TRANSCRIPT OF PUBLIC HEARING BEFORE THE CITY COUNCIL OF THE CITY OF SAN ANTONIO, TEXAS ON PROPOSED PARTICIPATION BY THE CITY PUBLIC SERVICE BOARD IN THE SOUTH TEXAS NUCLEAR POWER PLANT PROJECT HELD ON WEDNESDAY, JUNE 27, 1973 IN THE THEATRE OF THE PERFORMING ARTS, 9:00 A.M. to 6:00 P.M.

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MAYOR CHARLES L. BECKER: Good morning ladies and gentlemen. You have come to spend a few hours with us, if that's what it will be. I am going to attempt to dissiminate the pros and cons of this question of Nuclear Power. I don't think there is anyone in the audience who doesn't realize the fact that at present, San Antonio is under going a serious power shortage. We are not only concerned about the present, we are also concerned about the future power needs of our City. This City Council is not acting the role of the constructionist with regards to attempting to solve these matters, but what we are attempting to do, is to have placed before the public, an open forum such as this, questions on Nuclear Power or any other questions which may be of interest to the citizenry of the City of San Antonio. We feel that it's the proper way to handle this matter, any matter for that fact. It is our intention to always have hearings where ever possible on what ever subject it might be, that we consider of general interest to the public of this City, because after all they are the ones that are affected. So, with that preamble having been given, I would like first of all to say that I think that everyone here is acquainted here with our Councilmen, but in case you are not, I would like to introduce them if I may. I will start on my right, first we have Mr. Alfred Beckmann, then we have Clift Marton, Mr. Glenn Lacy, Dr. San Martin, Leo Mendoza, Mr. Al Padilla. The other councilmen with the exception of Mrs. Cockrell will probably be here later. Now, yesterday with the assistance of Dr. Bob West, Chairman of the TESORO Petroleum Company, I had the good fortune of being able to talk with Dr. Edward Teller, who is presently teaching some summer course at the University of Colorado at Bolder and we taped that conversation as best we could and Dr. Teller made some rather salient observations with regards to nuclear power. I think in the interest of this hearing this morning, it would be well if we sort of set the tone, if you will, with that conversation that took place and you will probably be surprised to note that Dr. Teller did not say that Houston's nuclear power was dastardly in ....(inaudible) in all the various things you might suspect. He was an advocate of nuclear power but at the same time he also had some rather, as I said important and salient observations to make about the usage of it. So, in the sense of fairness, if you want to call it that, I would like to first play that tape, it will give both sides of the pros and cons an opportunity to perhaps readjust their various speeches that they were going to make this morning on their - being for or against. So, if I may have that tape please, I would appreciate it.

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MAYOR BECKER: He was rather forceful in his remarks concerning that. Now, one of the things he was most curious about, was what type of plant we were discussing and I think that you probably heard that he said that the thorium type of plant was in his estimation, the plant of the future, whereby the property itself could be adapted to the use of thorium. If it started off being a nuclear plant, that plant could then be switched over through some engineering modifications to also encompass the use of thorium and you heard what he had to say about thorium as far as it - the prevelance of it and the quantities of it that are available.

The most significant thing he said was that where as one percent of approximately of all the uranium ore that is mined is useable for nuclear reactors, one-hundred percent of all thorium that is mined is useable in thorium type reactors. Then he went on to say something to the effect that in his opinion, the heavy water plants which are being proposed by, and I think I understood him to say, the Gulf General Dynamic Corporation were the ones that he would favor most highly because it did have this convertibility factor and was highly adaptable to the uses of thorium. The light water plant such as proposed by Westinghouse and General Electric, were not as adaptable in his opinion.

I am going to have all of these various tapes here, transcribed, mimeographed and made available to everyone. We talked for approximately an hour on this subject and I don't know how well you were able to receive the transmission of his speach out there in the audience, but we are not going to play the whole thing. I am just giving you certain of the highlights of it as I recall. This plant that he had reference to that was able to use thorium is called Cando and it is developed with the Canadian Government as well as Gulf General Dynamic Corporation. You heard what he had to say about the disposal of the waste and he didn't think that was any insermountable problem. Now, I asked the Doctor, if he would collaborate with the City Council in the future on this matter of nuclear power and he said he would be happy to. What I gather, the gentlemen is most realistic and his approach to the energy crisis is - not only to the United States but the World at large and he is not one to say that we dare not engage in the use of nuclear because even if there is a possible tendent risk attached to it, we almost use it as being either power and energy at certain risk or no power or energy with no risk and that was almost the conclusion that I was able to draw from his remarks. Now, he had a remark to make about the fast breeder reactor. I don't know if you were able to hear that exactly, but he said that if anything in his opinion the fast breeder reactor is potentially more dangerous than the reactors that are being used today. Needless to say, you can't include every question and take into account every facet of a topic as difficult and scientific as this topic is in an hour's telephone conversation. So over simplification would certainly be the understatement of this century which would be if we were to describe this conversation with Dr. Teller. I am certain, if the man were given an opportunity, he could go into depth and at greath length on any part of nuclear energy and because he is almost the, I would imagine, the prime foremost living authority on nuclear energy today, so we are going to have that transcribed and will make it available and it might perhaps be of some assistance in determing exactly the course Public Service Board might care to take or the City of San Antonio or whatever. So, I do appreciate you giving us an opportunity to play that for you and I am sorry we didn't.....(inaudible).

