e MD
MAGMA ENERGY

1 Fernley

WILDCAT (FERNLEY-HAZEN): (1-26-79 BK). EI: 4208 KB. N

S/4 1115n 150e.
13 3/8 @ 330, drld to 3668, ran ES, TMPL, TD 3670.
...Abandoned 5-1-75.OREGONCHACKAMUS COUNTY7-3s-9e W
R. L. K.

71-7

TIMBERLINE: (7-25-78 BK). EI: 5783 KB. GTM

N/4 660s 660e.
Spud 7-25-78, drld to 2010, ran ES, TMPL-"survey", 7 @ 1000,
PB to 850, reportedly 180 degrees F water (very little wtrentry), TD 2010. ...Comp as geothermal well 11-1-78.TEXASBRAZORIA COUNTY

GENERAL CRUDE

Plesant Bayou
API 42-039-31236(2/21/78), 16,500 test (se/6s-39e-3) 6 1/2 mi E Danbury, 320 ac lse, GEOP
Perry & Austin Sur 2, A-32; 1900 FNEL & 507 FNWL (Chochlate Bayou)
lse; 1079 fnwl & 11745 fnel sur; SC: 6000 WNW Monsanto # 2, DH, TD
6400; approx 4 1/2 mi NW Martin Ranch Fld; Elev: 8 GRD, C/Welsh Drlg &
Service Co, Dr 26 to 98, Spud 7/1/78, 20 @ 1323; Drld to 8484, mud 9.9, Ran DILL, FOCL, BHC/SONL, GR, CALP, CNL,
TMPL; took 50 SDWL cores; Drld to 14,484, hrd gas kick, closed BOP to prevent blowout, well reg 80 psi when closed, cond
mud to 15 # per gal; Drld to 14,781, ran DILL, ACSL; Drld to 15,675 (mud 15.9), STL DP (t/fsh 10,416); rec fsh, ran TEML,
noise; PB to 9075, STR DP (t/fsh 6088); rec fsh; ran logs; PB to 1150; TD 15,675. PBTD 1150. D&A 1/13/79.--- -- ---
(NO FIRST REPORT SUMMARY THIS WEEK)

GEOTHERMAL DRILLING PROGRESS

INITIAL CLASS: GT - Geothermal; GTD - Geothermal Deepening; GTR - Geothermal Redrill; GTX - Geothermal Recompletion
 IW - Injection Well; GEOP - Geothermal Pressure.

IMPERIAL COUNTY

15-9s-12e SB MCCULLOCH GEO- THERMAL	1-15 Hot Mineral API 04-025-90190	SALTON SEA: (7-15-78 BK). EI: -141 KB. NE/c 369s 2650w. Location.	GT
15-9s-12e SB MCCULLOCH GEO- THERMAL	2-15 Hot Mineral	SALTON SEA: (7-15-78 BK). EI: -156 KB. NE/c 660s 668w. Location.	GT
5-12s-13e SB UNION OIL OF CALIF	5 I. I. D. API 04-025-90193	WILDCAT: 3500. (9-6-78 BK). EI: -230 KB. NW/c 2451s 249e. Location.	GT
5-12s-13e SB UNION OIL OF CALIF	6 I. I. D. API 04-025-90194	WILDCAT: 3500. (9-6-78 BK). EI: -233 KB. NW/c 299s 2320e. Location.	GT
5-12s-13e SB UNION OIL OF CALIF	14 Sinclair API 04-025-90195	WILDCAT: 6000. (9-6-78 BK). EI: -230 KB. NW/c 2402s 699e. Location.	GT
8-13s-14e SB CHEVRON USA	1 Rutherford API 04-025-90172	WILDCAT: (5/4/78 BK). EI: -40m KB. SW/c 274m N 213m E. Loc.	GT
16-13s-14e SB UNION OIL OF CALIF	9 Veysey	BRAWLEY: (3-1-78 BK). EI: -141 KB. SE/c 499n 2644w. Location.	GT
16-13s-14e SB UNION OIL OF CALIF	10 Veysey	BRAWLEY: (3-1-78 BK). EI: -141 KB. SE/c 499n 2778w. Location.	GT
28-14s-14e SB MCCULLOCH GEO- THERMAL	2-28 Mercer API 04-025-90171	BRAWLEY: (1-15-79 BK). EI: -128 KB. NW/c 2700s 2041e. Contr: Republic. ...Preparing location.	GT
6-14s-16e SB PHILLIPS PETROLEUM	1 East Brawley Strat Test API 04-025-90180	WILDCAT: 2000 Pliocene. (5-17-78 BK). EI: 15 KB. SE/c 1150n 1650w (approx). Location.	GT
6-14s-16e SB PHILLIPS PETROLEUM	1-A East Brawley Strat Test API 04-025-90185	WILDCAT: 2000 Pliocene. (5-17-78 BK). EI: 15 KB. SE/c 1150n 1620w (approx). Location.	GT
9-14s-16e SB PHILLIPS PETROLEUM	2 East Brawley Strat Test API 04-025-90197	BRAWLEY: 2000 Pliocene. (12-27-78 BK). EI: -15 KB. NE/c 900s 2600w. Location.	GT
18-14s-16e SB PHILLIPS PETROLEUM	3 East Brawley Strat Test API 04-025-90198	WILDCAT: 2000 Pliocene. (12-27-78 BK). EI: -48 KB. NE/c 2700s 2500w. Location.	GT
7-16s-17e SB MAGMA POWER	44A-7 API 04-025-90188	MESA, EAST: (12-20-78 BK). EI: 30 KB. NW/c 2500s 2451e. Location.	GT
7-16s-17e SB MAGMA POWER	44B-7 API 04-025-90199	MESA, EAST: (12-20-78 BK). EI: 30 GR. NW/c 2500s 2549e. Location.	GT
7-16s-17e SB MAGMA POWER	46A-7 API 04-025-90200	MESA, EAST: (12-20-78 BK). EI: 30 GR. SW/c 1699n 2500e. Location.	U
23-13s-14e SB UNION OIL OF CALIF	1 Slater API 04-025-90189	WILDCAT (BRAWLEY): 9500 Miocene. (6-30-78 BK). EI: -55 KB. NW/c 2201s 800e. Contr: Peter Bawden. Spud 11-6-78, 20 @ 80, 13 3/8 @ 1200, drld to 8250, ran logs, TMPL-"survey", PB & KO @ 7080, redrld to 8520, ran ES, TMPL-"survey", PB & KO @ 6650 (approx). ...Redrld 6740.	GT

GEOTHERMAL DRILLING PROGRESSIMPERIAL COUNTY Contd

28-14s-14e SB MESA, EAST: (6-26-78 BK). EI: -128 KB. GT
 MCCULLOCH GEO- 1-28 Mercer NW/c 659s 2041e.
 THERMAL API 04-025-90165 Contr: Republic Drlg #4. Spud 7-11-78, 13 3/8 @ 1201, drld to 8959, ran DI, CDM, CNL-FDC-GRL, TMPL, 9 5/8 @ 5645 w/2100 sx, drld to 11,021, ran ES, TMPL-"survey", 7 @ 11,020, perf unrptd int, tested unrptd perms, no details released by operator, susp oper 10-11-78. Resumed 10-26-78, drld to 13,370, ran ES, TMPL-"survey", TD 13,380. ...Tstg, recovering hot wtr & steam, no other details released by operator.

7-16s-17e SB MESA, EAST: Miocene. (10-28-78 BK). EI: 24 (approx) KB. GT
 MAGMA POWER 48A-7 "7" SW/c 499n 2451e.
 Contr: Coastal. Spud 10-28-78, 13 3/8 @ 1225, 9 5/8 @ 5200, drld to 6305, lost DP, could not rec fish, PB & KO @ 5810, drld to 6915, ran ES, TMPL-"survey", 7 Inr @ 6765 w/pre-perfs 5755-6765, test indicate a commercial producer, TD 6915. ...Tstg.

LAKE COUNTY

1-10n-8w MD GEYSERS: 8503. (5-17-78 BK). EI: 2546 KB. GT
 THERMOGENICS, INC K-1 Klau Mines SE/c 1479n 1574w.
 API 04-033-90183 Location.

5-11n-8w MD GEYSERS: Franciscan. (11-15-78 BK). EI: 2569 KB. GTR
 MCCULLOCH 2-5 Francisco NE/c 1125s 3955w.
 Contr: H & C #4.
 Old Well Info: OTD 8910, 13 3/8 @ 1500, 9 5/8 @ 6200, redrld to

TD 8730, no details.
 New Info: Resumed 11-15-78, PB & KO @ 5500. ...Redrlg 7750.

9-11n-8w MD GEYSERS: 12,000. (5-17-78 BK). EI: 4686 KB. GT
 UNION OIL OF CA' IF 3 Cobb Mountain Estate SE/c 300n 2274w.
 API 04-033-90186 Location.

15-11n-8w MD GEYSERS: 12,000. (5-17-78 BK). EI: 4686 KB. GT
 UNION OIL OF CALIF 4 Cobb Mountain Estate SE/c 3349n 635e.
 API 04-033-90187 Location.

16-11n-8w MD GEYSERS: 12,000. (5-17-78 BK). EI: 4125 KB. GT
 UNION OIL OF CALIF 1 Cobb Mountain Estate SW/c 4149n 300e.
 API 04-033-90184 Location.

16-11n-8w MD GEYSERS: 12,000. (5-17-78 BK). EI: 4323 KB. GT
 UNION OIL OF CALIF 2 Cobb Mountain Estate SE/c 3500n 2400w.
 API 04-033-90185 Location.

34-11n-8w MD WILDCAT: (12-20-78 BK). GT
 AMINOIL USA 73-34 CA-956 NE/c 1496s 771w.
 API 04-033-90084 Location.

36-11n-8w MD GEYSERS: 10,000 (approx). (9-27-78 BK). EI: 1880 KB. GT
 NATOMAS 1 Davies-State 5206 SE/c 974n 2257w.
 API 04-033-90194 Contr: Atlantic. Spud 1-5-79, 20 @ 100. ...Drlg 550.

30-12n-7w MD WILDCAT (Clear Lake): 9500 (approx) Franciscan. (9-27-78 BK).GT
 OCCIDENTAL 1 Bouscal EL: 2133 KB.
 GEOTHERMAL API 04-033-90194 NE/c 1640s 1476w.
 Contr: Atlantic. Spud 9-12-78, 20 @ 285, 13 3/8 @ 3060, 9 5/8 @ 7950, ran E-log, temperature survey, reportedly encountered 230 drgrees F (approx), TD 9020 (Franciscan). ...Sus 12-30-78.

33-12n-8w MD GEYSERS-NEW POOL WILDCAT: 8990. (11-30-77 BK). EI: 2831 KB.GT
 MCCULLOCH GEO- 1-33 Newfield NE/c 82s 1551w.
 THERMAL API 04-033-90147 Contr: Hunnicutt & Camp #4. Spud 11-26-77, 20 @ 200, 13 3/8 @ 1535, drld to 4115, PB & KO @ 1604, re-drld to 6015, 9 5/8 @ 5993, drld to 6912, stk DP, unable to rec fish, backed off @ 6100, PB & KO @ 6100, drld to 7411, stk DP, unable to rec, PB & KO @ 5990, re-drld to 8990, ran ES, TMPL, 9 5/8 @ 6000, PB to 6660, 7 Inr 5900-6660, TD 4115 (OH), TD 6912 (RD #1), TD 7411 (RD #2), TD 8990 (RD #3), PBTD 6660. ...Susp oper 11-15-78.

36-12n-9w MD GEYSERS: 12,000. (3-29-78 BK). EI: 2949 KB. GT
 UNION OIL OF CALIF 1 Binkley Ranch NE/c 3998s 1200w.
 API 04-033-90171 Location.

MONO COUNTY

15-3s-28e MD WILDCAT: 6499. (12-20-78 BK). EI: 7316. GT
 UNION OIL OF CALIF 1 Clay Pit NE/c 1299s 499w (approx).
 API 04-051-90021 Location.

GEOTHERMAL DRILLING PROGRESS

MONO COUNTY Cont'd

32-3s-28e MD WILDCAT (Mammoth Lakes): 6499. (12-20-78 BK). EI: 7316. GT
 UNION OIL OF CALIF 1 Mammoth NW/c 1601s 1749e.
 API 04-051-90020 Location.

NAPA COUNTY

29-10n-6w MD WILDCAT (Middletown): 9500. (8-4-78 BK). EI: 2250 KB. GT
 AMAX Exploration 1 Amax SE/c 449n 2798w.
 API 04-055-90012 Contr: Montgomery #6. Spud 8-4-78, 20 @ 320, drld to 8200, ran
 logs, drld to 8755, ran ES, TMPL, rr 11-8-78, TD 8755
 (Franciscan). ...Reportedly comp as temperature observation well-200 degrees-220 degrees F.

SOLANO COUNTY

32-12n-9w MD WILDCAT: (6/22/78 BK). GT
 AMINOIL USA 2 Aidlin SE/c 46m N 640m W.
 API 04-097-90257 Loc.

30-10n-7w MD WILDCAT: (6/22/78 BK). GT
 PHILLIPS PETROLEUM 1 Briggs Creek Strat Test NE/c 381m S 61m W.
 API 04-097-90265. Loc.

SONOMA COUNTY

4-10n-8w MD GEYSERS: 8000. (6-3-77 BK). EI: 3178 KB. GT
 SHELL OIL 33A-4 U. S. Government NE/c sec 3-10n-8w 1676s 8453w.
 API 04-097-90391 Location.

6-11n-8w MD GEYSERS: 8500. (12-10-77 BK). EI: 3136 KB. GT
 UNION OIL OF CALIF 39 DX State 4596 SW/c 2762n 1502e.
 API 04-097-90366 Location.

7-11n-8w MD GEYSERS: 8000. (1-4-78 BK). EI: 3302 KB. GT
 UNION OIL OF CALIF 40 DX State 4596 SW/c 36n 3250e.
 API 04-097-90370 Location.

7-11n-8w MD GEYSERS: 9003. (1-25-78 BK). EI: 3302 KB. GT
 UNION OIL OF CALIF 41 DX State 4596 SW/c 36n 3198e.
 API 04-097-90373 Location.

16-11n-8w MD GEYSERS-WO: 12,000. (4-3-78 BK). EI: 1880 KB. GT
 UNION OIL OF CALIF 1 Angeli SW/c 961n 1820e.
 API 04-097-90379 Contr: Loffland. Spud 9-1-78, 20 @ 80, drld to 11,440, ran ES,
 TMPL, 9 5/8 @ 10,200, rr 1-11-79, TD 11,440 (Fractured Greywacke).
 ...Tstg.

17-11n-8w MD GEYSERS: (5-21-78 BK). EI: 2086 KB. GT
 UNION OIL OF CALIF 24 LF State 4597 SW/c 544n 1706e.
 Contr: Loffland Bros #27. Spud 5-21-78, 20 @ 274, drld to
 9489, ran ES, TMPL, PB & KO @ unrptd depth, re-drld to 8686,
 9 5/8 @ 8686, rr 8-30-78, TD 9489 (OH), TD 8686 (RD #1) (Franciscan). ...Susp oper 8-30-78.

17-11n-8w MD THE GEYSERS GEOTHERMAL: (5/11/78 BK). GT
 UNION OIL OF CALIF 3 L F Horner State 4597 NW/c 55m S, 457m E.
 API 04-097-90245 Loc.

18-11n-8w MD GEYSERS: 10,000. (1-4-78 BK). EI: 2824 KB. GT
 UNION OIL OF CALIF 7 Cobb Mtn. Hunting Club SE/c 1601n 2178w.
 API 04-097-90360 Location.

18-11n-8w MD GEYSERS: 10,000. (3-29-78 BK). EI: 3290 KB. GT
 UNION OIL OF CALIF 42 DX State 4596 NW/c 26s 3188e.
 API 04-097-90382 Location.

18-11n-8w MD GEYSERS: 10,000. (3-29-78 BK). EI: 3378 KB. GT
 UNION OIL OF CALIF 43 DX State 4596 NW/c 830s 2470e.
 API 04-097-90381 Location.

18-11n-8w MD GEYSERS: 10,000. (3-29-78 BK). EI: 3378 KB. GT
 UNION OIL OF CALIF 44 DX State 4596 NW/c 856s 2440e.
 API 04-097-90380 Location.

18-11n-8w MD GEYSERS: 10,000. (1-25-78 BK). EI: 3572 KB. GT
 UNION OIL OF CALIF 28 LF State 4597 NE/c 1781s 3549w.
 API 04-097-90375 Location.

GEOTHERMAL DRILLING PROGRESS

SONOMA COUNTY Contd

<p>18-11n-8w MD UNION OIL OF CALIF 29 LF State 4597 API 04-097-90374</p>	<p>GEYSERS: 10,000. (1-25-78 BK). EI: 3572 KB. NE/c 1758s 1240w. Location.</p>	<p>GT</p>
<p>18-11n-8w MD UNION OIL OF CALIF 1 Occidental Federal API 04-097-90383</p>	<p>GEYSERS: 8000 Franciscan. (3-29-78 BK). EI: 2818 KB. SE/c 1545n 2558w. Spud 10-4-78, 30 @ 62, 20 @ 270, 13 3/8 @ 1860, drld to 8090, stk DP, unable to rec, PB & KO @ 3000 to ST fish. ...Drlg 8150.</p>	<p>GT</p>
<p>18-11n-8w MD UNION OIL OF CALIF 2 Occidental Federal API 04-097-90384</p>	<p>GEYSERS: 8500. (3-29-78 BK). EI: 2818 KB. SE/c 1571n 2211w. Location.</p>	<p>GT</p>
<p>19-11n-8w MD UNION OIL OF CALIF 7 GDC API 04-097-90377</p>	<p>GEYSERS: 7000. (2-8-78 BK). EI: 2014 KB. SE/c 1099n 869w. Location.</p>	<p>GT</p>
<p>29-11n-8w MD UNION OIL OF CALIF 9 GDC API 04-097-90362</p>	<p>GEYSERS: 8000. (2-8-78 BK). EI: 2198 KB. NW/c 510s 1210e. Location.</p>	<p>GT</p>
<p>29-11n-8w MD UNION OIL OF CALIF 10 GDC. API 04-097-90363</p>	<p>GEYSERS: 8000. (2-8-78 BK). EI: 2198 KB. NW/c 590s 1161e. Location.</p>	<p>GT</p>
<p>29-11n-8w MD UNION OIL OF CALIF 11 GDC API 04-097-90364</p>	<p>GEYSERS: 8000. (2-8-78 BK). EI: 2198 KB. NW/c 551s 1109e. Location.</p>	<p>GT</p>
<p>34-11n-8w MD AMINOIL USA 37A-34 CA-958 API 04-097-90395</p>	<p>GEYSERS: 6500 Franciscan. (1-5-79 BK). EI: 2880 KB (approx). SW/c 660n 1800e. Contr: Montgomery. Spud 1-5-79, 20 @ 600. ...Drlg 1875.</p>	<p>GT</p>
<p>12-11n-9w MD UNION OIL OF CALIF 2 Ottoboni Federal API 04-097-90269</p>	<p>GEYSERS: 6500. (11-2-77 BK). EI: 2736 KB. NW/c 2788s 2040e. Location.</p>	<p>GT</p>
<p>13-11n-9w MD UNION OIL OF CALIF 1 Curry API 04-097-90386</p>	<p>GEYSERS: 8000. (5-17-78 BK). EI: 1827 KB. NE/c 1299s 200w. Location.</p>	<p>GT</p>

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GEOTHERMAL DRILLING PROGRESS

NEVADA

CHURCHILL COUNTY

14-23n-35e MD SOUTHLAND ROYALTY 45-14 DIXIE VALLEY: 8000. (1-15-79 BK). GT
C 660s 660w.
Location.

18-24n-37e MD SUNOCO ENERGY DEV 1 S. W. Lamb DIXIE VALLEY: (9-16-78 BK). GT
NW/c 330s 330e.
Spud 9-16-78, 20 @ 70, drld to 7250, ran ES, 9 5/8 @ 5620,
TD 7250. ...Shut in.

LYON COUNTY

34-10n-25e MD CHEVRON RE- 76-1 U. S. WILDCAT (WILSON HOT SPRINGS): (1-11-78 BK). EI: 3750 GT
SOURCES
Contr: Ecklund. Spud 1-11-78, 7 @ 200, drld. to 2002, ran ES,
TMPL, TD 2002. ...Comp 2-20-78.