Now, I would like to ask the City Public Service Group, if they are ready to make their presentation at the chairman block?

MR. JOHN LOCKE: Mr. Mayor, members of the Council, ladies and gentlemen. This hearing, we assume and presume is for the purpose of acquanting the public in general with the decision that the Public Service Board has to make regarding entering the South Texas Project which it means the participation in the building and operation of a nuclear plant. This is a project with which our engineers have been working along with the engineers of Houston Light and Power and which serves Houston and Central Power and Light which serves the Corpus Christi area which started as an investigatory project and has built into a farm project to build a nuclear power plant. The Public Service was in this deal on the basis that if they chose to participate, they would pay thirty percent of the cost of the plant and receive thirty percent of the power from it. The Houston Power and Light is the manager of the plant, they have done all of the preliminary work; however, assisted by our engineers and have purchased the land for it. The plant will be located in Matagorda County near Bay City and it is approaching a point where the contracts will be left with the construction of the plant. Under our deal with the project, we were permitted until July 1, 1973 to decide whether or not we wish to participate. If we choose not to participate, they would refund to us the money that we had spent up untill now. If we did participate, we would get our thirty percent participation. The plant will be built whether we participate or not. The only question that we have to decide at this time is whether we wish to pay our thirty percent of the cost and get thirty percent of the power. Now in approaching this problem and so that everyone may be as fully informed as possible, we propose to first cover, in a brief way, the present energy situation that we have in San Antonio and the area and the available power at this time and other types of power that may be available and as our first speaker on that, I am going to introduce Mr. Arthur Von Rosenberg who is one of our principal engineers and who will speak on that point. Mr. Von Rosenberg.

MR. ARTHUR VON ROSENBERG: I think in previous meetings we have covered the present energy situation and all of you are familiar with the natural gas shortage we are faced with here and the fact that our existing units that we have built - service units - were designed for natural gas priority with only emergency for oil. Presently, we are under a temporary power priority for gas and the Public Service Board issued by the Rail Road commission on the twenty-first of June, which puts the generation of electricity in the high human needs categories. This order contained the statement that this only were true so long and were to remain in the category so long as we were soliciting efforts to our customers. Now, if we look into the future to see what our energy source is going to be for a short term, let's say the next decade, next ten years. You really have two alternatives or possibly three: You have coal which there is an abundant supply of coal in the United States. A conservative estimate would say that you would have a three hundred year supply. In addition to that you can look at foreign oil, you can get it in here but it is bad from a situation of relying on foreign oil imports and national security situation, balance of payment situation from both view points are bad. We have here at Public Service, we require considerable generation in this next decade - the next ten years - to heat our plant. We have a historical low growth of eleven percent. Our peek forcast for 1973 is $16.50 and 1980 when we talked about the joint project is $34.25, more than doubled. We have done extensive analysis of the various fuel alternatives on economic basis for supplying these needs. We studied some 37 combinations of different fuel costs and capital costs, operating and maintenance costs and using studies, we maintained these costs from literature, various other companies, our own files and records. These studies take into account they're done by computer model that actually assimilates the usage of these plants and how they would be loaded and what the load

would be on them, how much fuel they would burn, what would be the operating maintenance cost and what would be the capital cost for the life of the plant. The basic result of these studies show that coal is 100 million dollars at 1971 dollars superior to oil and gas for this next ten year period for the life of the plant which is to be built in 1981. A joint nuclear effort is 55 million 1971 dollars for 1981 superior to the coal plant. The problem that you have with nuclear is that it takes a long lead time to get into a nuclear project, some ten years. A coal plant takes some four to six years. We have recommended and it has been approved by our Board of Directors that the unit that goes in 1976 be converted to coal. We are now and will build a coal plant in 1977. We are actively soliciting bids for coal now and our specifications are out some 80.....(inaudible). To meet the power requirements, it looks like we would go for coal - we would recommend coal in 1979 and '80 and we would also recommend to our Board very strongly that they get into the joint nuclear project and that we go nuclear as soon as possible. And our first chance on this is 1980 for the joint plant and 1982 at Bay City. We don't want to freeze our long range plan at this time because we are looking at all of the various alternatives to this fuel situation. I would like to introduce now Mr. Gene Krause, who is head of our energy planning group to talk to you about our other long range fuel possibilities.

MR. GENE KRAUSE: Thank you Arthur. The Council asked at the last briefing that we address here today the issue of solid waste or garbage and that we talk a little about the other energy planning that we are doing at C.P.S.B.. In order to do that, and to talk intelligibly about it, I have assembeled a little chart to speak from and it should and we should draw the curtains and have the screen available to show the chart. The engineering division has over the last few years assembeled a group of people on this energy systems planning consisting of twelve professionals. In addition to these, we called upon other professionals within the company and we called upon consultants to do very broad planning in the energy field. Arthur Von Rosenberg has discussed a few of the studies that appear up there. You will notice along the left we address the fuels that we are using today: natural gas, coal, oil and to the right in the barn, we show what percentage of the total C.P.S.B. demand that these sources might meet. We will notice that natural gas in 1970 for example, was able to serve one hundred percent of C.P.S.B.'s demand, if you will take the width of that block in 1970 as being one hundred percent. When we look at the other sources, coal and coal gasification which is just another form of using coal, we are fairly certain that if we so desired, we could use coal to serve one hundred percent of C.P.S.B.'s needs for the future for a long ways. Oil is a little more difficult, we are not sure of the percentages there. I am sure it is a fairly narrow line. I would not like to say that we are definite on that. The oil situation is quite variable, but it indicates that supply is tight. Nuclear energy is on the market place. We can buy it today. We could serve, if we so desired, one hundred percent of C.P.S.B.'s needs. Well, this group has looked at many other things and I was glad that Dr. Teller was questioned about some of these for I think they hold pretty good potential. It may be out in the future pretty far, but I believe they do hold pretty good potential. I'll show you a little more detail on solid waste and conservation in just a few moments since that was an issue that was to be brought up here today, but I would also like to mention solar energy. Our people are in contact - in direct contact - with the Mundales at the University of Arizona. We have been in contact with Dr. Glum at S.M.U. who has some new methods. We have also been in contact with the Arthur B. Little Company, Peter Glazier, who has a project up in the northeast to use solar energy for heating and air-conditioning. In addition to that, we have traced down quite a few other sources and have done quite a bit of research in the area of

thermo-porta tank converters which are the kind that are used in the space ships. Our idea here is and although we haven't gone so very far, this is also a difficult field. Our idea is to go to the source of the research, keep up with it, know what is going on and try to know as early as possible when that system can be applied in San Antonio and applied economically and reliabilly and safely. In the area of thermal effluents we have done quite a bit of work as you know our elective plant and energy with the efficiency of about one-third that means that two-thirds of the energy, if moved is lost. You think that perhaps it's a good time to begin.....(inaudible). I did not show in all of the areas that we are studying. We are studying the broad energy spectrum, but what I want to bring out here is that we are in addition, looking at hydro-electric, geothermal and I noticed that hydrogen was mentioned this morning. We are actively interested in that, hydrogen being a good energy carrier, not being a real prime fuel source, but with some possibilities or as an energy carrier and to be mixed with our natural gas as perhaps over the long term like ten, fifteen, twenty years we could slowly work into that technology. We have done a good bit of work in fuel cells here again, it is not a prime energy source, it is a source of energy conversion which has potential for converting with a little greater efficiency. That means then that when we convert with a little greater efficiency, we effectively have more fuel available to us. We have looked at Magneto Hydro Dynamics which is MHD work in metal vapor cycles, these are.....(inaudible) cycles, potassium vapor cycles is going on at the Oak Ridge National Laboratories. This has the potential for increasing the efficiency of present large plants by perhaps five to ten percent again with the potential of making more fuel available because the economy is cheap. We have looked at tidal winds,.....(inaudible) sulfur batteries and several other areas. What I am trying to show on this chart is that our planning for the future has got to be flexible. We cannot settle in on natural gas, coal, oil or nuclear and assume that one or two sources is going to serve San Antonio from here on out. Our long-range plan must be flexible, it must have the flexibility so that these developing technologies can be applied and can be applied without penalities due to poor planning, when they become available and economical.

Now, let me go into a little further detail on the solid waste. We had a meeting a week a go Monday with the Public Works people and Mr. Morton attended that meeting where we discussed methodology preceeding with solid waste and to be fairly brief here this morning. Let me show you several ways that we have looked at in handling solid waste. This is a method called insineration. The City of Nashville, Tennessee is implementing this method and essentially what happens here, you bring in garbage, you put it into an insinerator, you make steam with it and then you do something useful with the steam. Now in this boiler, there is really nothing but garbage being burned. There is perhaps a little auxillary fuel, but electric energy is not made directly here, we make only steam or hot water. This steam or hot water is in turn used to produce perhaps heating requirements for down town areas, winter heat and it is used for producing cold water which is used for comfort conditioning in the summer. A system like this one uses about twelve hundred to fifty tons of garbage a day which is very close what San Antonio produces. It puts out, for example enough cold water to cool something like thirteen thousand residences which is not insignificant.