WASHOE COUNTY

31-18n-20e MD MAGMA POWER 2 Steamboat WILDCAT (STEAMBOAT SPRINGS): (8-22-59 BK). GTM
EI: 3500 (approx) KB.
Spud 8-22-59, 13 3/8 @ 155, drld to 475, ran ES, TMPL-"survey",
TD 475 (in Volcanic Ash & Hard Basalt). ...Comp 9-3-59,
reportedly flowed some steam & hot water, prod int 155-475.

15-32n-23e MD SUNOCO ENERGY DEV 1-15-G Holland Livestock Ranch GERLACH: (12-17-78 BK). GT
SW/c 660n 200e.
Contr: Signal Drlg. Spud 12-17-78, 13 3/8 @ 2000 (approx).
...Drlg 3825.

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GEOTHERMAL DRILLING PROGRESS

OREGON

HARNEY COUNTY

14-33s-35e W ANADARKO OIL	SE $\frac{1}{4}$ A-8	WILDCAT: 2000. (10-6-78 BK). Location.	GT
6-33s-36e W ANADARKO OIL	SE $\frac{1}{4}$ A-5	WILDCAT: 2000. (10-6-78 BK). Location.	GT
7-33s-36e W ANADARKO OIL	SW $\frac{1}{4}$ A-6	WILDCAT: 2000. (10-6-78 BK). Location.	GT
18-33s-36e ANADARKO OIL	SW $\frac{1}{4}$ A-7	WILDCAT: 2000. (10-6-78 BK). Location.	GT
29-34s-34e W ANADARKO OIL	NE $\frac{1}{4}$ A-26	WILDCAT: 2000. (10-6-78 BK). Location.	GT
34-34s-34e W ANADARKO OIL	SW $\frac{1}{4}$ A-31	WILDCAT: 2000. (10-6-78 BK). Location.	GT
8-35s-34e W ANADARKO OIL	NE $\frac{1}{4}$ A-34	WILDCAT: 2000. (10-6-78 BK). Location.	GT
10-37s-33e W ANADARKO OIL	SE $\frac{1}{4}$ B-56	WILDCAT: 2000. (10-6-78 BK). Location.	GT
13-37s-33e W ANADARKO OIL	SW $\frac{1}{4}$ B-61	WILDCAT: 2000. (10-6-78 BK). Location.	GT
22-37s-33e W ANARARKO OIL	NW $\frac{1}{4}$ B-64	WILDCAT: 2000. (10-6-78 BK). Location.	GT

MALHEUR COUNTY

13-17s-42e W AMAX EXPLORATION	30 Geothermal Well Permit	WILDCAT: 2000. (4-4-78 BK). Location.	GT
24-17s-42e W AMAX EXPLORATION	29 Geothermal Well Permit	WILDCAT: 2000. (4-4-78 BK). Location.	GT
26-17s-42e W AMAX EXPLORATION	31 Geothermal Well Permit	WILDCAT: 2000. (4-4-78 BK). Location.	GT
5-18s-43e W CHEVRON RESOURCES	SW $\frac{1}{4}$ 5-1-78	WILDCAT: 2000. (10-6-78 BK). Location.	GT
9-18s-43e W CHEVRON RESOURCES	NW $\frac{1}{4}$ 9-1-78	WILDCAT: 2000. (10-6-78 BK). Location.	GT

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GEOTHERMAL DRILLING PROGRESS

UTAH

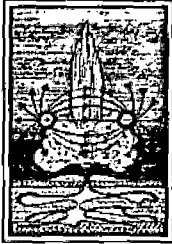
BEAVER COUNTY

3-27s-9w PHILLIPS PETROLEUM 3-1 Unit		WILDCAT: SW NE 2740 fsl 2850 fwl.	GT
9-27s-9w PHILLIPS PETROLEUM 9-1 Unit		WILDCAT: NW NE 1000 fml 2560 fel.	GT
10-27s-9w PHILLIPS PETROLUUM 13-10 Unit		WILDCAT: SW NW 1882 fml 200 fwl.	GT
15-27s-9w PHILLIPS PETROLEUM 25-15 Unit		WILDCAT: NW SW 2719 fml 1094 fel.	GT
18-27s-9w GEOTHERMAL POWER 15-6-PC		WILDCAT: EI: 5545 KB. Rig release 7/25/78. Ran COM, FOR, DEN Gr, BHC, SON, RES. 1890 TD. ...SD.	GT
33-26s-9w PHILLIPS PETROLEUM 82-33 Unit		WILDCAT: NE NE 1284 fml 77 fel.	GT
3-27s-9w PHILLIPS PETROLEUM 54-3 Unit		WILDCAT: SW SW.	GT
35-26s-9w PHILLIPS PETROLEUM 12-35 Unit		WILDCAT: NW NW 750 fml 100 fwl.	GT
16-27s-9w		WILDCAT:	GT
THERMAL POWER COMPANY	72-16 Utah State	NE NE 990 fml 990 fel. Rig release 11/4/76. Ran CB, HI, RES, TEMP, ALPHA. 1245 TD. ...SD.	
2-27s-9w THERMAL POWER COMPANY	14-2 Utah State	WILDCAT: EI: 6262 KB. SW NW 2310 fml 350 fwl. Rig released 10/13/76. Ran COM, NEV, FOR, DEN, RES, ALPHA, TEMP. 6106 TD. ...SD.	GT
36-26s-9w THERMAL POWER COMPANY	24-36 Unit	WILDCAT: SW NW 2310 fml 4290 fel.	GT
21-27s-9w GETTY OIL	52-21 USL -27-391 KGRA	WILDCAT: NW NE 990 fml 2310 fel. Ran DI, LL, BHC, SON, NEV, FOR, DEN, FF, TEMP. 7916 TD. ...SD.	GT
29-29s-6w UNION OIL COMPANY	Porminco No 1	WILDCAT: 821 fml 59 fel. ...SD.	GT
7-26s-6w UNION OIL COMPANY	42-7 Cove Fort Sulferdale Unit	WILDCAT: EI: 6442 KB. SE NE NW. Rig released 3/1/78. Ran COM, NEV, FOR, DEN, BHC, SON. 7705 TD. ...SD.	GT

MILLARD COUNTY

33-25s-6w UNION OIL COMPANY	31-33 Cove Fort Sulferdale Unit	WILDCAT: EI: 6501 KB. NW NE. Rig released 7/19/78. Ran COM, NEV, FOR, DEN.	GT
30-24s-6w CAROLINE HUNT TRUST ESTATE	15-30 Cove Fort Sulferdale Unit	WILDCAT: NW NW.	GT

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Volume 4 Issue 8

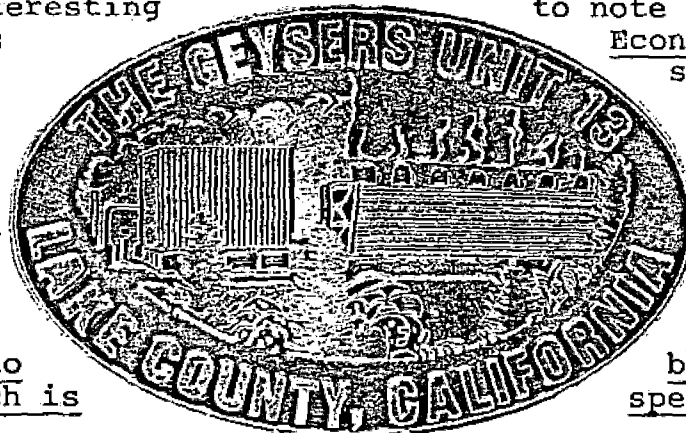
September 30, 1977

GEYSER

UNIT 13 - LARGEST IN THE WORLD

Unit 13 will be the largest single geothermal unit in the world and the first in Lake County. Pacific Gas & Electric Company's current construction schedule calls for the power plant to begin producing electricity on October 1, 1979, which will be about four and one-half years after they filed their Environmental Data Statement with the California Public Utilities Commission. PG&E received certification for construction from the Public Utilities Commission in November of last year and started initial site preparation and grading this spring. The main building housing the turbine, generator and condenser will be 173 feet long, 83 feet wide, and 66 feet high. Seismic design is in accordance with the Uniform Building Code as adopted by Lake County. The building will be steel frame construction with forest green, rustic colored steel siding to blend into the environment. The cooling tower will be behind the turbine building, forming a "T"-shaped complex. It will be 360 feet long, 71 feet wide, and 65 feet high. Its basin is capable of holding over 400,000 gallons of water. The transformer and switching facilities will be designed to step up the electricity generated to transmission line voltage levels. The entire power plant complex will be enclosed by a chain link fence, and the landscape graded and planted. The landscaping plans will be submitted to the Lake County Planning Department for their approval. PG&E will have as many as 75 to 85 workers on site during construction. Some will be from PG&E's General Construction Department, others will be from the approximately twenty different contractors on the job. It is interesting

to note some figures prepared by PG&E's Department, of geothermal Geysers. Estimated 640 jobs directly thermal development, 1,000 people jobs. The ries of these mated in 1977 to -- most of which is



Economics and Statistics showing the effects development at The There are an estimate people working in involved in geoment and another in supporting wages and salaries people is estimate about \$28 million spent locally. Also,

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INTERNATIONAL GEOTHERMAL ENERGY NEWSLETTER

about \$4 million of construction equipment and supplies are purchased locally for construction, operation, and maintenance of the project. Another economic benefit of construction are the property taxes and lease payments. In total, the composite impact is a contribution of \$66 million to the regional economy of this year. By 1981, PG&E forecasts this to reach \$93 million, which is \$226 per person. On a broader scale, everyone in California benefits from geothermal development. This is a cleaner and less expensive resource from which to make electricity, and not dependent on other states or other nations. Currently, PG&E generates about seven percent of its total electric capacity from geothermal steam, and while that seems minor, it is an important factor in maintaining continuity of service at rates lower than they might otherwise be. About \$29 million will be spent to build the Unit 13. Aminoil has that much and more invested in wells and steam collection pipes. So, the development of geothermal is not inexpensive. Unit 13 will be Aminoil's first steam production for an electrical generating plant and since their exploration operations in the Geysers were initiated over ten years ago, it appears to be the end of a long struggle. Aminoil has dedicated approximately 1,000 acres in this immediate plant site vicinity to provide the steam reserves (709,560,000,000 lbs. of steam) required to operate this plant for the next thirty years plus. The plant design is for 135 MW which will require approximately 2,770,000 lbs of steam per hour to operate. To provide a safety margin and build in sufficient flexibility to service individual wells, it is Aminoil's plan to develop a minimum field capacity producing rate of 3 million lbs. of steam per hour. To provide this amount of steam it will take approximately 20 wells, 16 of which Aminoil has already drilled and tested for a total current capacity of 2,245,000 lbs. per hour. During 1978 Aminoil will drill an additional four wells, and at that time, will have a total of 20 wells providing an average of 150,000 lbs. of steam per hour per well. Individual flow rates vary from a low of 65,000 lbs. per hour to a high of 300,000 lbs. per hour. The 20 wells drilled in the thousand acre dedication area will result in a 50-acre per well spacing pattern. Over the life of the field, replacement wells will be required to maintain the 3,000,000 lbs. per hour desired rate and it is Aminoil's current forecast that one replacement well will be required every three years. The steam reservoir conditions include a pressure of approximately 500 lbs. psia and 475°F. Under these conditions, the steam is quite close to saturation state. Since the operating pressure of the steam turbine generator is approximately 100 lbs., at delivery the steam (338°F) will have approximately 10° of superheat. To deliver this steam to the plant site there will be required about 31,000 feet of 11" to 48" pipe costing approximately 5.5 million dollars to purchase and install. Although the normal operating pressure of the line will be only 100 lbs., its design rating will be at least 180 lbs., and its minimum burst pressure would be approximately 900 lbs. The pipeline will be insulated with 3" to 4" of fiber glass with an exterior aluminum coating. It will be provided with a pneumatic pressure control system which will automatically direct the steam, in the event of steam turbine failure or planned shut down, to a muffler venting system which will immediately effectively reduce the noise impact to acceptable levels (below 90 decibels at 100', per Use Permit requirements). Within one hour, the field flow will be reduced to 20% of the normal flow rate with a combined manual and automated valve control system. That is, at the steam relief site,

valves will be manually closed throttling the amount of steam which is being vented down to 20% of normal flow. (The consequent pressure build-up will activate automatic throttling of V-ball valves at each of the producing wells so that their flow will be reduced to approximately 20% of capacity.) Under these conditions, the amount of H₂S which is being vented will be reduced to approximately 46 lbs. per hour (88 ppm H₂S) which would result in less than 30 ppb (ambient standard) at the nearest Anderson Springs residences even under the worst wind/weather conditions anticipated. Claude Jenkins said that Aminoil "will continue to do its part in the development of this clean and relatively inexpensive energy source -- Geothermal Steam -- which will be providing both jobs and significant tax revenues for Lake County residents in addition to assisting in the resolution of our nation's energy problem." C. H. Sedan said that to date PG&E has invested or has plans to invest over \$500 million in geothermal energy at The Geysers, both in Sonoma and Lake Counties. "We intend to continue building geothermal power plants at the rate of one per year as long as there is a proven supply of steam and a need for electric energy," said Sedan.

PON ISSUED FOR PROGRAM ON GEOTHERMAL ENERGY UTILIZATION

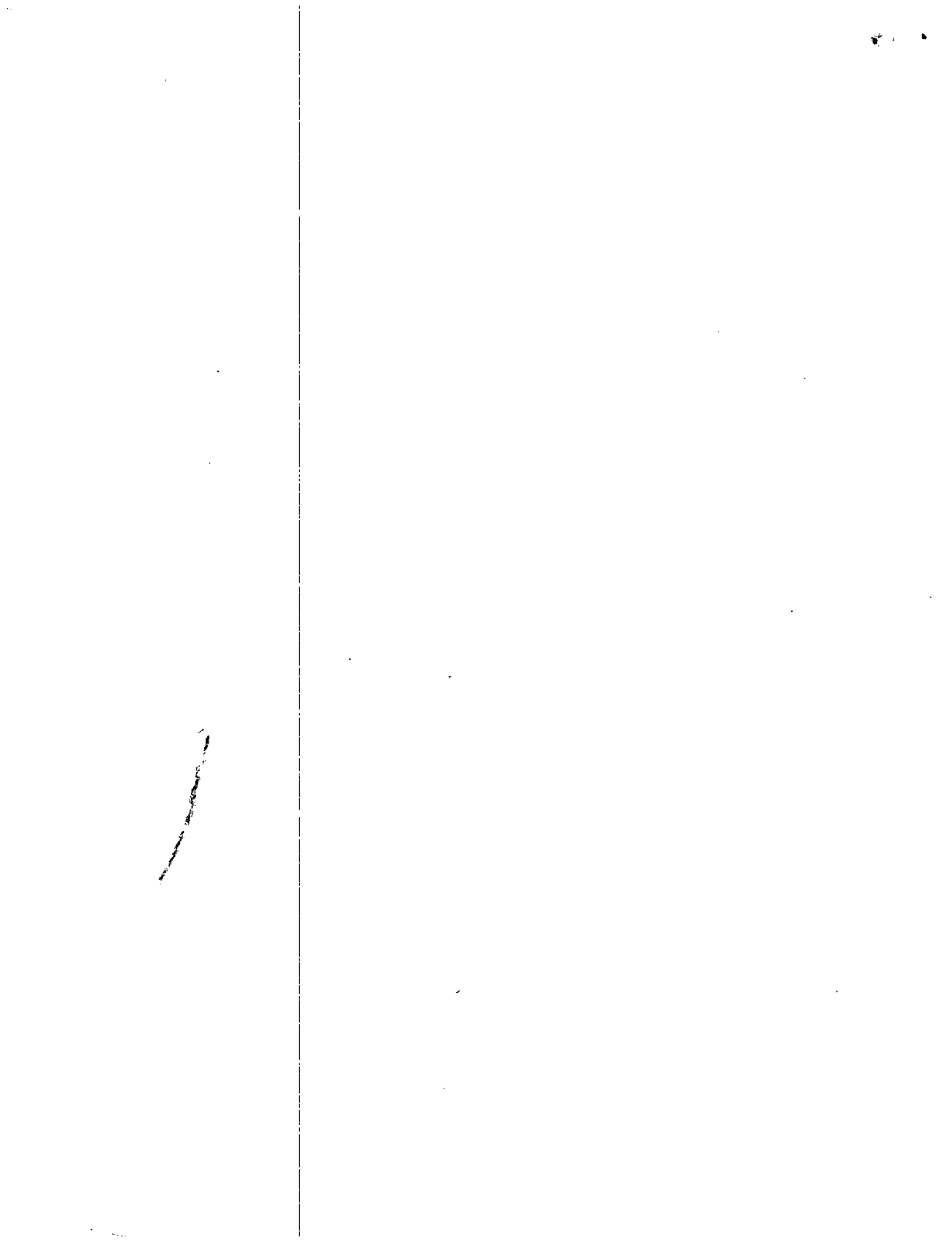
ERDA's San Francisco Operations Office will issue a Program Opportunity Notice (PON) on or about September 16 requesting proposals for field experiments involving the direct utilization of geothermal energy resources. Primary interest under the PON is for site-specific field experiments in space heating and cooling, agricultural or aquacultural uses, industrial processing and hot water heating. ERDA has allocated a total of \$1.5 million and anticipates funding the initial phase of four or more projects under this PON during FY 1978. Any interested parties who would like to submit a proposal must do so by November 30, 1977. There will be a pre-proposal conference at the San Francisco Operations Office at 10 A.M., Room 620, Friday, October 7th. Additional information may be obtained by writing: ERDA/San Francisco Operations Office, Procurement Division, 1333 Broadway, Oakland, CA 94612. (Refer to PON EG-77-N-03-1553.)

SHELL LEAVES IT ON THE TABLE

Results of the Geysers-Calistoga KGRA sale on September 14th, 1977 are as follows: Parcel #1: 16,053.15 acres. Per Acre: 15.11 Thermogenics Inc. -- \$24,929.10. \$33.00 Shell* -- \$54,553.95. Parcel #2: 1203.81 acres. Per Acre: \$20.11 Thermogenics -- \$24,208.62; 23.00 Aminoil USA -- \$27,687.63; \$603.00 Shell* -- \$725,897.43. Parcel 3 for 80 Acres. NO BIDS. (*Asterisk indicates highest bidder.)

LANDS COMMISSION CONSIDERS APPLICATIONS FOR BOGGS

Sacramento: The California State Lands Commission will consider applications for permits to prospect for geothermal resources on Boggs Mountain State Forest in Lake County when it meets September 29 in Sacramento. Geothermal Kinetics, Inc. (of Phoenix, AZ), has applied to the Commission for permits to prospect for geothermal resources. The Public Resources Code permits the Commission to issue permits and leases



U.S. ENERGY

J.W. ROTH
Bailey Control Systems

Need (Demand) vs. Supply (Source)

ENERGY NEED:

U.S. energy use in 1972 was 74 quadrillion BTU. (BTUX10¹⁵). A 4% compound growth rate is generally agreed to be required in order to maintain economic health consistent with a business as usual scenario. This would result in an energy demand of 222 quadrillion BTU by the year 2000. However, taking into account energy conservation goals through improved energy use, it is projected that energy needs by the year 2000 can be reduced 30 quadrillion BTU.

This will be achieved through more efficient transportation, (8) improved building construction, (7) industrial savings, (8) waste heat utilization, (2) and improved electrical generation efficiency (5). In addition, some savings will accrue from economic discipline resultant from the high cost of energy. Such savings are projected at an additional 10 to 15 quadrillion BTU by the year 2000. It is therefore realistic to peg energy demand for the year 2000 at 180 quadrillion BTU. This is equivalent to a growth rate of 3.23% compound from 1972, and a projected energy demand in 1985 of 112 quadrillion BTU.

ENERGY SUPPLY:

The energy consumed in the U.S. during 1972 was obtained from the following sources:

Oil	Quadrillion BTU	%
Domestic	22.4	30.3
Imported	10.0	13.5
Natural Gas	20.6	27.8
Coal	15.0	20.3
Nuclear	.7	.9
Other	5.3	7.2
Total: (year 1972)	74.0	100.0

In assessing the role of these sources for serving our future needs, it should be noted that from 1972 to the present, our dependence on oil has actually increased. In 1977, oil is projected to provide 35.5 quadrillion BTU, yet domestic production of oil is only expected to be 17.5 quadrillion BTU. Therefore, we are presently more dependent on foreign oil than we were at the time of the oil embargo.