Let's look at another method. This is the front end of a method used by Union Electric in St. Louis. What happens here is that the refuse comes in and is ground up by the hammermill, it goes

hrough a magnetic separator where the metals are separated out and I nderstand there is an air classifier system being installed to take ut other noncombustibles and then we go to the next slide. Here we e the garbage going into a receiving bin then going into a blower ystem and the surge bin and on into a conventional boiler. This is coal fired unit, this is not a new unit, it's one that has been in nion Electric since ..... (inaudible) sometime modified to receive the garbage. That system has been in operation for about one year. t had some early troubles, but I think the operation has stabilized now. The investigation of the inside of the boiler thus far indicates that there are practically no short term effects. There are some problems removing bottom ash. There were many early problems which solids had collected in the bottom and stuffed in the bottom. The long term effects are not yet analyzed and it is suspected that there will probably be a little extra corrosion on the boiler tubes and perhaps the life of the boiler will be reduced somewhat. However, it must run for several years before you can make those predictions.

This is another system. This system was developed out in California by Combustion Power Company. The research was financed by Department of Housing and Urban Development. We visited that site in the spring of '72 to look at what was operating at that time and this system works in a little different way than the others. You have on the top right where it says solid waste processing, again a grinder crusher which reduces the particles' size. There is an air classifer, magnetic classifer to take out the nonburnables, metal, glass, rocks nd so forth and then there is waste storage. After that comes really he new technique. There is a fluidized fed combuster which is a urning technique first used in Europe. The burnables are injected ere and burned and burned very completely so that very little undeireable effluent is produced and we result after that burning in ot gases and ash and perhaps a very small amount of light metal so n aluminum removal.....(inaudible) is installed and separators are stalled to remove the ash. The clean air then goes to a hot air rbine which in turn drives an electric generator to produce elecicity. When we visited that place, only the fluidized fed combuster nd one of the separators as well as the shredder classifier system re working, they were working quite well. Today, we understand the ntire system is working and working very well. None have been sold oday. Those are the three systems that we are quite familiar with nd there are others, the landguard system for example, I think that produced by Monsanto. It is a pyrolysis system and this means estructive distalation and is also a candidate.

The next steps in this, I believe, are to determine or ptimize the system to determine which one or which ones of these or hat mixture of these and perhaps others should be applied and how do e optimize the lay out on the property. How do we optimize the transportation of the garbage so that we don't get into a corner in the uture on it and so that we really reduce cost on a community wide asis. This is a methodology that we are going to follow and working ith the Public Works people and of course these are the kinds of studies that are not yet done and this is what we originally requested the revenue sharing funds for last year.

Now then, to give you another example of the work that we are doing to try to improve human economy. Let's look at another slide. e have an idea here called an Energy Sub-Center and the entire philosophy here is to increase the efficiency of energy conversion by utilization of waste pete and we will begin at the bottom where it says as turbine generator and the word electricity. This is a small gas

turbine driving an electric generator producing electricity. The gasses from the carbon generator goes through a waste heat boiler or heat recovery boiler there where hot water or steam is made. Now, then, the hot water can be distributed directly for winter heating, it can be distributed near the top of the chart for an absorbtion chiller to produce summer cooling, cold water for summer cooling. So, we reduce the air conditioning demand that is normally put on the electric part of it by using waste heat to serve these demands. In addition to that, we are working with Southwest Research on a small sewage treatment plant. This actually is a fairly complex small chemical plant that would use waste heat in order to process sewage and produce portable water on the output side. Those studies are quite successful today on paper. They have not gone through the pilot stage but our paper studies indicate a good potential for success. On the other side you will notice waste heat going through a pyroelectric unit and you will notice the garbage going into that. This is a technique for destructive distalation through the use of heat and oxygen to reduce garbage to methane gas, a live oil, a coal char and perhaps a little fertilizer. The fuel that would come from this pyroelectric unit would of course go back into the turbine, and start the driving force. The overall term and efficiency is, if we can get all of this to work properly, might be up fifty to sixty percent and maybe higher. We are very optimistic about this system. We have done quite a few paper studies. We have even gone so far as to look at areas in San Antonio where this can be applied and have found areas with extremely good potential. For example, the Methodist Hospital area, a very rapidly developing high load area which may have as much maybe as eighty percent of our total load by 1980. We are very optimistic about this system. I might add here, we have been working on this for a long time, we haven't spent so very much money yet, but as early as January of 1972, Southwest Research and C.P.S. took this idea to HUD in Washington and made a presentation in hopes of getting some money for this project. We were not successful but some how in about October of '72 this idea came back to Soutwest Research via NASA, Houston wondering whether some help could be had on this idea. That HUD was interested in it and NASA was now sponsoring it. And you might be further interested in an article, next slide. This appeared in Business Week about a week or so ago and it is very much like the project we took to HUD in 1972, but it was awarded HUD. NASA awarded this to United Aircraft Hamilton Standard Division gave them 700 thousand dollars for the initial investigation and the pilot size is to be for sixty people. We had thought together with Southwest Research that the pilot stage was not really necessary since new technology really was not involved that we could expand to full scale size immediately. Anyway we hope to get benifit from these studies. That about concludes my portion of the presentation. We will go back again here to our planning philosophy that we emphasize in our long range schedule the flexibility so that the new technique, the developing techniques can be injected without detrimental affects on our main phase which might be coal or oil or nuclear or some mixture of these. The next speaker is Jesse Poston, he will address the joint nuclear project.