We therefore have yet to come to grips with our energy independence goal by the turn of the century.

Looking to 1985, it is hoped that domestic gas and oil production can somehow be maintained at present levels. Meanwhile, we need to reverse the trend on dependence for foreign oil while we double coal production. "Other" sources must also double. Presently, "other" is primarily hydro power. This can be increased only slightly. Therefore, for "other" sources to double by 1985, rapidly increasing contributions must come from geothermal, solar, waste material and secondary recovery. The balance of our energy needs will necessarily be assigned to nuclear. Following is the resulting energy source projection for 1985:

Oil	Quadrillion BTU	%	Source Growth From 1972
Domestic	17.5	15.6	-24.1%
Imported	17.5	15.6	+75.0%
Natural Gas	20.6	18.4	-0—
Coal	30.0	26.8	+100%
Nuclear	15.9	14.2	+2,171%
Other	10.5	9.4	+98.1%
Total: (year 1985)	112.0	100.0	

Projecting to the year 2000, source contributions will necessarily reflect the dwindling reserves of domestic oil and gas. As shown above, these are expected to drop from 43 quadrillion BTU in 1972 to 38 in 1985. By year 2000, they are expected to drop to 27 quadrillion BTU. In view of our energy independent goal by the end of the century, we are therefore facing a loss of 29 quadrillion BTU while our needs grow by 68 quadrillion BTU. Therefore, we are faced with the need to obtain an additional 97 quadrillion BTU from coal, nuclear, or "other" sources between 1985 and 2000.

Looking at "other" sources in the year 2000, hydropower is projected at 5 quadrillion BTU, geothermal: 3, solar: 7, waste materials: 5, and secondary recovery: 5, for a total of 25 quadrillion BTU.

Coal, including success with coal liquefaction

and coal gasification, can optimistically be a source for 70 quadrillion BTU with approximately 27% provided through liquefaction and gasification (18.6% and 9.1% respectively).

The nuclear contribution is projected at 46 quadrillion BTU, 6% of which will come from breeder reactors if they do become commercial at or about 1995.

The energy source projection for 2000 therefore looks as follows:

	Quadrillion BTU	%	Source Growth From 1985
Oil			
Domestic	12.4	6.0	-29.1%
Imported	-0-	-0-	
Natural Gas	14.6	8.1	-29.1%
Coal	70.0	38.9	+133.3%
Nuclear	46.0	25.6	+189.3%
Other	25.0	13.8	+138.1%
Total: (year 2000)	168.0	93.3	
Needed:	180.0		
Shortfall:	12.0	6.7	
		100.0	

Where will the 6.7% shortfall come from? It could possibly come from newer technologies such as solar-electric direct conversion, oil shale or biomass (production of petro-chem substitutes from marine biomass, agricultural wastes, and garbage). However, such sources are classified as "maybe" rather than "probable". It likely will not come from fusion or hydrogen since these technologies will not yet be commercially available by 2000.

Perhaps we will find it necessary to continue to import as much oil as we produce, assuming it will be available to us.

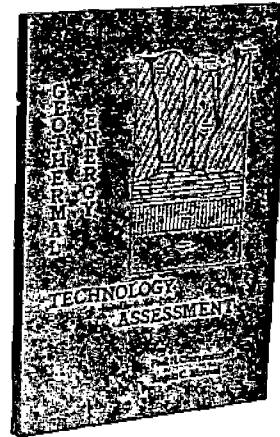
Most significant of all, however, is the clear requirement for us to remove the roadblocks so as to develop all available energy sources including coal and nuclear. Despite rapid development of "other" sources and stringent conservation measures, we will still be dependent on coal and nuclear to supply 64.5% of our energy needs in the year 2000.

In order for this to happen, coal production must increase 367% and nuclear 6,471% over 1972 levels.

(Data compiled from various sources.)

J.W. ROTH, Bailey Control Systems
May 1977

Can the Vast Reservoir of Geothermal Energy be Harnessed for Practical Results?



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Proponent Learns Solar Cost

WASHINGTON (UPI) — One of the nation's top solar lobbyists says she decided not to buy a solar energy system for her home.

The reason: It's too expensive.

Pam Deuel, lobbyist for Environmental Action, said a solar water and space heater for her two-bedroom, one-story Cape Cod-style house in northwest Washington would have cost \$10,000 to \$12,000. A colleague from Environmental Action helped her with the inquiries.

The estimate was based on the high price of solar equipment, high plumbers' fees, and a change that would have been required in the angle of her home's roof.

High Cost

The first problem was finding a solar energy company. Three listed in the telephone book did not answer and one had gone out of business.

Then she inquired at two banks for a home

improvement loan. One examined the high cost and "looked skeptically because they thought I wanted to save energy but was wasting money," she said.

She said the monthly payment for solar heating system for water only would have been \$68 a month for four years, more than her current energy bills. The interest rate, she said, would have been the conventional 16 percent charged for home improvement loans.

She also noted that a backup system is needed for periods when the sun will not provide all the energy needed.

Hidden Subsidies

Ms. Deuel is lobbying for a solar bank that would provide low-cost government loans for installation of solar energy equipment.

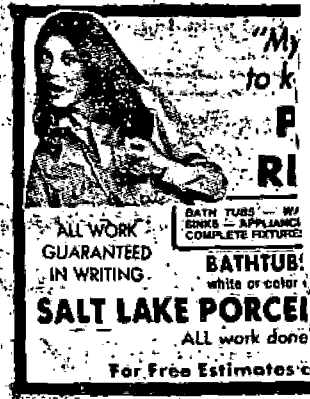
She said studies indicate the government, through hidden subsidies such as the oil company's oil depletion allowance, already spends \$15 billion

a year on nuclear, coal and other conventional energy sources.

Tax credits of up to \$3,000 are currently available for those purchasing solar systems.

She also hopes increased production will drop prices.

Remember how expensive pocket calculators were at first, she said. Then the market exploded, everybody bought one, and the price plummeted. Something similar could be happening to solar energy, she said.



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MONDAY, APRIL 16, 1979

in Kentucky had operating income of \$1.5 million for the third quarter.

GEOHERMAL ENERGY CORPORATION

Geothermal Energy Corporation (GEC) was founded to bridge the gap between exploration companies and energy users. The risk and return objectives of geothermal resources discoverers differ markedly from those of utility (be they investor-owned, municipal or cooperative) and other (mainly industrial) users of electrical energy.

Aside from California's The Geysers, domestic geothermal energy development has been extremely slow. Geothermal energy cannot be transported economically beyond 5-10 miles except by conversion to electricity. Utilities cannot afford to run the risk of running out of steam before the large amounts of capital required for plant construction can be recovered. However, the ability to predict reservoir longevity confidently on a sufficiently reliable basis in the early stages of reservoir development requires production history under commercial conditions. On the other hand, exploration companies are unwilling to commit the large sums necessary to develop geothermal reservoirs without a ready market for the output. The result is a gap, which GEC has the capability to help fill.

The goal of GEC is to initiate geothermal resource development by constructing the initial power plants on newly discovered or

previously undeveloped reservoirs. The construction and operation of small size (5-20 MW), as warranted, plants will establish production history under commercial conditions early on in reservoir development.

In addition to the creation of a production history, prototype units serve other purposes, for example, as a testing ground for current and developing technologies. The result of such testing will match the most appropriate and efficient power generation technology to the reservoir characteristics for the follow-on larger scale (55 MW and up) units.

The risks of reservoir development are greatest at the initial stage of development. The use of small-size plants and best-known current technology minimizes these risks by identifying, isolating and resolving early stage problems. As a result, GEC can reduce the time and cost to bring the reservoir into full production. Small-size units with their shorter construction schedules also have the beneficial financial effects of providing a more immediate return on capital to the resource owner and providing a cash flow contributing towards the later full-scale plant construction program.

Geothermal Energy Corporation has signed a Letter of Intent with several companies to construct geothermal power plants on their properties, covering some 500,000 acres of prime geothermal targets in nine Western states. These firms have joint

ventures with major partners in three of these states. GEC is also negotiating with other large holders of geothermal properties with a view toward the construction of power plants on their reservoirs.

In the initial stages GEC intends to make use of the Federal Geothermal Loan Guaranty Program, which is a Federal program best suited to minimize the reservoir risk inherent in geothermal resource development. GEC intends to provide or arrange the remaining financing required for both prototype and follow-on units.

Project design, engineering and construction services will be obtained on a contract basis. It is expected, for instance, that Morrison-Knudsen Company of Boise, Idaho, will be GEC's managing contractor for several of the projects currently planned. A number of environmental firms are presently being evaluated for their ability to provide highest quality compliance performance.

GEC is maintaining a continuous dialogue with a variety of other firms including equipment suppliers, engineering, etc. so as to remain fully informed as to available, alternative technologies and equipment. The ultimate goal - the successful development of geothermal energy on a commercial basis - will depend on obtaining the optimal match of technology, financial structure and sound management techniques with the particular characteristics of the geothermal reservoirs to be developed.

GEO THERMAL REPORT

NOV 16 1978

Vol. VII, No. 22 November 15, 1978

PRESIDENT SIGNS ENERGY BILL WITH GEOTHERMAL TAX INCENTIVES

Real victory for geothermal developers can be made out in tax benefits included in National Energy Act passed by Congress shortly before it adjourned and signed into law by President Carter last week. Some think tax breaks given geothermal still aren't enough and will press for more tax relief and equity in omnibus geothermal bill to be introduced early next yr.

STEPHENS' SUMMATION. Interagency Geothermal Coordinating Council will submit the omnibus legislation and Randall C. Stephens, head of its institutional barriers panel names, describes and sums up geothermal tax victory and ultimate goals this way: "Permanent elimination or minimization of regulatory and legal barriers, and temporary incentives to stimulate early demonstration of the many feasible applications of geothermal resources to a wide variety of uses."

Stephens feels tax breaks in Energy Act put "hydrothermal resources in great shape, but I don't believe there was enough for the user." He points out, for example, the residential tax credit for a homeowner installing geothermal hot water for heating of 30 per cent for first \$2000 and 20 per cent of next \$8,000, up to maximum of \$2,200, isn't available to utilities. "This holds back real geothermal expansion," he says. And Stephens also feels NEA didn't do much for hot water direct use demonstration technology.

But what NEA does is resolve the major problem hanging over and inhibiting geothermal exploration for yrs. by authorizing:

Deduction of intangible drilling costs for geothermal wells on same basis as for oil and gas wells;

FULL DEPLETION. Provides for full 22 per cent depletion allowance for geothermal, in effect, removing misconception that geothermal resources aren't depletable. Depletion allowance is granted without requirement for demonstrating depletability of resource. The 22 per cent rate sinks to 15 per cent by 1984, same schedule as oil and gas;

Geopressured methane gets depletion allowance of 10 per cent, for wells drilled after Sept. 30 and before Jan. 1, 1984, and thereafter newly drilled wells will be treated as normal gas wells. Wells producing both hot water and methane get 10 per cent depletion for methane and 15 - 22 per cent for income from hot water, and there's no limit on quantity of geothermal production on which depletion can be taken;

Special business investment tax credit of 10 per cent, over and above normal

investment credit, is granted to "alternative energy property" including geothermal equipment for geothermal electrical production up to transmission stage. Credit won't be allowed for public utility property defined as "property used in furnishing or sale of ... electrical energy ... water ... or steam ..." and must conform to equipment standards to be developed by DOE. Credit drops to 5 per cent if property is financed by tax-exempt industrial development bonds, and available for equipment whose construction is completed between Oct. 1, 1978 and Dec. 31, 1982. Also applied to geopressured natural gas producing equipment.

The Act also provides other incentives for converting from oil and gas to geothermal sources, via accelerated depreciation of oil and gas equipment scheduled for early retirement. Also certain exemptions from environmental limitations can be obtained by switching from imported oil to geothermal.

GEOPRESSURED DEREGULATION. Geopressured methane isn't subject to price regulation for one yr. from Nov. 9, 1978 enactment date of NEA. Higher costs of such methane is incremental rather than rolled-in, i.e. the higher costs must be borne by industrial customers rather than rolled-in and averaged over all consumers. Stephens believes rolled-in pricing would open up larger markets to geopressured methane, if Act were amended to allow it.

Finally NEA authorizes Federal Energy Commission (FERC) to order interconnection, sale exchange or other coordination and expansion of transmission capacity if a small power producer, cogenerator or electric utility requests it. To order such, FERC has to find it more efficient, or that it encourages conservation of energy or capital. Small power producers are defined as persons not engaged primarily in generation of electricity, who are producing power from renewable resources and from a site not more than 80 MW in capacity.

WHEELING TOO. FERC also can order wheeling to promote reliability and effectiveness of electric utility system. Though it's not clear whether geothermal is included under renewable sources, a geothermal facility producing power and using heat for heating or agricultural use or other applications qualifies as a cogeneration facility.

Tax legislation to be sought in omnibus bill, according to Stephens, may include accelerated depreciation on R&D write-offs for innovative industrial applications. Minimum tax on geothermal intangible drilling costs may be reassessed, and ineligibility of hot water distribution utilities for 10 per cent business tax credit may be changed.

Also proposed bill might include section to increase from 75 to 90 per cent Federal guaranty of geothermal loans for publicly owned utilities, due to inability of such small utilities to absorb risks. Steps may also be taken to increase Federally subsidized housing program and other govt. subsidy programs to participate in geothermal development.

For subsidized programs, for example, loan limits and other policy constraints may preclude use of geothermal energy, in their efforts to reduce initial costs, even at expense of long term savings. To correct situation, omnibus legislation might recommend exemption of geothermal equipment costs from Housing and Urban Development (HUD) and Farmers Home Administration (FHA) loan and loan guaranty programs.

Dept. of Commerce, FHA and HUD may also be given active roles in demonstrating space heating and industrial and agricultural applications.

Stephens told GEOTHERMAL REPORT, to get direct use applications moving and off the ground some type Federal corporation may be recommended for establishing district heating systems. Here, Stephens said, geothermal loan guaranty program may be modified to repay loan from revenues and/or forgive repayment in case of business failure, interest subsidies, additional tax incentives, etc.

Two meetings will be attended by Stephens to explain new tax legislation, omnibus recommendations and to ask geothermal industry and interested parties for their recommendations and comments, especially for coming omnibus proposals. First meeting will be DOE sponsored workshop for Denver/Keystone, CO Nov. 15-17 on initiatives for direct use aimed at packaging recommendations for omnibus bill.

Stephens will also speak at Nov. 28-30 conference of Geothermal Resources Council in San Diego, CA. There, Stephens will be especially looking to GRC members and conference attendees for input and omnibus suggestions and has scheduled a special session night of Nov. 29th to discuss further tax legislation.

IN INDUSTRY

GRC CONFERENCE AT HOLIDAY INN AT EMBARCADERO, SAN DIEGO IS POINTED TO FINANCIAL-INVESTMENT INSTITUTIONS ESPECIALLY.

Stars of geothermal firmament, led by Bob Greider, GRC prexy and now with Intercontinental Energy and formerly Chevron, who will deliver keynote talk on geothermal economics, will speak on galaxy of geothermal topics. Session subjects include nature of the resource, exploration, utilization, reservoir engineering, economics, latter in which Greider is acknowledged master, etc.

TOGETHERNESS WITH \$. To increase no. of financial investment co.'s now involved in geothermal development, conference will also stress large no. of exploration-development projects now in planning stages. And hopefully will bring resource developers, engineering firms, utilities, on one hand, together with financial institutions and sources of dollars to finance projects on the other.

With Greider delivering keynote address will be Suzanne Reed, geothermal member of CA State Energy Commission, speaking on state initiatives in support of geothermal, and Tsvi Meidav, private consultant, describing world developments in support of geothermal and top U.S. prospects, all underscoring hot water resources.

Other speakers and topics: R. J. Schultz, EG&G Idaho, non-electric applications; Paul Rodzianko, Geothermal Energy Corp., introduction to geothermal powerplant financing; Herb Rogers, Rogers Engineering, financing-construction of commercial geothermal plants; Richard Richards, Sierra Pacific Power, utility's evaluation of broad-based geothermal development; and ever so many others.

FIFTEEN PROPOSALS WERE SELECTED FOR SECOND ROUND OF DIRECT USE FIELD EXPERIMENTS by DOE's San Francisco operations office (GR, 1May'78,3), and all 15 site specific projects will be funded on cost sharing basis of about \$5 million in fiscal 1979. Budget requests will be made in FY-80 for about \$10 million additional to finance the direct use projects.

Winning co.'s, municipalities, colleges, etc. haven't signed final contracts yet, but were selected last mo. To serve one of DOE's primary geothermal objectives, the 15 projects were chosen to demonstrate broadest possible types of

geothermal energy

During 1978, exploration for geothermal energy continued at the same moderately low level of the last few years. Most countries are making determined efforts to develop geothermal energy, wherever feasible, to supplant hydrocarbon fuels. Countries without any other energy resources are the most eager to develop geothermal systems, but exploration is also taking place in countries that have abundant fossil fuels. Exploration is being funded internally within many countries; in addition, the United States, New Zealand, and the United Nations are financing geothermal-energy projects in several countries. The development of proved resource areas largely depends on loans from the World Bank or from foreign aid. All this international funding has been at a low level during the last few years.

The U.S. is the only country where the development of geothermal resources depends on private industry. All other countries have some form of nationalized development of geothermal energy. The U.S. oil and mining industries have assumed the dominant role in geothermal exploration. These companies have a primary interest in developing the high-temperature (greater than 200° C), high-quality geothermal systems suitable for generating electricity. Even the high-temperature resources are only marginally economic, and the industry



Steam rises from Minerva Springs, part of Mammoth Hot Springs at Yellowstone National Park. (Photo by U.S. Geological Survey)

has been waiting for incentives to make exploration economically attractive. The enactment in October 1978 of a 22% depletion allowance and a deduction for intangible drilling costs should stimulate the industry to increase exploration. (In spite of the slow pace in 1978, Phillips Petroleum discovered what may be a significant geothermal resource at Humboldt House, near Imlay, in northern Nevada. This fault-controlled hydrothermal system contains water above 200° C at depths below 1,200 m.) Another concern of the geothermal industry is availability of land for exploration.

During 1978, the Division of Geothermal Energy of the U.S. Department of Energy initiated a significant new program of sharing the cost of deep exploratory wells. The government bore as much as 50% of the cost of several exploratory wells along the eastern margin of the Basin & Range in Utah. In 1979, this program will partly finance 10 or more deep exploratory wells in the high-heat-flow area of northern Nevada. Low-temperature geothermal resources (less than 100° C) suitable for space heating and some industrial processes, held little economic interest for private-industry exploration.

The Division of Geothermal Energy is operating a major exploration program for low-temperature resources along the densely populated East Coast. About 40 temperature-gradient holes, each about 300 m deep, were drilled along the Eastern Coastal Plain from New Jersey to North Carolina. The targets in this program are warm aquifers at depths between 1.5 and 2 km, thought to overlie Jurassic granitic plutons having above-normal radiogenic heating. Last year, the Department of Energy also selected Union Oil's geothermal prospect in the Valles Caldera of New Mexico as the site for a demonstration plant generating 50 megawatts. In the next 3 years, the government will provide as much as half the cost of this \$100-million plant.

The U.S. Geological Survey has completed the second *Assessment of geothermal resources of the United States*, which should be available early this year as a Survey Circular. This latest assessment will include new sections on the reliability of the estimates and on the distribution of low-temperature resources. The Geological Survey and cooperating agencies recently completed the field work on a regional geothermal assessment of the Snake River Plain in Idaho. In 1979, researchers from the Survey, state geological agencies, and several universities will begin a regional geothermal assessment of the Cascade Range of California, Oregon,

and Washington. Many of the western states are receiving federal support for exploration studies of potential low-temperature geothermal resources.

The most promising geothermal sites outside the U.S. are along Quaternary volcanic belts. Along the American Cordillera, Mexico, Costa Rica, Nicaragua, El Salvador, and Chile have active geothermal programs. Costa Rica is in the early stages of exploration, but the other countries are well along in development and in 1981 will have a combined geothermal electrical generating capacity of 260 megawatts. The western Pacific margin has exploration activity in the Soviet Union, Taiwan, Japan, the Philippines, Indonesia, and New Zealand. The combined electrical capacity in 1981 in this region is expected to be 985 megawatts. Iceland and the Azores are areas of geothermal development on the Mid-Atlantic Rift. By 1981, Iceland should have 60 megawatts of electrical generation and geothermal space heating for all cities having more than 1,000 people. Along the northern Mediterranean belt, Italy, Greece, and Turkey are seeking geothermal energy. Italy and Turkey should reach a total electrical capacity of 495 megawatts during 1981. In the African Rift zone, Ethiopia, Djibouti, and Kenya are exploring for geothermal energy. Kenya may have a generating capacity of 30 megawatts during 1981. In the Tibetan Plateau, the Peoples Republic of China has an active exploration program and a geothermal power plant generating 1 megawatt.