JESSE POSTON: Thank you Gene. Mayor Becker, City Councilmen and citizens. I don't want to belabor the Council or the citizens here with more details before we can get into the actual main subject of our meeting this morning. I would like to go over breifly some of the highpoints that I think need emphasis to sort of set the stage for what we think the issues that should be talked about this morning

nd that is that the City Public Service has engineers and planning taff which have studied the problem of handling the burgeoning growth f San Antonio's energy demand and has been studying these solutions nd I think have looked into all the solutions that show promise, has itted them into an energy plan that will take us through the '80's and 90's in the most economic fashion. You were talked to awhile this orning about the availability of fuel what our studies show, and what he national trends have been in so far as gas and oil and coal and uclear. Our people have carefully studied what other major cities in he U.S.A. have done and are doing in the utilizations of these fuels. e watched with careful interest what has happened and what is happening n the national level in so far as legislation in the use of fuels in he future in so far as availability supply and we look at economic very strongly. The growth of San Antonio has experienced in the past years, and we have no reason not to believe that same growth won't be experienced in the future, has been about eleven percent compounded annual increase in electric demand. If San Antonio, to stay abreast of this healthy growth, if San Antonio is to keep its children and grandchildren here for jobs and for the future, then it must meet these electrical energy demands. When you look at the load curve and load projection and fit the most economic charges of electrical generation availability available to meet this demand, our planning is as follows. We utilize the oil, gas burning boilers, we try to convert them to burning oil as quickly as we can, we go to coal. We think we are planning to make coal in '76 and '77 out of the summer site and possibly some more coal units at that location before 1980. When you look at the increment of demand San Antonio will need in 1980 and '82, it shows that we need about 350 mega-watts additional on each of those years. Your engineering department in studying all of these alternatives and in studying the state of New York is recommending to its management that this increment of necessary demand in 1980, '81, and '82, be nuclear power. And the nuclear power is available from the South Texas Project. Since World War II, Houston, orpus, San Antonio and the two companies in Austin.....(inaudible) in he City of Austin have planned together and have talked together and t has always been in the desire of these people to jointly plan and oordinate generating units. It would be unreasonable and a tightly nterconnected system such as this for everyone to put all of their enerating capability at one time and the next year maybe have a little it of a valley. So, the South Texas Project is in a situation where he principals of these companies met in 1971 and talked seriously about he feasibility of getting together and building a power plant in oncert. These talks lead to more serious discussions and have lead us where we are today. Namely, that there has been a site purchase in tagorda County, about ten thousand acres. It is in the Central Power d Light Service area but it is a location that will be convenient to uston, San Antonio and Corpus. They have engaged the Brown and Root gineering Company that has done considerable engineering on the site so far as the soil analysis, all the environmental and ecological ctors that go into siting a large industrial complex that this will . There will be about a seven thousand acre lake involved. The site ll support four eleven hundred megawatt units. The South Texas roject that we are talking about this morning, only envisions two of hose megawatt units. Both of those two eleven hundred megawatt units ill cost around 900 million dollars. Incidentally the largest generating nit that San Antonio has today is four hundred and thirty megawatts. o, you can see the relative size of the installation. The units are scheduled to start construction in 1976, January 1, 1976. The hardware for the plant, the nuclear steam supply and all the pertinent gear has not been selected. The quotations of the majority of this

gear has been given and are being evaluated. And now, Mr. Locke, would you like to introduce our next speaker that will talk about some of the details, some of the technical details relating to a nuclear power plant.

MR. LOCKE: Thank you Jess, I believe you know that we have in house very capable and competent people who are working on this problem and have been working on it for a number of years. We are proud of them, we think they rank with the best, however, we also have today some, I guess they are out of town, experts, they are recognized in the field as very competent people in so far as nuclear energy is concerned and the first of these is Dr. Draper, Dr. E. Lynn Draper, Jr., he is a native Texan, which I think makes him unusual in this field, He was born in Houston, Texas, went to school in Houston, Williams College, Rice and Cornell Universities. He joined the faculty of the Mechanical Engineering Department of the University of Texas in 1969. I might tell you while I was in school in 1933, when I graduated in 1933, there was quite a competition between the Electrical Engineering School and the Mechanical Engineering and Mechanical Engineering had a calculator. I used to go and use it on the weekends to work out some of the electrical engineering problems and they greatly resented it, but I finally learned to get along with mechanical engineers, Doctor. He is the Associate Director of the Nuclear Reactor Lab and Director of the Laboratory at the University. He is also the Nuclear Engineering Academic Program Coordinator. He has published numerous articles on Neutron Physics, Radiation Application and Nuclear Fussion Engineering. He is active in the American Nuclear Society serving on the membership and program committees. He has been Program Chairman of topical meetings on fusion engineering and the Applications of California 252. And he will tell us what this is also, Mayor, and he has been designated as Technical Program Chairman for the 1975 Annual Meeting of the American Nuclear Society in Dallas. Dr. Draper.