In Central Europe, much less potential for high-temperature geothermal resources exists, and the exploration and development efforts are concentrating on low-temperature resources for space heating, agriculture, and aquaculture. France, Germany, Switzerland, Hungary, Bulgaria, and Romania are in various stages of geothermal development. The combined direct geothermal energy used in these countries could reach 5,000 megawatts in 1981. Several other countries are just beginning to assess their geothermal potential. Some of these are India, Jordan, Egypt, Thailand, Madagascar, and Fiji.

Geothermal development projects now under way will double the present worldwide electrical generating capacity to a total of 3,100 megawatts in 1981. If exploration activities increase in 1979 as expected, we should see a corresponding increase in the electrical generating capacity in 1985 and beyond.

Marshall J. Reed
U.S. Geological Survey
Reston, Va., 22092



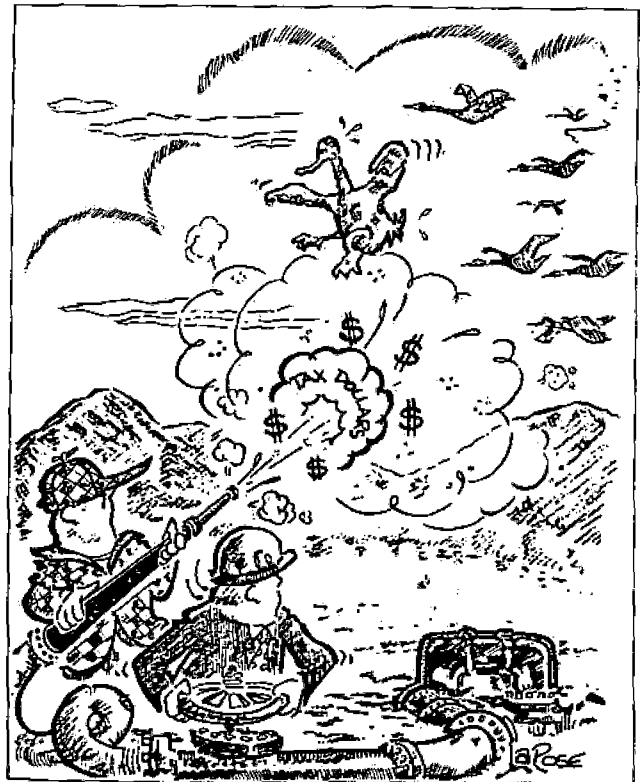
THE

TM VOLUME 5 ISSUE 10 DECEMBER 31, 1978

THE GEYSER

FIRST ANNUAL GEOTHERMAL COOKED (STEAMED) GOOSE AWARD GOES TO LAWRENCE LIVERMORE LABS

Senator William Proxmire, (D-Wisc.) has gained considerable notoriety over the past several years by presenting a monthly "Golden Fleece" award to the government agency or contractor who in Proxmire's opinion spends the public dollar the most foolishly. Following the example of the public-spirited Wisconsin Senator, The Geyser awards the University of California's Lawrence Livermore Laboratory the First Annual Geothermal Cooked Goose Award for its pioneering efforts in migratory waterfowl contaminated innard examination. According to an LLL news release, "A California Biologist's research is for the birds -- specifically for ducks and geese which might be harmed by geothermal energy development in California's Imperial Valley." We are inclined to agree. The biologist in charge of the LLL study, John Koranda, has taken on the monumental task of "Monitoring the health of more than 100,000 waterfowl that spend each winter basking in the sunny Imperial Valley near the Mexican Border." Koranda's work is part of an on-going DOE-funded study to determine, "possible environmental, health, and socioeconomic effects of planned geothermal power development in the [Imperial] Valley." That's a lofty research goal, and we don't dispute the usefulness of the overall project. What we question are some of the assumptions which underline the duck and goose research and some of the elaborate research methods involved in the project which is supported by U.S. taxpayers. For instance, the LLL news release says, "Trace element contamination from the [geothermal] brines, which contain salts and dissolved minerals, is a



"PREPARING DOE'S 'LLL-BRAND' PATÉ"

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INTERNATIONAL GEOTHERMAL
ENERGY NEWSLETTER

possible adverse effect of geothermal development." [Emphasis added.] While it's true that such contamination could be a problem, existing federal and California statutes and regulations limit the discharge of trace element contaminants into the environment. If the law prevents the entry of such substances into the ecosystems of the Imperial Valley, how will they get into the ducks? Furthermore, current designs for hot water geothermal projects call for the reinjection of most of the geothermal fluid into the formation with no discharge on the surface. The process used to check for the contaminants was elaborate and expensive. The LLL biologists in charge of the contract made a deal with Imperial Valley duck hunters to clean their killed birds for free. The hitch was the biologists got to keep the innards. To make sure the duck guts weren't contaminated by the cleaning knife, the LLL team invented a non-contaminating ruby crystal blade. Each duck gut was flash-frozen in the field on dry-ice and shipped to LLL where it was freeze-dried. The samples were "ground in a plastic container with plastic bearings, again to avoid metal contamination, and then compressed under eight tons into a dense pellet the size of a nickel." Each duck gut was logged into a special species chart, assigning each bird a number/type. A typical line reads: VKD067B/WNWR/751102/BIRD/DUCK/PINTAIL/BRAIN. After all the samples were logged into the computer and the guts pulverized, chemical and spectral analyses were performed. The results of all this effort: the birds were found to be highly contaminated with lead, arsenic, and other poisons. The source of these contaminants? Unknown. The birds were migratory. Snow birds on their way south, Canadian quakers on their way to Quito for the winter. What the brain of a pintail can determine about the environmental impacts of geothermal development in the Imperial Valley is beyond us. But, as sure as you pay taxes, some bureaucratic bird-brain let this contract. We think federal R&D dollars would be better spent on resource assessment and demonstration.

-- By J.R. Twiel, Washington D.C.

DOE'S GEOTHERMAL EFFORTS IN SHAMBLES

The Department of Energy's Division of Geothermal Energy (DOE) has been reorganized for the third time in less than 18 months. According to certain DOE officials, this third reorganization has left the Division in confusion and disarray. When the Geothermal Division was created back in 1975 as part of the Energy Research and Development Administration (ERDA), it focused primarily on technical issues relating to drilling and resource identification. In 1977 the Division was "informally" restructured into five regional "teams" -- each of which focused on a specific geographic region of the country. On paper, DGE had been transformed from a "technical branch" organization to a "matrix" organization. This "unofficial" matrix structure lasted for about six months. Then, in early 1978, the Division was changed again. Actual regional teams were set up and were staffed as if they were the sole structure. In November 1978, as part of the Department's overall "Commercialization Program," DGE was again reorganized. When implemented, this "commercialization" reorganization will create two totally separate geothermal organizations within DOE. In addition to DGE, there will be another geothermal shop headed by a "Resource Manager for Geothermal Energy." Rudy Black, formerly DGE Director, will

become the new "Resource Manager." He will be one of fourteen such managers in DOE. However, since geothermal is not one of DOE's "top priorities" as outlined at recent public meetings, Black will take with him only a skeletal staff of seven people (down from his request of fifteen). Black will have two assistant directors, one for marketing and one for planning, and a few people to work for each. Black's team will transfer from the Energy Technology branch of DOE to the Resource Applications branch. The Division of Geothermal Energy, less these eight people, will be headed by Bennie Dibonna, currently the head of the Eastern and Gulf States Regional Team. Dibonna will have two deputies, one for "resource assessment" and one for "hard technology." Each deputy will use several two-person teams to implement their programs. The Division of Geothermal Energy will remain under the Energy Technology branch. The new Resource Manager will be responsible for the development of all of the Nation's hot water geothermal resources. DGE loses that function but retains jurisdiction over hardware, resource assessment and the geopressured and hot dry rock geothermal programs. The reorganization will not be accompanied by an increased budget, according to DOE officials. Both the Resource Manager and the new DGE will share the old DGE budget. Proportionately, some thirty projects representing nearly \$8 million will be directed by the Resource Manager. (According to internal DOE projections, the total funding for all the Department's geothermal activities is slated to significantly decrease over the next three-year budget cycle.) The reason behind the split of DGE into two separate entities is based on Dep. Asst. Undersecretary Jackson Garoud's theories on "Commercialization," recently adopted by the Department as an operational philosophy. For example, Rudy Black, as "Resource Manager for Geothermal," is supposed to provide the focal point for industry in seeking DOE assistance. He is, however, being given minimal staff, little line responsibility, and a miniscule budget. Black's resource "task" is presently engaged in developing a plan of action. However, observers say they appear to have little knowledge about how the commercial and industrial members of the geothermal community operate, and little desire to learn. The members of the Federal Advisory Committee on Geothermal Energy (which now serves Black) were apparently not consulted about any of the changes in the geothermal structure or about the new program definitions of the Resource Manager or DGE. Some related events raise additional concerns. The Geothermal Loan Guaranty Program will supposedly be assimilated by Resource Manager Black, even though its budget far exceeds his. The Valles Caldera Hot Water Demonstration Plant may be taken over by a special DOE Office of Funded Projects, if this office survives the inevitable interneccine warfare associated with Resource Managers having to give up expensive projects important to staffing, funding, and prestige levels. In addition to these problems, there appear to be at least three major programmatic victims of the recent reorganization: the "Policy Program," the "Regional Program," and the "Environmental Program." The Division of Geothermal Energy will have few policy responsibilities except perhaps for the geopressured resources of the Gulf Coast. The Resource Manager's group will not have any explicit programs either, except as an implication of planning. The Environmental Program for DGE's technical work will be handled by a centralized office within the Energy Technology branch. According to DOE officials the Division will have only one, part-time nonspecialist advisor on environmental matters, while the Resource Manager may have no environmental coordinator. The "regional geothermal team" structure was yet another victim of the November reorganization. Several observers

feel that losing the regional teams may be a significant blow to the federal goal of promoting the timely development of geothermal energy, since several states had already begun to enter into successful cooperative planning exercises with the teams. These efforts had the potential of consolidating and streamlining federal and state geothermal decision-making. Commercial and industrial interests also felt that the regional team concept was beginning to give them a direct shot at influencing both federal and state programs. Black, the new Resource Manager, suggests that his group will interface with each state and county individually. However, observers say that Black's seven people are likely to be overburdened and thus unable to provide the same level of interaction at the local level which was starting to be achieved by the regional teams. This latest re-organization is not yet official. At press time the appointment of Rudy Black as Resource Manager was not even official. What has complicated the situation is the recent forced resignation of Robert Thorne as the Assistant Secretary for Energy Technology. This firing had the immediate effect of slowing down the approval chain for all of the personnel and financial transactions which are associated with the split of the old DOE into two separate entities. Everyone and everything is on an "acting" basis and final results are probably not going to be available for some months -- at least until a new Assistant Secretary for Energy Technology has been confirmed by Congress. John Deutsch, of the Energy Research Office, seems a likely candidate. It is also likely that Eric Willis will continue as Deputy Assistant Secretary for Energy Technology in the interim.

-- By Reginald Thurgood for
"The Geysler"

NATOMAS GEOTHERMAL

Third quarter earnings for Natomas' 98%-owned subsidiary, Thermal Power Company, improved over the second quarter, despite mechanical problems with pollution control and other equipment which held plant utilization at The Geysers Unit No. 12, 110,000-kilowatt plant below expected performance levels.

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GEO THERMAL REPORT

JAN 2 1979

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FEDERAL GEO THERMAL PROGRAM GREET'S NEW YR. -- SPREAD THINNER

In past yr. DOE geothermal program lost two directors and one Asst. Sect'y. but not before commercialization cleft old geothermal div. in twain. As 1979 begins, with Asst. Sect'y. for Energy Technology Robert D. Thorne gone (GR, 15Dec'78, 1) and persistent rumor that Asst. Sect'y. for Resource Applications George McIssac will soon resign, two from whom commercial reorganization gained great support, wonder is will halving of old geothermal div. stick?

BLACK'S NEW STAFF. Splitting-off of a separate 9-man hydrothermal staff under former geothermal div. chief Rudolph A. Black, now new geothermal resource mgr. working for McIssac (GR, 1Dec'78, 1), may be subject to more musical chair games, depending on who winds up in Thorne's seat and McIssac's if he really does resign. Though commercialization programs were moved at Asst. Sect'y.'s level, DOE headman James R. Schlesinger and Under Sect'y. Dale D. Meyers supported it.

Whether or no change of brass deadens and blunts split-off of hydrothermal geothermal resources from old div., Congressional watchdogs on House Science and Senate Energy Committees are concerned. And rightly so, they point out when a program is spread over two Asst. Sect'y.'s, consequently different Congressional authorization subcommittees and divested of single management, it usually spells disaster for that program. Proof of the pudding usually comes in following yr. budgetary nosedive.

BUDGET STEADY. Strangely, geothermal requests in coming fiscal 180 budget to be sent to Congress by Carter Administration Jan. 22nd are said to remain steady at this yr.'s \$150 million appropriations level. Big gainers will again be geopressured, shooting from \$17.6 million to better than \$30 million. Hot dry rocks development effort centered at Los Alamos National Lab will also be increased from its \$15 million level.

Hydrothermal technology applications, reflecting transition to commercialization phase, will be cut heavily from its \$30 million level, by roughly 30 percent. Reduced budget probably means no more non-electric PON's and no more cascade plants such as now under way at Roosevelt Hot Springs, Utah and Battle Mountain High and northern Basin and Range Province in northern NV (GR, 15 July 78, 3-4 Mar 4) and the beneficial spread of knowledge information carried out by DOE contractors.

EAST COAST QUESTION. East Coast drilling program to climax in sinking best geothermal production site from Florida to New Jersey to a 7000-ft. depth sometime this yr. (GR, 1 June '78, 4) would also be affected by lack of direct use funds. No money would mean no planning for next step after 7000-ft. well is drilled by Gruy Federal of Houston.

NO DEMO. No more Federal support for non-electric and industry-coupled case study hydrothermal works, a second 50 MW binary process demonstration plant seems out of the question. First 50 MW flash steam plant went to team of Union Oil of CA and Public Service of N.M. at Valles Caldera, N.M. site at an expected cost of \$100 million, to be split by DOE (GR,1Aug'78,1). Despite hard lobbying for 2nd demo from Congress and industry advisory geothermal committee to DOE -- rather blatantly espoused by those members standing to gain most of the Federal millions were binary demo built (GR,15Sept'78,2) -- there are technical problems to be resolved first. A Soviet binary plant built at Puratunka was forced down by excessive freon leaks (GR,15Dec'78,3). Geothermal div. technicians feel it would be wise to get operating time with 5 MW binary loop on low grade resources at Raft River, ID before proceeding further with larger plants.

Again, DOE thinking at the top seems opposed to further demo construction, especially now that tax benefits in National Energy Act have been conferred on geothermal industry (GR,15Nov'78,1), and more on tap in this yr.'s Omnibus bill (GR,15Sept'78,2). Many industry leaders in asking for tax benefits said just give us the equal tax treatment and we won't need the big Federal R&D outlays. In turn, DOE top levels now seem to be saying, "Okay, you have equal tax treatment and incentives. Let's see some hydrothermal plant construction."

FEEDBACK FROM GEOTHERMAL RESOURCES COUNCIL'S WELL-ATTENDED SAN DIEGO CONFERENCE is it accomplished just what it set out to, namely, attract and interest financial community to money-making potential of geothermal resources. Technical sessions were pitched to level of newcomers' understanding, and business mgrs. were warming to direct use and electrical generation projects before end of 4-day meeting.

GOOD IDEAS. There was something for confirmed geothermal developers too: good ideas on joint venturing, leverage leasing and additional tax incentives to those included in this yr.'s National Energy Act in context of geothermal omnibus bill to be introduced next yr. by Interagency Geothermal Coordinating Council (GR,15Nov'78,1). Several parties were identified at conference as being interested in going ahead with commercial geothermal works and projects, possibly via Federal loan guaranty program.

Loan program also came in for its share of glory, being singled out several times as that without which nothing much would be happening in national commercialization efforts. Vito Magliano, taking over for Mark Silverman as San Francisco operations office loan mgr., introduced loan assistance program to conferees and described progress under two yr. loan program (GR,15Mar'76,1). Three loans have been approved, one application is all but processed and two other applications have been received.

Mapco's \$29 million loan request would build a four well steam supply system for a 50 MW geothermal powerplant at Westmorland in Imperial Valley, CA. Four wells for the system have already been drilled by Republic Geothermal at Westmorland.

Approved loans since 1976

<u>Borrower</u>	<u>Location/Project</u>	<u>Amount (million)</u>
Republic Geothermal	East Mesa/Resource development	\$9
Geothermal Food Processors	Brady Hot Springs/Food drying	2.8

<u>Borrower</u>	<u>Location/Project</u>	<u>Amount (million)</u>
CU-1	Brawley/Resource development	\$1.8
<u>Application pending:</u>		
Mapco	Westmorland/Resource development	29.0
O'Brien Resources	Roosevelt Hot Springs/Resource devel.	12.0
Northern CA Power Agencies	The Geysers/Powerplant	41.0

Conferees learned DOE loan program mgrs. have now run the course and have gained experience from the process. If enough data is furnished in loan application, it should now be processed in 4-6 mos. Prediction is that NCPA application submitted Sept. 1st should be able to be signed by Deputy DOE Sect'y. John O'Leary in January.

DOE attendees at San Diego led by geothermal resource mgr. R. A. Black, including Burt Barnes and Randall Stephens and Larry Falick, are now planning follow-ups with new blood and co.'s at conference to stimulate commercialization by providing them with more info on loan guarantees, joint ventures, govt. leading programs, etc.

INTERNATIONAL NEWS

JAPAN METALS & CHEMICAL AND TOHOKU ELECTRIC'S KAKKONDA 50 MW GEOTHERMAL PLANT HAS been running successfully since start-up last May. About 10 kilometers south of Matsukawa on the northern part of Honshu, mainland of Japan, Kakkonda is the successor to 22 MW Matsukawa geothermal plant also built by Japan M&C and running for past 12 yrs. (GR, 15Aug'77, 3).

Kakkonda's hydrothermal field has been studied in detail during last several yrs. by geological, geophysical (seismic, electric), and geochemical surveys and test drillings. Eleven producing wells and 13 reinjection wells of 1000 - 1600 meter depths were drilled before plant start-up.

INCLINED DRILLING. To economize on ground surface area, according to Prof. Masami Hayakawa of Tokai Univ. geophysics dept., inclined drilling methods were adopted for both production and reinjection wells. All wells are concentrated around power plant site on mountainous terrain, in a narrow area, within 5 to 10 meters of one another. "The results have been quite successful," says Hayakawa. "To make the underground structure clear, at a glance, a nice three dimensional model was designed and prepared," Hayakawa said.

BINARY PLANTS. "Two binary cycle power generating systems using freon and isobutane (in different places) have been under testing, and operating smoothly as one of the Sunshine projects. Each plant is of 1 MW capacity," he said. Sunshine is a long term microseismic observation program conducted by Ministry of International Trade and Industry.

Hayakawa also summed up 9th International Group Training Course on Geothermal Energy held at Kyushu Univ. from Sept. 12 to Nov. 16, 1978. Course was sponsored

by UNESCO, Kyushu Univ. and Japanese Govt., as outgrowth of first such course conducted by UNESCO in Paris in 1968. "The no. of participants are 12 including the geologists, geophysicists and engineers from Bolivia, Chile, Egypt, Indonesia, Iran, Nicaragua, Philippines, Thailand and Turkey. Although the period is short, the contents are substantial, including not only lectures, but also laboratory experiments and field surveys," said Hayakawa.

"Apart from these projects, I might say in Japan we are eager to develop and utilize the deeper geothermal energy such as at depths of four to five kilometers in the next several yrs., via U.S.-Japan geothermal research cooperation."