DR. E. LYNN DRAPER, JR.: Thank you, good morning Mayor, councilmen, ladies and gentlemen. What I will try to do this morning, is to give a brief run down of the operating characteristics of nuclear power plants, how they contrast with fossil fuel plants that we are more accustomed to in this part of the country. I will try to address some of the questions that I think are uppermost in our minds, mainly those of safety and reliability of the nuclear plant and then I will try to be responsive to whatever questions you might have at whatever time you choose. To put this in the proper context, I think we need to remember that for many years, the needs of this part of the country has been met by an abundance of oil and gas. We have been very late getting into this business if you look at the parts of the country where nuclear power has been developed, you will see they're in regions where there is high population density without very abundant fossil fuel, mainly in the regions of the Great Lakes, the East Coast and West Coast. Within the last few months we have been acutely aware of the dwindling supply of oil and gas in our region and now we have to look to other forms of power. So, I would like to start by showing a slide that demonstrates some of the means of generating electricity. I would like to have the first slide please. While the slide is coming on, I might remind you that the population of the United States is increasing about a percent and a half a year but our consumption of electricity is growing about eight percent a year. You heard this morning that in San Antonio that we have an even faster growth rate, about eleven percent per year. This means that we have to either look for alternative supplies of electricity or we have to find ways of doing without electricity. I think most of us would like to find these alternative ways. Those that are available to us with present technology would include this first one. This is meant to depict a hydro-electric plant. I hope those of you in the

back that will not be able to see the slides, will move forward. I was back there a moment ago and it is pretty hard to see from the back. This is meant to show you how electricity is generated in the most simple way. You have a lake. The energy is stored in the potential energy of the water in the lake. You allow the water to go over a dam, fall through distance and when the water falls, it strikes a turbine. The falling water turns the turbine which is in turn mechanically connected to an electrical generator. This generator is essentially a magnet within a coil of wire and when it spins, it generates electricity. Now hydro-electric plants are very simple to construct, very simple to operate. Aside from the fact that a large lake must be constructed, they have minimal environmental effect. Unfortunately, to produce significant amounts of electrical power, using hydro-electric energy, one needs a very large lake and a very high dam and it turns out that in Texas, we don't have those resources reserved. There are a few hydro-electric plants on the Colorado River, but their electrical output is very small compared to the thousand megawatt plant that is being discussed today.

Our more conventional type of generation for this part of the country is fossil fuel. This particular slide happens to say coal fuel, but in essence it is the same for any fossil fuel. The chemical potential energy stored in the fuel is released in the combustion process. You see in the lower right hand corner, there is a furnace. There is a fire in the furnace and in this case it is burning coal. It could equally well burn gas or oil. The heat from the gas or oil or coal is used to turn water into steam in a boiler. The steam is contained at very high pressure and is passed through the turbine. The high pressure steam then, is exhausted through a lower pressure and as the pressure decreases, the turbine drives an electric generator and electricity is produced. The steam, after it leaves the turbine, passes through the condenser which is the white box in the lower middle of the screen and in the condenser, the steam is reconverted to water and passes back into the boiler. The most salient feature of this flight is that the water passes through the boiler and terbine and does not reenter atmosphere. You see there is a closed loop there. All the heat that enters the atmosphere does go through the condenser so there is a separate stream of water. We will see in a moment when we talk about a nuclear plant that the situation is the same. The water that passes through the reactor and therefore has some slight chance of becoming radioactive, never comes in contact with the environment. The water that passes into the environment in this case is from a lake or cooling tower, cooling pond or some other source of reservoir. The temperature of that water is increased only a few degrees. The water that is circulated through the turbine is perhaps a thousand degrees fahrenheit in a form of steam, but the condenser water only changes from ambient temperatures a few degrees.