IN INDUSTRY

DOE'S FLEXIBLE, LOW COST AND TRANSPORTABLE GEOTHERMAL PUMP TEST FACILITY IS LINED-UP with a solid schedule of industry testing from now through end of 1979. Industry is broadly interested in test facility, which can be jacked up and let back down on a flat bed truck, because of substantial savings in dollars and time it makes possible. Mfrs. can test and calibrate their pumps without having to install them in actual geothermal wells since Barber Nichols Engineering fabricated test facility for about \$100,000 for DOE geothermal div.

NO WELL DAMAGE. Facility consisting of test rig and data acquisition system trailer allows for testing heated-simulated geothermal water or moving about from well to well. But with test rig it's not necessary to pull pump from well and re-install it after modifications or repairs, thereby avoiding risks of damaging well by losing a pump or destroying well's productivity.

Ingenious Barber-Nichols design on universal basis allows all potential geothermal pump mfrs. to test-develop their product line. Test loop can accept submersible or vertical shaft driven deep well pumps for use in 13.375-in. or smaller casings. Submersibles and vertical shaft/bowl assemblies up to 11 ft. long can be tested in loop and addition of spools to loop allows assemblies on up to 35 ft. long to be installed in loop. Other test maximum parameters: fluid specific gravity range, .6 to 1.1; pump flow rate, 1000 gpm; fluid temperature, 500 F; inlet pressure, 500 psi; outlet pressure; 1200 psi; pump horsepower, 750 HP; etc.

MCFARLAND BRAINCHILD. GPTF is one of Cliff McFarland's brainstorms, since, "increasing well productivity, by better downhole pumps, among other things, is a major goal." McFarland, now heading geothermal div. hydrothermal development, says to come up with reliable and economic downhole pump for geothermal industry is a "very important item with tremendous pay-off." GPTF is now being used by Reda pump subsidiary of TRW at Bartlesville, OK. A small electrical submersible 70 HP pump is being tested, but not at temperature, as precursor for full scale 550 HP model.

Next on GPTF schedule beginning next April or May, Worthington wants to test reliability of its hydraulic downhole pump.

Then in Fall of 1979 it will be used by Sperry Vickers in development of organic downhole vapor pump sized at 250 HP and good for temperatures up to 350 F.

To our readers, than which none are greater, nor more loyal,
best of all HAPPY NEW YEARS!

GEO THERMAL REPORT

FEB 1 1979

Vol. VIII, No. 3 February 1, 1979

AUSTERITY, INFLATION WHITTLE GEOTHERMAL BUDGET

Jimmy Carter's austerity rhetoric hit harder at Dept. of Energy's fiscal 1980 budget authority (appropriations) request of \$8.4 billion, down from \$11.4 billion in current FY-79, than it does in actual spendings, which are projected at level lines. Outlays in FY-80 are expected to be \$10.2 billion, compared to \$10.4 billion this yr.

PETROLEUM STRETCH-OUT. Major cutbacks are for strategic petroleum reserve, which now calls for storage of 750 million bbls. of crude oil in 1985-6 time period, instead of original 1 billion bbl. by 1985. Storage work has been plagued by accidental fire in La. salt mines and slowdown in storage sites. FY-80 outlay is \$2 billion, compared to \$2.4 billion this yr. Other reductions hit nuclear fission development, coal, oil and natural gas, plus demonstration of energy systems.

Solar energy was only DOE program to receive large overall increase, up by about 25 per cent, to \$515 million. Govt.-wide, solar spurred to \$804 million, including solar tax credits. Inflation was the watchword, and steps to reduce it were given top priority in both budget and economic report submitted by Carter last week.

~~HYDROTHERMAL DROPS.~~ DOE geothermal appropriation request of \$140.9 million was down by about \$17 million from current yr. level, and at a glance big loser was hydrothermal resources, supposed to spring-board into commercial contexts this yr. anyway, while Feds sit back and watch industry move the ball. "Increased private investment in the near-term development of hydrothermal resources can be expected, capitalizing on the significant progress already achieved through earlier Federal investments," budget document said.

Drop in hydrothermal programs is more real than apparent, however, when \$21 million for demonstration plant at Valles Caldera is stripped out. Other facilities expenditures and a ~~\$9 million item to carry Rudy A. Black's new commercialization group~~ (GR, 1Dec '78, 1) are also included in hydrothermal's \$59.1 million, meaning basic geothermal program is significantly reduced.

Backbone of basic development program, namely what remains of hydrothermal and after hot dry rocks (\$15 million) are deducted from technology development, is left at about \$45 million in FY-80, compared to better than \$70 million in FY-79. Resources definition loses most ground in basic technological effort which also includes PON's for non-electric, drilling-stimulation, energy conversion research, scaling-corrosion programs and geosciences.

Hot dry rock development centered at Los Alamos National Lab will continue at

\$15 million per yr. A major objective, DOE said, is to reduce cost of geothermal wells by 25 per cent in 1982, and 50 per cent by 1986.

MCINTYRE ON DEMOS. OMB director James McIntyre said at main budget briefing a few days ago the administration no longer favors expensive demonstration plants and, to nobody's surprise, a second geothermal demo wasn't among the budget requests. Apparently, for binary intermediate temperature demo, DOE is willing to run with Raft River 5 MW thermal loop. Industry spokesmen are on the record as being unwilling to jump from small Raft River facility to commercial size binary plant or commit utility funds for so great a leap-frog, from 5 to 50 MW (GR,15Oct'78,3). Issue of 2nd demo plant can also be expected to provoke Congressional questions, especially since FY-79 appropriations included \$4 million for second demo, and total of \$11.5 million to get both demos started.

FY-80 budget includes \$6 million to support geothermal resources development fund to tune of guaranteeing additional \$50 million in loans, upping total loan guarantee authority under DOE program to \$350 million.

BUREC CONTINUING. Interior Dept.'s Bureau of Reclamation still is waging pretty stout geothermal campaign, despite announcements last Summer that it was giving up as far as desalting geothermal brines at East Mesa, Imperial Valley, CA for new, economic augmentation of Colorado River flows (GR,15Aug'78,1). Though it announced then it would study geothermal sites elsewhere, BuRec's total \$758 million budget in FY-80, up \$170 million over FY-79, includes \$91,000 to wrap-up geothermal hydrothermal resource investigation at E. Mesa and continue where it left off. Primary emphasis will remain on determining whether geothermal hot water reservoirs can be desalted as fresh water augmentation for the Colorado.

Along with desalting geothermal brines, studies will also be made to develop technology for concurrent electric power production from geothermal brines. A separate energy R&D program is being funded at \$175,000, with first studies to look at binary fluid and total flow systems which appear more fruitful for BuRec's dual water-power applications. A final report on E. Mesa operations and analysis of data will be prepared under energy R&D line item, which has a total of \$677,000 for the coming fiscal yr. Areas to be studied in addition to geothermal, include conventional and pumped storage hydropower, solar and wind power generation, low-head hydropower and non-conventional energy sources such as hydrogen.

BuRec outlays also include a \$325,000 request to carry on Susanville, CA geothermal investigations (see composite budget table, p. 3).

Interior's Bureau of Land Management, which manages geothermal leasing program for all public lands, will continue spending about \$2.5 million on leasing program.

SURVEY CUT. U.S. Geological Survey's base program of resources assessment, on which DOE development-commercialization programs so depend, was cut \$2 million, to \$10 million. Rationale for resource assessment decrease, after Survey requested a program at FY-79 \$12 million level, was general belt-tightening in line with DOE reduction in hydrothermal resources. Reduction in Survey resources assessment was vaguely reminiscent of meat-axing suffered three yrs. ago when its resources investigations were almost obliterated, down to \$3 million. That time protests by Interior and ERDA officials resulted in program restoration (GR,1Feb'76,2). Survey's extracurricular geothermal research program carried on with outside groups by contract and grant continues at roughly \$1 million.

COMPOSITE FEDERAL GEOTHERMAL BUDGET
(In thousands)

	FY 1979 Budget Authority	FY 1980 Appropriation Request
<u>DCE</u>		
1. Hydrothermal Resources	\$ 70,900	\$ 59,100
2. Geopressured Resources	27,700	36,000
3. Geothermal Technology Develop.	57,600	43,900
4. Program Direction	<u>1,800</u>	<u>1,900</u>
Subtotal	158,000	140,900
 Plant & Capital Equipment	 2,600	 1,600
 Loan Program	 --	 6,288
<u>Bureau of Land Management</u>		
1. Geothermal leasing program	2,500	2,500
<u>U.S. Geological Survey</u>		
1. Geothermal Investigations & Resource Assessment	12,000	10,000
2. Extracurricular Research	1,000	1,000
<u>Bureau of Mines</u>		
1. Corrosion-Resistant Materials for Geothermal Plants	150	150 (est.)
2. Geobrines Minerals Recovery	600	600 (est.)
<u>Bureau of Reclamation</u>		
1. Desalting Geothermal Brines	1,252	910
2. Geothermal Energy R&D	200	175
3. Susanville, CA Geothermal Investigations	435	325
<u>Agriculture Dept.</u>		
1. Forest Service Leasing Program	775	750

JOHN DEUTCH, ACTING DOE ASST. SECT'Y. FOR GEOTHERMAL, MUSHED THROUGH HIS FIRST INTER-agency Geothermal Coordinating Council meeting as chairman (whether "acting" or for real, nobody seemed to know), and geothermal industry may be better for it.

Deutch heard BLM's Winston B. Short sum-up geothermal streamlining task force recommendations, quickly answered questions of other Council members, got their acceptance and then asked that letters be prepared for his signature to appropriate agencies instructing immediate acceptance and putting into effect of recommendations.

Streamling recommendations are in response to President Carter's request last yr. for Interior and Agriculture Dept.'s to speed up their leasing and environmental reviews and eliminate unnecessary red tape to geothermal development. Task force headed by Short, and with DOE geothermal div.'s Burton B. Barnes and Randall C. Stephens providing most push, launched series of workshops and public meetings in the West and Washington, D. C. last Spring and Summer. From these came discussions and proposals resulting in recommendations, most relating to leasing/permitting programs (GR,15July'78,1).

Specifically, task force recommendations accepted by Council number 18 in all, and ranged from establishing permanent group to review DOE, Interior and Agriculture regulations -- point being always to speed geothermal matters and toss out unnecessary paper, to revising lease forms (combining application and lease forms) and to requiring 30-day time limitation on postlease response to permit application, so as to give developer/operators better fix on what to expect after filing plan of operations for deep test wells, etc.

After Stephens went through many proposal for this yr.'s planned Omnibus Bill of geothermal legislation, Deutch asked for more time to consider them.

MEANWHILE, HEARINGS ON PROPOSED NEW LOAN GUARANTY REGULATIONS ARE SET FOR SAN FRANCISCO and Dallas on Feb. 13 and Feb. 21 respectively, but nobody has asked to speak at either hearing. Eyecatchers among new regs is doubling of loan ceiling for a single project, increased from \$25 to \$50 million, and quadrupling of present \$50 million ceiling, to \$200 million, on any combination of loans by a single borrower. The liberalized regulations make loan program "more appealing to lenders and borrowers," in DOE loan program mgr. Larry Falick's view. Hearings may be scrubbed if nobody shows up, in which case written comments may be received until Mar. 6th before proposed rulemaking takes effect.

SITE NEAR CRISFIELD, MD WAS SELECTED FOR EAST COAST DEEP GEOTHERMAL WELL, to 5000 ft., after relatively shallow 1000 ft. wells were drilled this past Summer to pinpoint optimum deep site. DOE contractor, Gruy Federal, will start drilling in March and expects to complete it in mid-April for a cost of \$750,000. Estimated bottom hole temperature is predicted at 185 F.

Other favorable future sites for residential and industrial heating applications, perhaps, are at Roanoke, VA; Salisbury and Ocean City, MD and Dover, DE.

AND BRINKERHOFF SIGNAL DRILLING OF DENVER GOT A SIMILAR, \$3 MILLION JOB TO DRILL 7500-ft. deep well through volcanic and into basement rocks to tap geothermal heat of Snake River Plain. DOE believes about 21,500 sq. mi. lower half of Idaho may have substantial geothermal payoff, the geological tip-off being region's past volcanic activity.

Brinkerhoff will drill well at DOE Idaho National Engineering Lab, some 50 mi. west of Idaho Falls. The basement rocks hold geothermal fluids believed to have temperatures of 250-300 F, plenty ripe for space and industrial heating. Immediate plans call for using geothermal heat at Idaho Chemical Processing Plant to replace partially an existing oil-fired system. Western part of Snake Plain has long been used for geothermal space heating, but eastern portion's potential is less known.

A hardware bonanza for Defense

The 3% defense spending increase President Carter insisted upon in his fiscal 1980 budget—despite protests from liberals—now looks a lot bigger than expected. Although total Pentagon outlays are budgeted for a rise of \$11 billion, to \$123 billion, defense spending may grow even higher. And that could pose a nasty political problem for the Administration.

Once Congress gets a look at Carter's budget proposals—they are scheduled to go to Capitol Hill on Jan. 22 with spending set at \$532 billion and the deficit at \$29 billion (page 72)—the battle will begin. Liberals will soon discover that within the total defense budget, spending for weapons systems will grow twice as fast as total outlays, to 6% or more.

There are two reasons for the unexpected spurt in hardware spending, neither of which will satisfy Carter's liberal critics. One is that the Pentagon

The Pentagon has started dipping into \$75 billion in leftover appropriations

has finally begun to dip into \$75 billion in appropriations left over from previous years. The threat that this backlog would result in a sudden uncontrollable spurt of defense spending has been worrying the Administration for the past two years. "I certainly hope this isn't the year Defense learns how to spend all the money it has," says one Administration official. In recent months, the pace of defense spending has quickened to \$9.2 billion a month, from \$8.6 billion a month in fiscal 1978. **Payroll limits.** A second boost to the hardware budget is made possible by the cap of 5.5% on all federal pay increases. The limit to Pentagon manpower costs leaves more room within the total budget for buying weapons systems. As a result, payroll costs are budgeted for an increase of less than 6% in current dollars, while procurement spending will grow by 14% and research and development outlays will rise by 10%.

Congress is only beginning to comprehend the disparity between the fat defense budget and the leanness of all other spending. "Defense will look like a mountain rising from the plain," predicts a top Senate Budget Committee staffer. The first battle will come over a \$4 billion supplemental appropriation request for the current fiscal year that Carter will send to the new Congress soon.

Only one nondefense area will emerge as a big winner in the 1980 budget. On the President's personal orders, spend-

ing for basic research will rise by 2% after adjustment for inflation. But at the same time many applied-research programs, especially those designed to subsidize business development of new commercial technology, are being savaged.

Elsewhere in the budget, the picture will be bleak. The Administration tried to protect social programs from deep cuts, but the ax fell on some anyway:

- Public service employment jobs under the Comprehensive Employment & Training Act (CETA) will be maintained at 625,000 slots through the current fiscal year, but will fall to 467,000 by the end of fiscal 1980, for a saving of \$1.5 billion. This number could rise if unemployment climbs sharply, but no additional funding is provided for in the budget.

- Other CETA programs also are being trimmed. Youth jobs will be cut from 1 million this summer to 750,000 next year. And the Young Adult Conservation Corps will be cut in half from its current level of 29,200 members.

- The Housing & Urban Development Dept.'s Section 8 program, which provides rent subsidies for housing costs in excess of 25% of income, will be cut to 300,000 units from 362,000 this year. HUD's subsidized-housing outlays will drop by \$1.7 billion, to \$2.8 billion.

With the exception of defense, the Administration moved to cut new spending authority to agencies that have built up backlogs of uncommitted funds. New authorization for the Environmental Protection Agency's sewer treatment grants program, which already has \$19 billion in spendable funds, is being cut back by \$400 million from 1979's \$4.2 billion. And the trouble-plagued strategic petroleum reserve will have its budget authority cut to \$8 million from \$3 billion.

The Energy Dept. is also taking it on the chin in other programs. Total funding of the department will fall to just above \$7 billion in 1980 from \$10 billion this year. Big energy losers include the killing of one of two planned solvent-refined coal demonstration plants, at a saving of \$700 million, and a coal gasification program, where more than \$100 million was lopped off.

Even though President Carter miraculously "restored" \$2 billion in planned cuts for the Labor Dept. and the Health, Education & Welfare Dept. in the final days of the budget process, liberals will be far from satisfied. The assembly of a special four-member White House lobbying task force indicates how difficult the congressional battles will be. ■



The Energy Dept.'s Walden: Many of her solar programs are now in jeopardy.

The squeeze on funds for solar energy

The Energy Dept. and the Office of Management & Budget have prepared a rude shock for the \$150 million U.S. solar power industry. Instead of the \$1 billion or so that Energy Secretary James R. Schlesinger was expected to request for solar programs in the fiscal 1980 budget, he asked for just \$750 million, and the OMB lopped off \$100 million more. Although the spending request still represents an increase of 30% over the \$500 million for solar work in the 1979 budget, critical federal commercialization programs were the budget-cutters' principal targets.

At the OMB, there is skepticism about almost all of the government's efforts to push commercialization of new technologies, and officials there told the Energy Dept. to scale back such efforts across the board. Unfortunately for the solar industry, many of the Energy Dept.'s commercialization projects were in the solar area.

Meanwhile, Energy has decided that solar space-heating technology is not ready, in cost or in technical terms, for a major marketing push. Solar heating, says Energy Under Secretary Dale D. Myers, is "at an earlier stage in the research and development spectrum than we had thought." Thus, the department has determined "not to go to the

next phase" of a concentrated push to commercialize solar heating systems.

Shifting emphasis. Omi Walden, Assistant Energy Secretary for conservation and solar applications, who has had responsibility for many of the programs now in jeopardy, adds that while solar heating is "much further along than space cooling," work is still needed that would "better integrate" space heating development with hot water systems. As a result, programs designed to increase public acceptance as well as to protect

Solar's expected budget is pared from \$1 billion down to \$650 million

consumer interests will be confined largely to the simpler solar hot-water systems themselves.

Such shifting emphasis, argues William S. Bergman, executive vice-president of the Solar Energy Industries Assn., is based upon "a nonunderstanding of where air space-heating systems are today." It also deprives the industry of important marketing help. Sheldon H. Butt, president of the industry group, now guesses that his estimates of as much as \$800 million a year in solar sales by 1981 could be cut by one-half without federal support.

Another decision likely to rankle industry would cancel government plans to buy a large number of current-technology solar photovoltaic devices, which convert sunlight directly into electricity. The purchases were meant to bring down costs by encouraging mass production. But Energy reportedly is not persuaded that needed cost reductions are feasible with current technology, and wants to concentrate most research on second-generation devices that would use materials now in development.

'Research mentality.' Butt argues that today's photovoltaics, if mass produced, could generate economically competitive electricity in some areas of the country. Attributing Energy's stance to a "research mentality" that pursues higher technology rather than what is available now, Butt concludes, "If one wants to chase the rainbow forever, one can do just that."

One solar application that Energy still hopes to push in the near term is for agricultural and industrial process heat. Under last year's energy tax bill, investments in this field can draw a 10% tax credit plus the 10% credit generally applied to capital investments. Industry would like to see this credit increased to 50%, and Energy reportedly also favors larger tax breaks. But other agencies, especially the Treasury, are opposed, and no decision has been made.

President Carter approved the budget cuts prior to the recent completion of an Administration-wide study of solar po-

tential. A final draft of that document, which Carter has yet to see, endorses solar energy and proposes strategies ranging from maintaining the status quo to initiating heavy new incentives.

Industry optimism. Herbert R. Epstein, a solar lobbyist who assisted in drawing up the final report to the President, is optimistic that the study will prove a "watershed in public policy" on solar energy. Epstein's enthusiasm, however, derives mostly from the encouraging tone of the report. "I think the Administration would like to do as much for solar as it can without spending more money," says Epstein.

But whether or not the White House will back commercialization plans that the solar industry will press before the current Congress is questionable. For its part, Congress has demonstrated its willingness to bolster politically popular solar programs, such as last year's tax credit. Yet with budget-cutting also a political imperative, the solar industry may face further disappointments. ■

ENVIRONMENT

The threat of a federal ban on throwaways

Last year Americans bought some 75 billion beverage cans and bottles—and threw most of them away. The \$6.7 billion beverage container industry would just as soon keep it that way, but it is likely to hear otherwise on Jan. 31. That is when the Carter Administration's Resource Conservation Committee, an interagency group, is expected to call for a nationwide ban on throwaways.

The committee will argue that a deposit on most drink containers would help clean up litter, save energy, and generate a net increase in jobs. The container industry says broader recy-

cling programs would work better. It worries that a national deposit law would only multiply the chaos it claims has been created so far by deposit laws in four states. "It's a horrendous idea," declares Albert J. Barr, a spokesman for the Glass Packaging Institute in Washington.

A big loss. At this point, the committee is only proposing that a deposit law be written. But Congress-watchers say a shift in personnel of key committees on the Hill would give such legislation perhaps its best chance in years of passing. And if it does, a national law would all but certainly spell trouble for the makers of one-way beverage containers.

The reason: State deposit laws have almost invariably pummeled sales of

The container industry is making a test of its selling skills in Michigan

beverages in one-way bottles and cans—especially cans—even though money-back deposits on such containers, in effect, change them all into returnables. The pattern was set in 1972 when Oregon's pioneering deposit law sent the can industry's share of the beer and soft drink markets plunging from 40% to about 7% in one year. Container makers cite disruptions, although not as severe, when Vermont and Maine implemented similar laws.

To sharpen its skills at persuading consumers not to change their buying habits despite a deposit law, the container industry is making a test state of Michigan. Easily the most industrialized and most populated state to implement a deposit statute so far, Michigan is barely six weeks into a law that imposes a 5¢ deposit on reusable containers and 10¢ on one-way bottles and all beer and soft drink cans. Just ending is a six-week, \$1 million advertising blitz by can makers designed to acclimate consumers to the new law more quickly. "We're just hoping that cans will maintain their market," says Thomas V. Carley, a spokesman for the Can Manufacturers

Bottles in Detroit: Faygo has spent \$8 million preparing for a state return law.



JAMES BAPIS

M. Wright

July 2, 1979

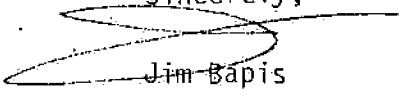
Wil:

Ignored at home, but published on the road. Here is a clip we received from Tulsa on the geothermal work at Hill AFB. It's interesting that the article has a Las Vegas, Nev., dateline.

I suspect this is the Air Force "version" of the announcement, because it contains information and phrases in our original story but later stricken at the request of DOE.

As I indicated before, I think we should take another crack at the story, using some updated angle.

Sincerely,



Jim Bapis

University of Utah
Staff Writer
Public Relations 333 Park Building
(801) 581-7912

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MAY 27 1979

By letter

Utah Air Base Due Geothermal Search

World's Own Service

TULSA, Nev. — The Department of Energy in cooperation with the U.S. Air Force, has initiated a program to investigate the geothermal potential at Hill Air Force Base near Ogden, Utah.

Scientists from the University of Utah will conduct the exploration program and have already begun a search for possible sources of geothermal energy at Hill AFB, a 5,195-acre military installation which is the state's largest employer.

The three-phase study is a joint project between the Departments of Energy and Defense and involves the University's Department of Geology and Geophysics and Earth Science Laboratory in the Research Institute.

A GEOTHERMAL Energy Initiative Management Control Group has been organized by the Air Force Logistics Command at Hill to oversee the scientific effort to find new heating sources for some of all the facility's 1,189 buildings.

Air Force spokesmen emphasized that while the project is highly speculative, the investment is warranted because of the potential for reducing Hill's heavy dependence on natural gas and fuel oil.

The Department of Geology and Geophysics-ESL research team expects to have indications by late summer whether a pilot well should be drilled to heat the first group of buildings. In proposing the study, base officials indicated their initial target for geothermal heating was building 840, a 217,000 square-foot

warehouse in the East Area, where the heating load is heaviest.

The base's principal mission is to serve as a logistics center for various U.S. weapons systems and related commodities. It provides shop and distribution resources for fighter aircraft, ballistic missiles, aircraft instrument systems and non-nuclear weapons.

IT HAS 13 centralized heating plants and base officials would like to replace as many of them as possible with geothermal power.

The University of Utah received a \$270,000 contract for its share of the work on a project that could reach \$500,000 if the early exploratory work shows promise.

One of the problems which scientists are likely to encounter is "cold water overflow," a condition in which cold runoff from the nearby mountains saturates the aquifers which may mask the presence of the possible geothermal fluids.

Roundup

Geothermal expert steamed

By George Ferguson

Associate business editor

During his national energy speech in early April, President Jimmy Carter overlooked geothermal as a source, to the amazement of Carlton Stowe, minerals specialist with Utah Geological and Mineral Survey.

"We estimate that about 2,400 quads (quadrillion BTU's) of energy exist in geothermal systems throughout the United States," said Stowe. "U.S. consumption for 1979 will be about 80 quads."

Of course, not all of it can be harnessed for one reason or another. But Stowe said there is a potential of 95,000 to 150,000 megawatts of electricity to be produced by geothermal water. He added that 230 to 350 quads of energy might be available for direct heat application.

Stowe thinks the Utah potential is particularly favorable because geothermal systems are located close to population centers. He predicts geothermal energy will soon generate electricity and provide heat for a wide variety of Utah buildings.

"Roosevelt Hot Springs near Milford has been the site of extensive geothermal exploration," Stowe points out. "Two 50 megawatt electrical generation stations are scheduled for production by 1984."

Stowe said that water temperatures are greater than 240 degrees centigrade (465 degrees fahrenheit) in the Roosevelt Hot Springs area.

"Drill rigs (virtually the same as oil and gas drilling rigs) encounter tremendous pressure when they hit a pocket in this area. Steam shoots out with a tremendous roar," said Stowe.

"In order for a power plant to maintain the velocity needed to turn turbine engines, it should be ideally located within a mile of the geothermal source."

Stowe said the Roosevelt Hot Springs region could ultimately produce 500,000 kilowatts or more of electrical power.

Phillips Petroleum and Getty Oil



Carlton Stowe

have done much geothermal exploration in the region.

Plans for the first power plant in the area were announced early in 1978 by Rogers International of San Francisco.

Mountain States Resources Corp. of Salt Lake City acquired 1,945 acres near Roosevelt Hot Springs, adding to its 12,000 acres in Sevier County.

There is a big joint venture underway by O'Brien Resources, Amax Exploration Co., Thermal Power Co., and VTN Corp., aimed at establishing a 55 megawatt geothermal power plant by 1982. It is supported by a \$12 million loan from the Department of Energy.

Other sites in southern Utah are being examined for geothermal systems capable of producing electricity," said Stowe.

Numerous hot springs throughout much of central and western

Utah indicate wide spread presence of low temperature geothermal systems capable of a variety of space heat applications for offices, greenhouses, warehouses and homes.

Stowe said the town of Monroe soon plans to heat a school and other public and private buildings using geothermal water that is 160 degrees fahrenheit. He added that Utah State Prison officials are examining the possibility of heating the minimum security portion of the prison with geothermally heated water.

Utah Roses, a major greenhouse in Sandy, is seeking to replace a fossil fuel heating system with a geothermal space heating system.

Geothermal energy is being used in many areas of the nation where water and steam with temperatures above 400 degrees fahrenheit are replacing fuel oil to generate electricity," he pointed out.

"At the Geysers area of California, 608 megawatts of electricity are produced from natural steam. This is more than enough to meet the electricity needs for a city the size of San Francisco."

Stowe said cities like Klamath Falls, Ore., Boise, Ida. and Reno, Nev., are using low temperature geothermal water for direct heat application such as industrial processing and space heating.

"During the past two years, a number of geological and geophysical investigations of known, but unexplored, low temperature resources have been in progress," said Stowe.

More than 20 geothermal test holes have been drilled along the Wasatch Front from southern Salt Lake County to the Utah-Idaho border. Investigations by UGMA geologists will continue into 1980 to provide more information on the nature of low temperature geothermal resources.

Stowe predicts geothermal energy will displace large quantities of fossil fuel in the generation of electricity and for heating offices and homes in Utah.

Mexican gas pipeline

Ogden lab purchased

FOR IMMEDIATE RELEASE
DECEMBER 30, 1977

**DOE TO INITIATE EAST COAST
GEOTHERMAL DRILLING PROJECT**

The Department of Energy is seeking proposals for drilling projects aimed at locating deep underground reservoirs of hot water along the Atlantic Coastal Plain, from New Jersey to northern Florida.

This hot water is thought to be trapped within sedimentary rock formations at depths of about one mile (1.6 kilometers) or more, and could potentially be drawn to the surface by wells and used to heat homes and office buildings, or for industrial heat processes.

Under terms of the proposed contract, a qualified firm will be selected to manage and subcontract the drilling of sixty 1,000-foot deep wells to measure heat flow and one 7,000-foot deep exploratory well to determine the most promising area for locating a reservoir. If this drilling and testing is successful, the contract may be extended for an additional 12-24 months for work on four additional deep wells.

The wells will be drilled at sites to be selected by a team of scientists from Virginia Polytechnic Institute and State University (VPI SU), in cooperation with appropriate Atlantic Coastal Plain state agencies and the United States Geological Survey (USGS). The selected contractor will work closely with these three groups to coordinate the drilling and testing program.

In addition, VPI SU will conduct heat flow measurements at the well sites and, with geoscientists from the state agencies, perform data analyses on all the wells. The VPI SU team, under the direction of Drs. John Costain, Lyn Glover and A. K. Sinha, has been conducting detailed studies of potential East Coast geothermal sites under contract with DOE's Division of Geothermal Energy.

Organizations interested in applying for the contract to manage drilling operations should obtain a copy of the Request for Proposals (RFP EY-78-R-08-001) from R. T. Stearns, Chairman, Source Evaluation Panel, U.S. Department of Energy, Nevada Operations Office, P.O. Box 14100, Las Vegas, Nevada 89114. Telephone (702)734-3251.

Deadline for submission of proposals is January 16, 1978. Final contract selection is expected to be made in April.

R-77-100

FOR IMMEDIATE RELEASE
DECEMBER 30, 1977

**DEPARTMENT OF ENERGY APPROVES IMPORT
OF INDONESIAN LNG TO CALIFORNIA**

The Department of Energy today approved a major project for the importation of liquefied natural gas (LNG) from Indonesia to California, provided that the price for the gas would not be tied to oil prices of the Organization of Petroleum Exporting Countries (OPEC).

The project, which would represent estimated capital investments of about \$2 billion, would be the first involving the import of gas from Indonesia.

Pacific Indonesia LNG Company, under an agreement with Pertamina, the Indonesian Government oil and gas production company, proposes to import 539 million cubic feet of gas per day, or more than 200 trillion Btu's of gas annually for 20 years, beginning early in the 1980's. That is about one percent of current nationwide gas consumption or over ten percent of current California gas consumption. The gas would be destined for California markets.

The gas would be produced and liquefied on the island of Sumatra in Indonesia and transported to an LNG terminal in California, by a fleet of nine cryogenic tankers.

The initial base contract rate to be paid for the LNG in Indon \$1.25 per million Btu's, which is \$0.18 less than the average current received by producers of new interstate gas in the U.S. However, the cost of shipping the LNG would be roughly an additional \$1.23 per million Btu's and total costs, after regasification, would be \$3.42. The Administrator of the Economic Regulatory Administration (ERA), David J. Bardin, who made the decision for the DOE, found this delivered price to be acceptable because it is less than the price of alternative new energy supplies suitable for use in California.

Pac Indonesia's agreement with Pertamina currently provides for increases in the LNG price, based upon increases in Indonesian oil and U.S. prices of all fuels. DOE did not approve the price escalation in the agreement, the Administrator said, but would approve a price provision based upon more general and objective economic indicators and approve a separate minimum-pricing provision designed to cover Pertamina's debt financing costs.

In other areas, the Administrator's opinion also:

- Ordered the submission of a contingency plan for use in periods of LNG service interruption to ensure continued service to high priority customers for five consecutive months; and
- Noted that LNG transportation and handling carries certain safety risks and imposed conditions to minimize both the risks and the potential consequences of a mishap.

R-78-001

**DEPARTMENT OF ENERGY
FEDERAL ENERGY REGULATORY COMMISSION**

NEWS RELEASE

WASHINGTON,



IMMEDIATE RELEASE
DECEMBER 22, 1977

FE-100

FEDERAL ENERGY REGULATORY
COMMISSION CALENDAR OF HEARINGS

Public hearings and conferences scheduled by the Federal Energy Regulatory Commission for the period December 15 through January 1, 1978, are listed below. All hearings will convene at 10:00 a.m., at 825 North Capitol Street, Washington, D.C., unless otherwise noted.

This is not an official notice of hearings but merely a reminder of previously scheduled hearings.

DATE OF HEARING	Docket Number	IN THE MATTER OF	DATE ORDERED
Dec. 15	ERT7-203	Wisconsin Electric Power Company	0-10/
Dec. 15	E-7777	Pacific Gas and Electric Company	0-12/
Dec. 15	RP77-124	McCulloch Interstate Gas Corporation	0-12/
Dec. 15	RP72-6	El Paso Natural Gas Company	R-12/
Dec. 15	RP75-62	Pennsylvania Power Company	JH-9/
Dec. 15	CP75-278	Michigan Wisconsin Pipe Line Company	JO-11
Dec. 15	RI76-129	Byron Oil Industries, Inc.	0-11/
Dec. 16	ER76-320	Connecticut Light & Power Company	JO-9/

FOR IMMEDIATE RELEASE
MARCH 24, 1978

DOE ANNOUNCES INTERIM ELECTRIC RATE INCREASE
FOR CALIFORNIA'S CENTRAL VALLEY PROJECT

A 95 percent increase in power costs for all customers of the Western Area Power Administration's Central Valley Project in California will become effective May 25, 1978, the Department of Energy, (DOE) announced today.

The interim rate includes a capacity charge of .52 per kilowatt per month based upon the use of CVP power facilities and an energy charge in power costs of 4.2 mills per kilowatt hour resulting in an average increase of about 95 percent for all customers.

Existing rates in effect since 1945, are 75 cents per kilowatt per month, plus an energy charge of four, three and two mills per kilowatt hour depending on amounts of energy used.

While a larger increase would be required to eliminate an annual \$29 million or more deficit, the DOE's Economic Regulatory Administration has decided to allow an interim rate which will increase revenues about \$20 million per year.

DOE said the higher rates are needed now because the previously announced rate increase for the project in 1974 was set aside by court action on procedural grounds. Further, DOE notes that under the law, power revenues should be sufficient to cover allocated project capital costs, interest charges, operation, maintenance and replacement costs and provide for financial assistance for irrigation project costs.

DOE will set final rates following further consideration with the public and customers. The Department conducted hearings on the amended regulations and the interim rate proposal in Washington and Sacramento last month.

The Central Valley project serves a 21-county area with a population of 2.4 million. It is the drainage basin for the Sacramento River in the north and the San Joaquin River in the south, and it comprises one of the Nation's leading areas for producing wine, rice, nuts and raisins.

Valley Project electricity is used to pump water for irrigating and also for federal laboratories, including the DOE's Stanford Linear Accelerator; military, air force and naval bases; and the cities of Palo Alto, Redding, Roseville, Sacramento, and Biggs.

WAPA markets electric power from Federal Reclamation and Corps of Engineer projects in 15 western states.

DOE is currently drafting other comprehensive rate adjustment regulations and uniform rate making procedures for all the federal power marketing administrations including WAPA, Bonneville, Alaska, Southeast and Southwest, which were transferred from the Department of Interior to DOE on October 1, 1977. DOE notes full public participation will be involved as the Department goes through the development of these procedures.

R-78-105

FOR IMMEDIATE RELEASE
MARCH 27, 1978

~~SOLE BASIS TO PROVIDE OTHER...~~
In the summer of 1979, quiet electricity, generated from solar cells, will replace the noise of diesel electric generators at the Natural Bridges National Monument in Southern Utah.

About 18,000 square feet of solar cells (photovoltaic cells), installed on a 1.3-acre site, will provide up to 100 kilowatts of electrical power for the isolated park. This is a joint project of the Department of Energy and the National Park Service.

The cells will provide full power on sunny days and partial power in overcast weather. Batteries will store sufficient power to serve the park's needs for about 30 hours when sunlight is not available. Diesel powered generators that are now in use there will be retained for supplemental power.

The park, which is located 40 miles west of Blanding, Utah, contains three huge sandstone bridges which were carved from the surrounding rock by thousands of years of water erosion.

The project is being managed for the Department of Energy by the Lincoln Laboratory of the Massachusetts Institute of Technology. The project is a part of a program conducted by DOE to help bring solar cells into widespread use by the 1980's.

Installations such as this are not yet cost competitive but are an important means of providing information on operating performance and maintenance costs for such systems. These field tests are paralleled by an intensive DOE program to develop cheap production methods for large-scale manufacturing of solar cells.

The cells presently cost about \$11 per peak watt of output, down from \$21 cost of a year ago. DOE's goal is to reduce that price to \$0.50 per peak watt by 1986.

R-78-106

FOR IMMEDIATE RELEASE
MARCH 27, 1978

JEROME WIENER, FORMER PROSECUTOR,
TO HEAD SPECIAL INVESTIGATIONS

Jerome Wiener, a Washington lawyer and former prosecutor, has been appointed Director of the Office of Special Investigations for the Economic Regulatory Administration, Department of Energy, it was announced today.

ERA Assistant Administrator for Enforcement, Richard B. Herzog said that "Jerome Wiener brings experience as a federal prosecutor and an accounting background to his new tasks. Under Mr. Wiener's leadership, I am confident that the Office of Special Investigations will be a formidable law enforcement arm of the Department, and will pursue suspected willful violations of the petroleum price and allocation regulations vigorously, fairly and efficiently".

The Office of Special Investigations is the Office within the ERA's Office of Enforcement which investigates suspected willful violations that may warrant criminal penalties.

Mr. Wiener most recently was an associate of the Washington law firm of Melrod, Redman & Gartlan, engaged in civil and criminal litigation. From 1969 to 1973, he was Assistant U.S. Attorney for the District of Columbia, where he was actively engaged in all phases of criminal trial work. Previously, Mr. Wiener was a VISTA volunteer where he served with Community Legal Counsel in Chicago.

Mr. Wiener graduated with a B.S. in Accounting from Lehigh University and received his J.D. degree from Georgetown University Law Center. He is a member of the District of Columbia Bar and the Virginia Bar.

R-78-107

FOR IMMEDIATE RELEASE
MARCH 27, 1978

DOE REPORTS INCREASED U.S. URANIUM PRODUCTION IN 1977,
MORE EXPLORATION AND DEVELOPMENT DRILLING

The Department of Energy (DOE) today reported an increase in uranium concentrate production from U.S. mills in 1977. Exploration and development drilling by the uranium industry also was up from last year.

DOMESTIC DEMAND FOR PETROLEUM PRODUCTS
(Thousands of barrels per day)

**DOE HOLDS PRELIMINARY BRIEFING ON
CANONSBURG SURVEY**

4 Weeks Ending:

Product:	3/17/78	3/18/77	3/19/76	3/16/73	% Chg 78/77	% Chg 78/76	% Chg 78/73
Total demand	20,329	18,988	17,345	18,088	+ 7.1	+17.2	+12.4
Motor gasoline	6,905	6,894	6,666	6,478	+ 0.3	+ 3.6	+ 6.6
Distillate	4,706	3,929	3,461	3,785	+19.8	+36.0	+24.3
Residual	3,903	3,351	2,860	3,222	+16.5	+36.5	+21.1
Other products	4,815	4,814	4,358	4,603	0.0	+10.5	+ 4.6
Imports:							
Total imports	8,432	9,513	6,665	6,563	-11.4	+26.5	+28.5
Crude	5,816	6,640	4,549	3,028	-12.4	+27.9	+92.1
Products	2,616	2,873	2,116	3,535	- 8.9	+23.6	-26.0
R-78-109							

FOR IMMEDIATE RELEASE
MARCH 27, 1978

**U.S. RECORDS SIGNALS PRESUMABLY FROM
TWO SOVIET UNDERGROUND EXPLOSIONS**

Seismic signals, presumably from two Soviet underground nuclear explosions, have been recorded recently from the Semipalatinsk nuclear test area. The latest were recorded by the U.S. Atomic Energy Detection System last Saturday night. These signals originated at 10:57 p.m. EST, March 25, 1978. Signals from the earlier event originated at 10:37 p.m. EST, Saturday, March 18.

R-78-110

ENERGY UPDATEMarch 28 , 1978

Brief reports, for news media, of things going on at DOE. Issued weekly by the Office of Public Affairs. The items reported do not duplicate DOE Headquarters public announcements.