This is meant to depict a nuclear power plant and I would like to convince you that the only significant difference between this and the fossil plant is the form of the boiler. On the left hand side of the screen you see a large cylindrical container with hemispherical ends. This is a pressure vessel for the nuclear reactor. The red region in the center of this reactor represents the reactor's core and it is this part of the reactor that takes the place of the boiler in a fossil fuel plant. In this type of reactor, known as a boiling water reactor, water enters the core region. Its temperature is raised as it comes in contact with hot uranium oxide fuel rods. As the temperature is raised, it

is converted to steam and passes out of the top of the vessel over to a turbine. You can see that the turbine is connected to a generator. The steam from the turbine is recondensed and passed back into the reactor core. Over on the extreme right side of this slide, you see a cooling tower. This happens to be a mechanical draft cooling tower. It takes the place of a cooling pond or reservoir and it is that mechanism through which the excess heat is dumped to the atmosphere. In the nuclear reactor, the source of heat is not chemical energy any longer, you no longer have combustion processes. In the sense you have a flame and burning fuel, energy is released in a fission process. The energy that is released is stored in the form of nuclear potential energy and is released in a fission process which is depicted in this slide. In the core of the reactor, uranium is assembeled in rods, these rods are approximately a half an inch in diameter and about twelve feet long and a typical reactor core contains several thousand such rods. The rods are composed of uranium oxide. Uranium has the property at least one isotope of uranium. So, that when it is struck with a neutron, it will split in two pieces. This is know as fission. This slide depicts the fissure process. In the center of the slide, you see there is a large nucleus that is meant to be the uranium nucleus. Entering from the left is the neutron which is a small sub-nuclear particle which enteracts with the nucleus causing fissure. The two lighter nuclei are formed, these are fission products. They leave the process with great connetic energy. As these chart particles are slowed down within the fuel rod, that is within the one half inch diameter rod, they give up their energy to the fuel. That is what makes the fuel rod hot and what converts the water to steam. In the process of fission also, more neutrons are created in this particular slide you see on the right, that there are two neutrons. On the average there are about two and a half neutrons created in fission process. One of these must be used to sustain the chain reaction. That is, it took a neutron to start the reaction, it takes another neutron to make the next reaction go. But there is about a neutron and a half on the average left over. In a moment when we discuss the breeder reactor, I will tell you what happens to these neutrons, this one and a half neutron. In the reactors of today's design, the one and a half extra neutrons are wasted, that is they are absorbed in structural materials or cooling waters or they some how escape from the reactors core. They are not put to effective use. We will see in the breeder that it is very important they be carefully utilized.

This is meant to depict a particular type of nuclear reactor. As you heard on Dr. Teller's tape this morning, there are several types commercially available in the United States. I am sorry this slide is so dim, but I think you will be able to detect the general features. On the left hand side of the reactor core, contained in a pressure vessel, water enters the reactor, it is heated, turned to steam, steam drives the turbine, it is recondensed in the condenser and passed back through the core. Because the water actually boils in the reactors core, and is converted to steam, this is called a boiling water reactor. The physical characteristics of a plant such as this or that has a pressure vessel diameter, is roughly twenty feet. The hight of the vessel is roughly eighty feet, has a steel wall that is perhaps six inches thick. A very substantial structure. The fuel itself is contained in rods as I mentioned before that are about half an inch in diameter and perhaps twelve feet long. Reactors of this type are sold by the General Electric Company in the United States and accounts for about forty percent of the reactors that have sold in the United States today. Now a modification of this type of water - Oh, these slides are out of order, let me come back to this slide

A modification of this type of reactor would be the pressurized water reactor. This depicts pressurized water reactor. The salient difference between this reactor the boiling water reactor is that the pressure in the reactors core is maintained at such a level that the water does not boil. Boilling water reactor that we saw a moment ago, the pressure is held at about a thousand pounds per square inch. The water therefore boils. The reactors of the pressurized water reactor, this type of reactor the pressure is about two thousand pounds and it does not boil directly into the reactors core. The water is heated to about the same temperature however, about five hundred and fifty degrees fahrenheit, it exists in the reactors core. And to the right of the red loop, you see a steam generator. The steam generator is the second loop of water in which the pressure is maintained at a lower level. As the water from the high pressure loop comes in contact through steel tubes with the water in the lower pressure loop boiling occurrs and steam is generated so that the pressurized water reactor inserts a secondary loop where the boiling process takes place. The water take passes through the reactor is always in a liquid state, pressurized water reactor. These reactors are somewhat more compact instead of being twenty feet in diameter, the pressure vessel is perhaps fifteen feet in diameter instead of being eighty feet tall, it is perhaps forty feet tall. But the wall thickness is about ten inches instead of six inches. It is still a very massive structure. The water is converted to steam, the steam drives the turbine in the same way and then the water heat is rejected. In this case showing a cooling tower, a natural draft cooling tower. Reactors of this sort are also available commercially in the United States and in this case they are sold by three firms. The largest is Westinghouse, the other two areCombustion Engineering and Babcock and Woolcocks. Pressurized water reactors also account for roughly forty percent, a little over forty percent of the reactors in operation in the United States. Another type of reactor that is not depicted on a slide, is the high temperature gas cooled reactor that is the reactor that was described by Dr. Teller as being available from Gulf General Atomic Company. The same slide we have here for the pressurized water reactor will do for discussing the high temperature gas cooled reactor. A reactor of that type, the only difference between that reactor and this pressurized water reactor is that the red loop, the primary coolant loop replaces water with helium gas, so instead of passing water through the reactors core and then you contact this helium gas with water in a secondary loop, converts the water to steam and drives the turbon. The advantages of the high temperature gas cooled reactors are in thermal efficiency. Because the structural materials in the gas cooled reactor is graphite instead of steel, it can be run at a somewhat higher temperature and the thermal efficiency of the plant goes up from about thirty-two percent to about forty percent. This means that you reject roughly one half less heat to the environment.