**DOE AND CONTINENTAL OIL TO BEGIN
WYOMING OIL RECOVERY TEST**

DOE and Continental Oil Company have begun a 9-year, \$35.5 million cost-shared program to test a "chemical flooding" process for recovering oil left behind in a reservoir after conventional pumping is completed.

The process could yield an additional 700,000 barrels of oil from a 90 acre test site of the Big Muddy Field of Converse County in eastern Wyoming. If the process proves technically and economically feasible, more than one billion barrels of additional oil might be recovered from similar fields in eastern Colorado, eastern Wyoming and eastern Montana.

The process has been tested on a small-scale at a one-acre project the company is operating in the same field. Basically, the process involves injecting detergent-like chemicals into a "depleted" reservoir to release trapped oil, followed by a polymer solution to control viscosity and remove the crude oil. Finally, water forces the oil-chemical mixture to wells for pumping.

Conoco will contribute \$26 million to the 9-year project and DOE, \$9.5 million. DOE's Bartlesville (Okla.) Energy Research Center will administer the contract and monitor the work.

Representatives of the DOE met on March 24, in Canonsburg, Pennsylvania, with the property owner and tenants of the Canonsburg Industrial Park to give them a preliminary briefing on the results of a radiological survey conducted at the site. A final report of the radiological survey results will be available by the first week of April.

Representatives of the Pennsylvania Bureau of Radiological Health, which is part of the State Department of Environmental Resources, and the local office of the Occupational Safety and Health Administration (OSHA), part of the U.S. Department of Labor, also attended.

The Canonsburg site was formerly owned by the Vitr Chemical Company, which maintained a plant there for many years to extract vanadium, radium, uranium, and other rare metals from ore.

A year ago, the Energy Research and Development Administration (ERDA), one of DOE's predecessor agencies conducted a preliminary radiological survey of the 17-acre industrial park site. At that time, ERDA reported that it had found elevated radiation levels at the site and that it would conduct a long-term program to sample radon levels inside buildings there.

The survey since then has confirmed that radon levels in buildings on the site are in excess of guidelines set by the U.S. Surgeon General. DOE has begun engineering studies to identify the various options and estimate costs for decontamination actions which may be necessary.

A new system for generating electricity from hot geothermal fluids is being tested at Roosevelt Hot Springs, Utah, with funding from DOE.

The generating system uses a device called a helix screw expander, instead of a conventional turbine, to "move" or expand the hot fluids into steam to turn the generator.

The generating plant is expected to produce one megawatt (one million watts) of electricity. This will be the largest demonstration to date in the United States of electric power produced from a hot water well.

The main component of the helical screw expander consists of two large screws rotating in opposite directions. Besides being rugged and simple to operate the screws, while rotating, scrape themselves clean, thereby eliminating a build-up of salts and other corrosive materials found in the geothermal fluids.

The helical screw concept was developed by Hydrothermal Power Company, Mission Viejo California, with funding from the National Science Foundation, and DOE.

Field testing of the device is being managed by the Jet Propulsion Laboratory (JPL), Pasadena, California. Testing at the Utah site, which is owned by Phillips Petroleum, is scheduled to last 2-3 months.

200 RESPOND TO PRDA FOR SMALL HYDROPOWER PROJECTS

Two hundred individuals and organizations have responded to a request for proposals to study the feasibility of developing small dam sites throughout the country.

The proposals were received in response to a Program Research and Development Announcement (PRDA ET-78-D-07) issued by DOE's Division of Geothermal Energy in December.

Proposed dam sites are located in thirty states, more than half located in New England and New York State.

DOE expects to fund six-to-nine month feasibility studies of approximately 50 sites. Final selection of proposals should be made by mid-April.

Information on the project and copies of the list

RESERVE FUND FOR SMALL-FIRM PROPOSALS

Thursday, Feb. 1 — ENERGY RESEARCH ADVISORY BOARD
and
Friday, Feb. 2

National Academy of Sciences, Room 400A, Joseph Henry Building,
2100 Pennsylvania Ave., NW, Washington, D. C., 9 a.m. to 5 p.m.

Tentative agenda includes: Review of modus operandi of the Board;
Reports on issues developed by the Board members; Discussion of
recent requests for ERAB review; Briefings by DOE on additional
areas not covered in the first meeting; and Status report on Board
review of the Strategic Petroleum Reserve requested by the Under
Secretary.

Lastly, the Department of Energy announced the renewal of the
National Petroleum Council for a 12-month period ending on December 31,
1979. The Council advises, informs and makes recommendations to the
Secretary of Energy on the views of the oil and gas industries on any
matter relating to oil and gas or the oil and gas industries.

R-79-UZ8

FOR IMMEDIATE RELEASE
JANUARY 17, 1979

U.S. RECORDS SIGNALS PRESUMABLY FROM
SOVIET UNDERGROUND NUCLEAR EXPLOSION

Seismic signals presumably from a Soviet underground
nuclear explosion were recorded by the U.S. Atomic Energy
Detection System early this morning. The signals origi-
nated at 3:00 a.m., EST, January 17, 1979, from an area
north of the Caspian Sea.

R-79-029

ENERGY UPDATE.....January 18, 1979

Brief reports, for news media, of things going on at DOE.
Issued weekly by the Office of Public Affairs. The items
reported do not duplicate DOE Headquarters public
announcements.

INNOVATIVE CONCEPTS SOUGHT FOR SOLAR CELLS

DOE has begun a research program to find new methods
of converting the sun's energy into electricity using
photovoltaic, or "solar", cells.

The program, termed the Innovative Concepts Program,
will be coordinated by the Department's Solar Energy
Research Institute in Golden, Colo. To participate in
the program, researchers are being asked to submit
"letters of interest" to SERI by February 15, 1979.

Present plans call for similar solicitations twice
yearly. With a major goal of developing low-cost
photovoltaics, the research and development areas
include new high risk photovoltaic conversion concepts;
cell structures and geometrics; materials; junction
formation techniques; fabrication processes; and
material deposition methods.

The primary targets of the program include univer-
sities, small businesses and private inventors, many
of whom often find it difficult to obtain funding for
their high-risk ideas. Initial contracts are expected
to be for one year. Those projects that demonstrate
sufficient potential will be considered for renewal
or incorporation into previously established activities
in DOE's photovoltaic program.

Requests for further information and the solici-
tation document should be submitted in writing to:
Solar Energy Research Institute, Attn: Roger Ganger,
Contracts Branch, 1536 Cole Boulevard, Golden, Colo.,
80401.

The Department of Energy's (DOE) Office of Energy
Research has established a \$300,000 reserve to fund
meritorious proposals submitted by small and disadvantaged
businesses. The action is unusual in that it is to be
used exclusively for unsolicited proposals.

DOE said the reserve fund is expected to stimulate
the flow of such proposals for research and development
from these firms and enlarge their role in departmental
programs.

John M. Deutch, Director of Energy Research, and
Michael J. Tashjian, Director, Procurement and Contracts
Management, have prescribed procedures to be followed
in handling the reserve. Periodically, DOE will
publish in the Commerce Business Daily, appropriate
trade, professional and other media, broad topics of
interest under which the Office of Energy Research
desires innovative R&D proposals.

Interested businesses may contact Mark J. Kurzius
at 202/376-1703.

CONTRACT FOR OTEC HEAT EXCHANGERS

DOE is negotiating a contract with Westinghouse
Electric Corporation for detailed design and construc-
tion of a heat exchanger for the Ocean Thermal
Energy Conversion (OTEC) program. The shell-and-
tube design evaporator and condenser will be built
by the Westinghouse Steam Turbine Division at Lester,
Pa., for approximately \$2.3 million. It will be
tested aboard DOE's OTEC-1 Ocean Test Platform, which
is scheduled to begin operating near Hawaii in 1980.

The Westinghouse design was selected through
competition that began in August 1977. The heat
exchangers, the second to be tested aboard OTEC-1,
are rated at .13 megawatts. The testing will provide
data for the design of much larger units for use in
future OTEC power plants.

The OTEC program seeks to develop the use of the
solar energy stored in the surface of the oceans as
a clean source of economical electric power. Warm
ocean surface waters will be used to evaporate a
fluid whose vapor expansion drives a turbo-electric
generator and then is condensed by colder water from
the ocean depths for re-use.

The OTEC-1 test platform is being constructed
for DOE by Global Marine Development Company of New-
port Beach, Calif.

SNAKE RIVER GEOTHERMAL POTENTIAL

DOE has awarded a contract to Brinkerhoff Signal
Drilling Company, Inc., of Denver, Colo., to drill a
deep well to assess the geothermal potential of the
eastern section of Idaho's Snake River plain.

Numerous indications of past volcanic activity in
the Snake River plain, which stretches across the lower
half of Idaho, have led researchers to believe some
21,500 square miles may offer substantial geothermal
potential. In the western region, geothermal hot
water has been used for many years for space heating.
The potential of the eastern region, however, is less
known due primarily to underlying cold water.

The \$3 million project involves drilling a 7,500-
foot deep well through volcanic rocks into the much
older "basement" rocks underlying the Plains. There,
geothermal fluids are believed to exist at temperatures
of 250-300 degrees F, which would make the fluid use-
ful for space and process heating.

The well will be located on DOE's Idaho National
Engineering Laboratory, about 50 miles west of Idaho
Falls. The geothermal fluids will be used at the Idaho
Chemical Processing Plant as a partial replacement for
the present oil-fired system.



FOR IMMEDIATE RELEASE
JANUARY 25, 1979

COLLOFF RECEIVES DOE'S
DISTINGUISHED SERVICE MEDAL

Roger D. Colloff, the Special Assistant to the Secretary, Deputy Secretary and Under Secretary in the Department of Energy (DOE), has been awarded the Department's Distinguished Service Medal by Energy Secretary James R. Schlesinger.

Colloff was cited for his "superior performance" during the past two years. He was appointed Special Assistant on Oct. 1, 1977, when DOE began its operations. Before then, he served as a senior staff member of the White House Office of Energy Policy, where he had primary staff responsibility for the legislation creating DOE.

In presenting the award, Secretary Schlesinger said that Colloff "has been continually involved with the complex and sensitive issues of national energy policy. His professionalism, wide scope of expertise, and understanding of key energy issues have been invaluable to the effective performance of the Department."

Colloff resigned from DOE effective Jan. 26 to become Vice President and Assistant to Bill Leonard, Executive Vice President and Chief Operating Officer, CBS News.

R-79-041

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FOR IMMEDIATE RELEASE
JANUARY 26, 1979

DOE AWARDS \$509,500 CONTRACT TO HISPANIC FIRM

The Department of Energy (DOE) has awarded a \$509,500 subcontract, through the Small Business Administration, to Direct Courier, Inc., to provide messenger service for the scattered headquarters facilities of the Department. Direct Courier is a Hispanic firm headed by Ben Fernandez of Arlington, Virginia.

At present DOE, is located in 21 separate buildings in the Washington metropolitan area. This requires an extensive network of messenger support services for the agency to fulfill its mission effectively. Under this contract, Direct Courier will provide five-day dispatch service to transport packages and unclassified material in response to DOE requirements.

Direct Courier is a small business firm certified under section 8(a) of the Small Business Act. This Act is designed to assist small businesses, including those owned and controlled by socially and economically disadvantaged individuals, in securing contracts in the federal procurement process.

R-79-042

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FOR IMMEDIATE RELEASE
JANUARY 26, 1979

~~DOE AWARDS CONTRACT TO HISPANIC FIRM FOR
EAST'S FIRST DEEP GEOTHERMAL WELL~~

A site near Crisfield, Md., in the central section of the Delmarva Peninsula, has been selected for drilling of the first deep well to determine if useful geothermal heat can be found along the East Coast.

The site was selected by the Department of Energy (DOE) from four candidate locations. The area is part of a broad band of promising geological formations believed to contain zones of underground heat that could yield future supplies of energy for the populous, industrial East.

Selection of the southeastern Maryland site marks the beginning of a new phase in DOE's program to determine if this geothermal heat can be tapped economically.

Earlier in the program, researchers drilled relatively shallow, 1000-foot wells and lowered temperature probes into areas where air and ground surveys of magnetic fields, gravity data and other geologic studies had indicated the possibility of large masses of buried granite. Results of these initial tests revealed that several granite masses spotted from New Jersey to North Carolina are acting as heat generators through the slow decay of natural radioactive minerals.

Were these granites at the surface, this heat would be conducted to the top of the masses and dissipated to the air; however, along the Atlantic Coastal Plain, a mile-thick blanket of sand and clay saturated with water appears to be trapping the potentially large amounts of heat underground.

Beginning in March, drillers from Gruy Federal, Inc., Houston, Texas, will bore a 5000-foot hole into the subsurface formation outside Crisfield. The projected

temperature of the underground water at the base of the hole is approximately 185 degrees F -- too cool for electric generation, but suitable for low to moderate temperature applications, such as residential and industrial heating or for use in agriculture.

The production well should be completed in mid April. During the initial testing, the geothermal fluids will be reinjected into a second 5000-foot well to be drilled nearby. The project is expected to cost about \$750,000.

DOE officials selected the Maryland site because of the area's high geothermal gradients -- the underground temperatures increase about 2.5 degrees F with every 100 feet in depth, more than twice the average. Also the land, which is publicly owned, is on a geophysical anomaly, increasing the chances of a major geothermal find.

Several other sites have shown similar geothermal gradients and could be selected for possible testing in the future. The eastern geothermal region may extend as far south as southern Georgia and as far north as New Jersey.

DOE's exploration for geothermal resources on the Atlantic Coastal Plain has followed a program proposed and executed by Professor John Costain and co-workers from the Virginia Polytechnic Institute and State University with DOE support.

R-79-043

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FOR IMMEDIATE RELEASE
JANUARY 26, 1979

DEPUTY SECRETARY O'LEARY TO VISIT VENEZUELA

Deputy Secretary of Energy John F. O'Leary will visit Venezuela January 29 through February 1 at the invitation of the Venezuelan Minister of Energy and Mines Valentin Hernandez Acosta.

His visit will continue the bilateral consultations on energy between the two governments which began with Minister Hernandez visit to Washington in March 1978.

During his stay, Deputy Secretary O'Leary will discuss energy issues of mutual interest to the two countries, including the possibility of technical cooperation with Venezuela in specific fields.

While in Venezuela, the Deputy Secretary also will address the Venezuelan American Chamber of Commerce.

R-79-044

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Office of Public Affairs
Washington, D.C. 20585

Weekly Announcements

VOLUME 3, NUMBER 5
WEEK ENDING JANUARY 30, 1979

FOR IMMEDIATE RELEASE
JANUARY 23, 1979

FOR IMMEDIATE RELEASE
JANUARY 23, 1979

DOE AUTHORIZES BOTH COMPETITORS TO PROCEED WITH COAL-TO-GAS DEMONSTRATION PLANT DESIGNS

The Department of Energy (DOE) today authorized both the Conoco Coal Development Company and the Illinois Coal Gasification Group (ICGG) to continue designs of a demonstration plant that would convert coal into synthetic pipeline gas.

Both firms were awarded contracts some 19 months ago to begin a Government-funded design competition for a facility that could serve as the forerunner of commercial plants specifically suited for processing high-sulfur Appalachian coals into substitute natural gas.

Late last year, both projects reached comparable stages in the conceptual design phase and DOE convened a panel to evaluate pilot plant tests, technical feasibility, and commercial conceptual designs. In a review of the panel's findings, it was determined that insufficient information had been developed for the selection of one proposed project over the other.

Accordingly, both firms will now proceed with a detailed design of the demonstration plant, due to be completed by ICGG in July, 1980, and by Conoco in November, 1980. While the designs are underway, better estimates of construction costs, market potential, product economics and proposed cost-sharing arrangements will be gathered.

This information will be used to determine which plant eventually will be constructed. Enough information could be available in early to mid 1980 to permit a selection.

If selected, the Conoco plant would be built in Noble County, Ohio, near Caldwell. As originally proposed, the facility would be capable of processing up to 3,800 tons of high-sulfur coal per day, producing 58 million cubic feet of clean-burning pipeline gas.

It would use the "slagging Lurgi" gasifier, an advanced version of a coal gasification system developed in Germany before World War II. The plant could be ready for operation in late 1983, with the testing period expected to last about 3 1/2 years. Cost of construction and operation of the experimental facility would be shared by the Department and a consortium of companies headed by Conoco.

The plant originally proposed by the Illinois Coal Gasification Group, a consortium of five Illinois-based utilities would be located in Perry County, Illinois, near Cutler. The plant would convert 2,200 tons of coal per day into 18 million cubic feet of gas and 2,400 barrels of heavy coal liquids.

The proposed facility would integrate two previously piloted processes, the COED process which produces a char and the coal liquids, and the COGAS process which uses the char to produce synthetic gas. Construction and operation of the plant likewise would be co-funded by DOE and the private consortium.

R-79-035

BATEMAN, KERR AND LEGASSIE APPOINTED ACTING DEPUTY ASSISTANT SECRETARIES FOR ENERGY TECHNOLOGY

Secretary of Energy James R. Schlesinger today announced the appointments of Worth Bateman, Donald M. Kerr and Roger LeGassie as acting deputy assistant secretaries for Energy Technology.

Dr. Bateman will be the principal deputy, acting for acting Assistant Secretary John Deutch in his absence, and will have day-to-day responsibility for the overall operation of the Department of Energy's Office of Energy Technology.

Dr. Donald M. Kerr will be the Acting Deputy Assistant Secretary for Programs and Operations. In that capacity, he will have responsibility for the offices of nuclear waste management, fossil energy programs, field operations management, solar and geothermal energy programs, nuclear energy programs, and fusion energy within the Office of Energy Technology.

Roger W. A. LeGassie will be the Acting Deputy Assistant Secretary for Planning and Analysis. In that capacity, he will have responsibility for the Office of Planning and Technology Transfer and Resource Management and Acquisition within the Office of Energy Technology.

Since joining the Department on October 1, 1977, Dr. Bateman has been Deputy Director of Energy Research. In that capacity, he was responsible for initiating the ongoing assessment of the department's R&D programs, the formation of the Energy Research Advisory Board, and served on the President's Interagency Review Group on Nuclear Waste Management.

Between 1973 and 1977, Dr. Bateman was the director of the Washington based Land Use Center. Prior to that, he was senior vice president of the Urban Institute from 1969 to 1973. He was deputy assistant secretary of the Department of Health, Education and Welfare and also served in the Department of Defense from 1963 to 1966.

Dr. Bateman is a native of Maryland and received his bachelor's degree in economics from Western Maryland College in 1960. He was awarded a Woodrow Wilson Fellowship to Harvard University in 1960 and earned his Ph.D. in economics from Harvard in 1963.

Dr. Bateman is married to the former Grace Dawson and has four children; John, Robert, Sarah, and Elizabeth.

Prior to this appointment, Dr. Kerr was the Deputy Assistant Secretary for Defense Programs.

Dr. Kerr served as Deputy Manager of the DOE Nevada Operations Office until his appointment to the Office of Defense Programs in 1977. In that position, he directed activities at the Nevada Test Site and other operating locations involving full-scale nuclear testing, the Nuclear Emergency Search Team (NEST), and a variety of energy and environmental programs.

From 1966 to 1976, Dr. Kerr held a series of positions at the Los Alamos Scientific Laboratory (LASL), beginning as a staff member with the High Altitude Phenomenology Group. Dr. Kerr was assistant for research in the LASL director's office, and then completed his service with LASL in

1976 as the Alternate Energy Division leader, with primary responsibility for the hot dry rock geothermal, basic geosciences, solar energy and energy systems analysis programs.

A native of Philadelphia, Dr. Kerr was educated at Cornell University where he received his bachelor's degree in electrical engineering in 1963, an M.S. in 1964, and a doctorate in plasma physics in 1966.

He has been a member of the Army Scientific Advisory Panel and the Navajo Science Committee. He has been elected to Tau Beta Pi and Sigma Xi, and is a member of the American Physical Society and the American Geophysical Union.

Dr. Kerr is married to the former Alison R. Kyle of Lakewood, Ohio, and has a daughter Margot.

Prior to this appointment, Mr. LeGassie was the Associate Director for Program Analysis in the Office of Energy Research, and the working chairman of the Waste Management Task Force of the Department of Energy and the Interagency Review Group on Nuclear Waste Management.

LeGassie was previously Assistant Administrator for Planning, Analysis and Evaluation for the Energy Research and Development Administration from 1975 to the creation of DOE in 1977. Prior to his service at ERDA, LeGassie held numerous positions in the Atomic Energy Commission since 1952 associated with analytical activities.

LeGassie began his professional career as a research and development engineer with the Harshaw Chemical Company working on the design and operation of chemical pilot plants and production installations.

He received his bachelor of science degree in chemical engineering and his bachelor of arts degree in mathematics and chemistry from Columbia University in 1947 and 1948 respectively.

R-79-036

FOR IMMEDIATE RELEASE
JANUARY 23, 1979

SECRETARY SCHLESINGER NAMES
C. WILLIAM FISCHER SPECIAL ASSISTANT

Secretary of Energy James R. Schlesinger today named C. William Fischer as The Special Assistant to the Secretary, Deputy Secretary and Under Secretary of the Department of Energy (DOE). Fischer, who has been serving as Deputy Director of DOE's Energy Information Administration (EIA), will fulfill the various responsibilities of The Special Assistant.

A career Federal official, Fischer was Associate Administrator for Policy and Program Evaluation at the former Federal Energy Administration before joining EIA with formation of the DOE in October 1977.

Between 1975 and 1977 Fischer served as the first Assistant Director for Human Resources at the Congressional Budget Office.

Previously he was with the Office of Management and Budget in the Executive Office of the President, where he served as Deputy Associate Director for Human Resources, and Deputy Assistant Director for Legislative Reference, and Assistant Chief of the International Division.

Fischer started his Federal career in 1957 with the U.S. Bureau of the Budget where he became principal analyst for military research and development programs. He received the Bureau's Professional Achievement Award in 1962 and the Advanced Studies Award in 1963, as well as a Career Education Award of the National Institute for Public Affairs.

In 1965 and 1966, Fischer played a key role in developing the central analysis and evaluation staff and in implementing a programming/budgeting system in the Office of Economic Opportunity. During this period, he received the Meritorious Award of the William A. Jump Foundation.

After he returned to the Bureau of the Budget in 1966, Fischer directed legislative coordination and analysis and program, budget, and policy analysis largely in the domestic regulatory and economic fields.

Fischer was born in Pittsburgh, Pennsylvania, in 1931 and attended public schools there. He received his B.A. degree from Muskingum College in 1953 and a masters degree in Public Administration from Harvard University in 1964. He resides in College Park, Md.

R-79-037

FOR IMMEDIATE RELEASE
JANUARY 24, 1979

DOE ENCOURAGES NATURAL GAS HOOK-UPS
FOR RESIDENTIAL CUSTOMERS

Secretary of Energy James R. Schlesinger today sent letters to the chairpersons of the nation's state regulatory commissions encouraging them to take actions to foster natural gas residential hook-ups.

The Secretary said that on a national basis there is a net economic benefit in promoting the use of natural gas by new residential customers.

Since 1970, natural gas service has not been generally available to new residential customers.

The Secretary cited a new Department of Energy (DOE) study indicating that residential consumers could realize a net benefit of approximately \$480 million per year by 1985, or \$140 per customer, if new residential uses of natural gas are encouraged.

This estimate is based on a projection that by 1990 an incremental volume of 400 billion cubic feet of gas per year would be consumed in the residential sector under liberalized state hook-up policies.

Secretary Schlesinger's letter said that while the results of the DOE study "are sensitive to various external conditions, notably the world price of oil, it suggests that regulatory decisions which inhibit the growth of gas usage by residential users are promoting the inefficient allocation of premium energy supplies."

(Attached is a copy of the letter from Secretary Schlesinger to the state regulatory commissions. The report, Natural Gas Hookups: Real Resource Cost Analysis, is available in the DOE Press Room, Room 8F-044, 1000 Independence Avenue, S.W., Washington, D.C. 20585).



Department of Energy
Washington, D.C. 20585

To the Chairman of (State)
Public Utility Commission

Dear Sir:

The Department of Energy has recently completed a study of the economic benefits associated with new natural gas hookups for residential users. We believe the findings of our analysis will be of interest to you in your consideration of the utilization of natural gas by end users within your jurisdiction.

The study, which is enclosed with this letter, demonstrates that on a national basis there is a net economic benefit in promoting the use of gas by new residential customers, because it is less expensive for marginal industrial users to switch from gas to oil than to require new residential users to install oil or electrical based heating systems.

The Department's hookups study concludes that residential consumers could realize a net benefit of approximately \$480 million per year by 1985, or \$140 per customer, if new residential uses of natural gas were encouraged. This savings is based on the conservative estimate that an

full range of technical and equipment capability for communications, safety, brine disposal, metering, environmental laws, security, maintenance of site buildings, warehousing, operations of a control center in New Orleans, and petroleum logistic planning for fill and drawdown of the reserves.

In addition to the specific tasks at the DOE-owned sites, the contractor will operate and maintain crude oil pipelines from the Seaway Docks to Bryan Mound to the Seaway Tank Farm; from Saint James to Bayou Choctaw and Saint James to Weeks Island Pipeline; and the pipeline from the Sun Terminal in Nederland, Texas, to West Hackberry, Louisiana.

The Strategic Petroleum Reserves is a program managed by DOE and is being developed to protect the United States against future oil supply interruptions. The reserve storage provides for the rapid withdrawal and introduction of crude oil into the United States' domestic refining systems in the event of such interruptions.

R-78-390

ENERGY UPDATE.....October 4, 1978

Brief reports, for news media, of things going on at DOE. Issued weekly by the Office of Public Affairs. The items reported do not duplicate DOE Headquarters public announcements.

DOE EXTENDS CONTRACT WITH UNION CARBIDE CORPORATION AT OAK RIDGE

The DOE has extended for five years its contract with Union Carbide Corporation for the operation of four large DOE facilities in Tennessee and Kentucky.

The contract extension through September 30, 1983 provides for continued operation by Union Carbide's Nuclear Division of the Oak Ridge Gaseous Diffusion Plant, the Oak Ridge National Laboratory and the Oak Ridge Y-12 Plant, all in Tennessee; and the Paducah Gaseous Diffusion Plant in Kentucky.

Current DOE operating costs of the four installations are approximately \$800 million annually. There are about 19,400 employees. Union Carbide has been a major operating contractor of the DOE and its predecessor organizations -- the Energy Research and Development Administration, the Atomic Energy Commission, and the U.S. Army's Manhattan Engineer District -- since 1943.

The diffusion plants produce enriched uranium for use in nuclear power plants. Union Carbide's nuclear group is also associated with development of the more energy efficient gas centrifuge enriching technique. The Oak Ridge laboratory is engaged in the development of various energy technologies including nuclear, coal, solar, geothermal and fusion. The Y-12 plant is involved in production of nuclear weapons components.

DR. ROBERT SAN MARTIN APPOINTED DIRECTOR OF DOE'S DIVISION OF DISTRIBUTED SOLAR TECHNOLOGY

Dr. Robert San Martin has been appointed director of the DOE's Division of Distributed Solar Technology in the Office of Energy Technology. His responsibilities include programs to develop photovoltaics, wind energy, and biomass technologies.

Prior to his appointment, San Martin was director of both the New Mexico Solar Energy Institute and the New Mexico Energy Institute. These institutes are the focus of solar energy work for New Mexico and, as director, San Martin developed performance standards, solar initiatives, and outreach services. He also maintained a solar information center and coordinated statewide solar and geothermal research and development.

From 1974 to 1976, he was director of the Energy Research and Development Institute at New Mexico State University. In this capacity, he was responsible for coordinating campus energy research and development.

Born in 1940 in Tampa, Florida, San Martin received a B.S.E. (1963), a M.S.E. (1964), and a Ph.D. (1969) from the University of Florida.

San Martin will replace Dr. Henry Marvin, deputy program director for Solar, Geothermal and Electric Storage Systems, who had served as acting director of the office was formed in July 1978.

DOE INITIATES STUDY COMPARING ENERGY EFFICIENCIES OF FREIGHT TRANSPORT MODES

Is it more energy efficient to move freight by truck or by a "piggyback" (trailer-on-flatcar) railroad system? During the next six months, DOE, in cooperation with the Federal Railroad Administration and the Federal Highway

Administration, is funding a study comparing the relative efficiencies of both those systems when they're used to move goods between Chicago and Minneapolis-St. Paul.

The study, funded at \$46,736, is being conducted by a DOE contractor, Technassociates, Inc., Washington, D.C. Technassociates has arranged with C.W. Transport Wisconsin Rapids, Wisconsin, to equip several tractor trailers with flow meters to measure the fuel they consume in hauling freight between Chicago and the Twin Cities.

At the same time, similar freight will be shipped between the same two points by high-speed Chicago, Milwaukee and Pacific Railroad trains. The Milwaukee locomotives will be equipped to collect accurate fuel as part of the Federal Railroad Administration's Intermodal Freight Program.

Technassociates will analyze and compare all data collected by the trucks and trains, and compile it into a final report.

The study is funded by DOE's Office of Transportation Energy Conservation.

DOE TO INCREASE RESEARCH OPPORTUNITIES FOR HIGH ENERGY PHYSICISTS

DOE's Office of Energy Research announced plans to provide additional research opportunities for junior high-energy physicists who are not permanently established in the physics field.

DOE's Division of High Energy Physics will consider unsolicited proposals for both experimental and theoretical projects from individuals who show high promise in research.

The individuals should be untenured but candidates for tenure at a sponsoring institution with commitment to continuing research in high-energy physics. Cost-sharing is expected of the sponsoring institutions.

The program is designed to retain qualified high-energy physicists in the field until professional vacancies occur.

This effort is a follow-up to the initial program in fiscal year 1978 when \$400,000 was allocated to ten different institutions, six for experimental projects and four for projects in theory. DOE expects to issue a comparable number of such new research contracts in fiscal year 1979.

For additional program information contact Dr. C. Peaslee, Mail Station J-309, Division of High Energy Physics, Department of Energy, Washington, D.C. 20545

DOE EXTENDS ENHANCED OIL RECOVERY WITH HOUSTON BASED UNIVERSITY GROUP

DOE has extended a contract with the Houston-based Gulf Universities Research Consortium for two years to collect and analyze data from oil field experiments.

The contract with the consortium of 21 leading southern and southwestern universities will provide about \$830,000 for each of the two years, until September 30, 1980.

During the past three years the consortium of universities in the petroleum and chemical engineering field has provided data on experiments such as verifying leading candidate oil reservoirs for new field tests, analyzing enhanced oil recovery economics, and performing technical and engineering tasks.

Information will be provided to DOE headquarters

Speculate - return to Paul

Abandoning geothermal an option

A-8 THE NEW MEXICAN Santa Fe, N.M., Tues., Sept. 18, 1979

-GEO THERMAL-

By R. BEHNKE
The New Mexican Staff

An option to abandon plans for a 50 megawatt demonstration geothermal plant in the Jemez Mountains will be included in the final Environmental Impact Statement (EIS), a Department of Energy spokesman said Monday.

Bennie DiBona, the director of the Division of Geothermal Energy in the DOE, said the option not to build any geothermal-hydrothermal power plant in the Jemez Mountains would be submitted to the Assistant Secretaries for Energy Technology and the Environment.

Those officials will decide whether to continue with plans to build a 50 megawatt demonstration geothermal, electric producing plant in the Jemez Mountains.

The DOE has already awarded a \$50 million contract to Union Oil Co. and Public Service Co. of New Mexico to build a 50 megawatt plant on the Baca location.

However, residents in the area, including several Pueblo Indian tribes, recently expressed concern over the environmental impact of producing more than the 50 megawatts of power.

Four-hundred megawatts, Union Oil spokesmen claim, is the potential of the area.

While residents admitted that a 50 megawatt plant might be within most environmental limits, they were concerned with the impact of a 400 megawatt operation.

Residents made the concern known three weeks ago during a hearing on the EIS in Albuquerque.

DiBona, a speaker at the opening of a conference at the Santa Fe Hilton Inn on geothermal energy, said until DOE stationed a man on the scene in New Mexico, there had been no discussion with local residents about their concerns on the subject of geothermal power.

Once an office was opened in Albuquerque, "we realized a serious concern," he said.

The two most pressing concerns, DiBona said, were Indian concerns over areas of religious significance and concerns over both the fresh and hot water table.

DiBona said the problem of Indian concern "is a tough one."

Other potential problems with subsidence and seismicity, the

Continued from Page A-1

vibration of the earth, were cited by DiBona.

DiBona said if the Indians were only concerned about specific sites (of religious significance) "something could be done about it." However, if the Indian concern is a general one for the entire area then the problem would be much more difficult.

"We could guarantee protection for specific sites," he said.

He said meetings with the various pueblos would be conducted to determine if development of the

geothermal potential of only specific areas or the entire area of the Jemez Mountains was a cause for concern among the Indians.

Several residents testified at the draft EIS hearing that increasing production of electricity from geothermal power from 50 to 400 megawatts would substantially increase the environmental impact.

They argued, apparently successfully, that the EIS should address the 400 megawatt potential because if the 50 megawatt demonstration plant was a success

the 400 megawatt potential would probably be developed.

DiBona said the criticism was accepted and the total impact of 400 megawatts, and associated production facilities, would be addressed in the final report.

During the draft EIS hearing in Albuquerque, residents of the area said road traffic, housing and other factors would be impacted much more if a decision was made to go ahead with developing a 400 megawatt power source than if the project was limited to the 50 megawatt demonstration plant.

D2

Technology

Peter J. Schuyten

Geothermal Energy Gaining

LIKE still waters, the hot brine of geothermal energy usually runs deep, and is often expensive to recover. For years, geothermal energy — most commonly water trapped beneath the earth's surface that is heated by molten rock material called magma — has been a tempting, if largely untapped, curiosity of the energy world.

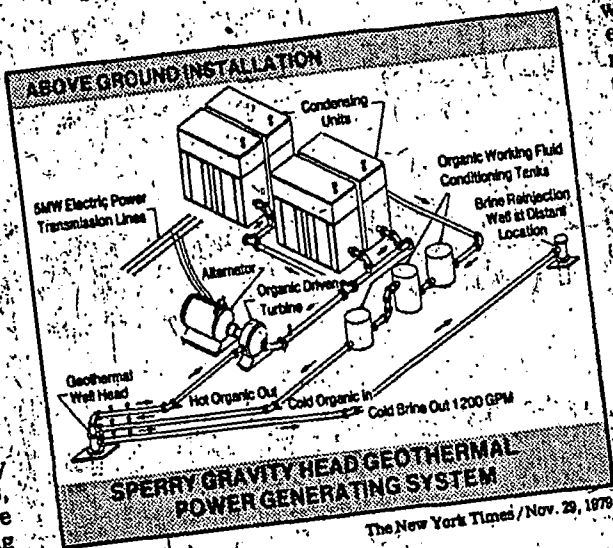
For one thing, these hot reservoirs are a relatively spotty resource, and, unlike more conventional fuels, their energy must be utilized where it is found. There is no economic way to transport hot water over long distances and still keep it hot.

But for all that, geothermal energy, although often obscured by the better-publicized quests for synthetic fuels and solar power, is finally emerging as a promising source of energy for the future.

"Geothermal, until lately, has not been appreciated for its size or its availability," said John W. Salisbury, deputy director of the Energy Department's geothermal division. "The highest-grade deposits are usable right now, and competitive with fossil fuels."

Indeed the Pacific Gas and Electric Company, in a program that began in the early 1960's with the Union Oil Company of California and the Magma Power Company, is currently generating some 6 percent of its electricity, or 600 megawatts, from steam produced in geothermal wells at The Geysers in northern California. This is enough power to supply a city the size of San Francisco.

Then too, shallower hydrothermal waters are also being used for space heating. The cities of Boise, Idaho, and Klamath Falls, Ore., for example, have been heating homes and businesses directly with



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naturally occurring hot water for decades. Aided in part by Federal financing that this year will total \$150 million, a growing number of companies are prospecting for water, sinking wells and building power plants that one day will distribute heat and convert this resource into electricity.

The idea of using geothermal power is particularly prevalent in the West, where temperatures of up to 600 degrees Fahrenheit are found at relatively shallow depths, several hundred feet in some cases. Reservoirs have been found in northern Nevada, southwestern Utah, New Mexico, Oregon, Idaho, Texas and California.

In the East, where underground water temperatures are more moderate, typically below 200 degrees, geothermal reserves have been located in Virginia and Georgia and on Maryland's Eastern Shore. These, say the experts, are ideally suited to industrial processes — the cleaning of chickens, for example, or the washing and bleaching of textiles.

Actually, geothermal energy is found in three forms. Along with hot water, there are geopressed reservoirs, where methane gas is dissolved in hot

water, and hot dry rock, often the byproduct of earlier volcanic activity. Today, however, the immediate goal is to harness hot water, since much of the technology to utilize it is available now.

For the near term, energy experts are counting on drilling and extraction techniques not unlike those used in the production of oil. Geothermal wells are dug to depths of as much as 8,000 feet. Then the briny waters bearing the 400-degree-to-600-degree temperatures considered suitable for central-station power generation are brought to the surface.

As pressure is released, the boiling hot water flashes into steam that can be used to power turbines. Once used, the steam is then condensed into water and injected back into the ground.

By the year 2000, the Energy Department estimates, some 25,000 megawatts of electricity could be produced in this way, or nearly enough to displace a million barrels of oil a day. To get there, research is being conducted on ways to reduce field costs and to utilize lower temperature deposits.

One such technique is a binary, or two-stage, process in which the energy in the hot brine is transferred through a heat exchanger to another fluid that has a lower boiling point. In this way, as much as 20 percent more energy can be extracted from a given volume of geothermal water.

One of the more promising approaches to binary geothermal energy conversion has been developed by the Sperry Corporation. In fact, the company's Sudbury, Mass., research center has just been awarded a \$16.5 million contract from the Energy Department for a 1981 field test of its so-called "gravity head" energy conversion system.

The Sperry system places a pump coupled to a small turbine in the well. The pump draws a fluid, say freon, into the well to a depth of 2,000 feet, where it captures the brine's heat and takes it to the surface. The heat transfer between the freon and the brine thus takes place in the well instead of on the surface, thereby increasing the efficiency of the process by 35 percent, the company says, and making electricity generation practical from geothermal waters with temperatures as low as 300 degrees.

Utah Roses Goes Geothermal

By Robert H. Woody

Tribune Business Editor

If you think your gas bill is high, consider Utah Roses Inc., a firm that grows roses year-round in greenhouses at Sandy.

Their natural gas heating bill topped \$100,000 during three months last winter, says C. Richard Wright, president.

But much of the problem may have been solved



Mr. Woody

weekend when drillers hit hot water on a site 15 miles south.

The well flowed 190-degree water at the rate of 200 gallons a minutes, says Mr. Wright. And plans are under way to build a greenhouse at the site, close to the Utah State Prison.

Plan Sandy Test

At the same time, drillers were moving in equipment to drill another geothermal test hole at the Sandy greenhouses under a \$450,000 grant from the U.S. Department of Energy.

The issue is simple, says Mr. Wright. A lot of greenhouses are going out of business if energy costs keep climbing.

Expectations are that drillers will have to go to 4,000 feet at the Sandy site. However, they reached the hot water at only 400 feet at Bluffdale, a few hundred yards from a well drilled earlier at the prison.

Owned by Brother

The Bluffdale site is owned by Ralph Wright, chairman of Utah Roses, and elder brother of C. Richard. Ralph will lease the site to Utah Roses.

Utah Roses will build a greenhouse of about 70,000-square-feet for starters, says C. Richard, based upon initial estimates of well flow.

Ralph Wright, said that if all goes

well, the firm will eventually build a million square feet of greenhouses at Bluffdale.

That compares with 250,000-square-foot at the Sandy facility, where 40 are employed in the growing and marketing of near \$1 million worth of roses yearly.

As far as is known, this will be the first major application of geothermal energy in the state.

According to C. Richard, growers try to maintain a high (60 to 65) humidity environment with daytime tempera-

tures of 75 to 80 degrees and nighttime temperatures of 60 to 65 degrees.

Passive Solar Aid

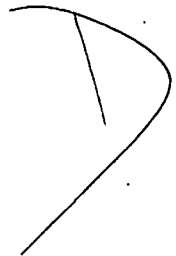
During winter, greenhouses get passive solar heating on clear days.

If the company had not developed geothermal sources, it would have to consider such alternatives as inflatable plastic envelopes over the roof areas or internal blankets drawn over the eaves during the cold night hours.

Because of the ravages of weather, the roof envelopes would have to be replaced yearly, he said.

11/20/79

Roger Stoker looks out!



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Section II