Let me back up now two slides to discuss for a moment, the breeder reactor. We talked a minute ago about the fission process and I said that took place in uranium. As Dr. Teller mentioned in his tape, it only takes place in a small fraction of the uranium, mainly the uranium 235. On the left hand side of the slide there is a full circle depicting a hundred pounds of uranium. On the right hand side of the slide, there is - it shows that ninety-nine point three pounds of this hundred pounds of uranium or uranium 238. With present technology, this uranium is not useful as a fuel in a nuclear reactor. Also on the right hand side you see a tiny black wedge, that is seven tenths of one pound and that represents the uranium 235 content of the uranium ore, so the useful fuel in the reactors of today's design is about seven tenths of one percent or seven tenths of one pound in every hundred of the uranium that is mined. The breeder reactor is a device meant to convert the ninety-nine point three pounds of uranium 238 to useful fuel. It does this by capturing neutrons, you will remember there one and a half extra neutrons in the fission process.

These neutrons are captured in the U-238 and in the process, U-238 is converted to plutonium, a useful fuel. It will also be by this process that thorium will be utilized. Instead of driving the reactor with uranium 235, one would probably drive it with uranium 233. Replace the uranium 238 with thorium. When thorium captures neutrons and it in turn is converted into a useful fuel. Both uranium 238 and thorium 232 are useful in breeder reactors but not in reactors of today's technology. The fast breeder reactor, one relying on converting uranium 238 to plutonium, is in the development phase at this point. This is meant to depict the flow diagram of a fast breeder reactor. On the left you see a reactor cooled with sodium instead of using water or helium gas as the primary coolant, liquid sodium is used as the coolant. This is used for two reasons, first of all it is a very good heat removal agent. That is, it can take the heat out of the reactor more effectively than either cooled water or helium gas and also it doesn't slow the neutrons down. The breeder reactor is reliant on using neutrons as energy that are born in the fission process before they are slowed down by collision with structural and coolant material and sodium does not slow them down. So, the heat is removed with liquid sodium. It is given up to an intermediate sodium loop and that sodium loop gives up that heat to a steam loop. The reason for the insertion of the secondary sodium loop is that there is no possibility then of the radioactive sodium which passes through the reactor of ever coming into contact with this steam and turbon loop. In this type of reactor, you see there are really four loops. There is a primary coolant, a secondary sodium loop, a steam line and finally the loop that is connected to the environment will run the reactor cooling the condenser.

The ways that people are most concerned I think, about nuclear power, are their environmental effects. And those generally fall under two classifications: One, is the release of radioactive materials and the other is in the release of waste heat. In this part of the country, we usually dump our waste heat in reservoirs or cooling ponds and in other parts of the country where other alternatives are used and this slide is meant to depict one of those. These large structures in the back ground are cooling towers. These are natural draft cooling towers that are used in California to reject waste heat from the atmosphere. In the State of Texas we are lucky that we have abundant water resources and we can build cooling ponds that act as recreational as well as power plant cooling reservoirs and so these types of cooling towers are not used in this part of the country. Another alternative is mechanical draft cooling tower in which water is passed over fans. You have seen cooling towers of this sort, I think, cooling plants in the Houston area. Again they are not so commonly used as the cooling ponds.

The next few slides show some of the components of a nuclear reactor as it is being constructed. This is a fuel inspection process and the lower right hand corner there are a number of small pellets. These little pellets are uranium dioxide, they are about a half an inch in diameter and half an inch tall and it is these pellets that comprize the fuel of the reactor. The pellets are ground to very exacting specifications and then loaded into longs or conium tubes to comprize the fuel rods of the nuclear reactor. The fuel rods themselves are roughly half an inch in diameter. Sufficient pellets are stacked up to make a rod about twelve feet long. Here you see a fuel element as it is fabricated. This is a fuel element containing several hundred fuel pins or fuel rods. The woman is in the final assembling process and the pertuberances are from the left hand side of the control elements. The nuclear reactor has started up by gradually withdrawing materials from the core region that absorbed neutrons as these materials are withdrawn, then the nuclear chain reaction can

take place. This is the top section of a fuel element again you see there are several hundred fuel rods arrayed with the control rods positioned in the center of the fuel element. This is the grid plate that holds the fuel rod in place. You can get some idea of the size of the nuclear reactor from this particular slide. You see the man on the right? This is a grid place that is roughly twelve feet in diameter, several inches thick and it is made of stainless steel supports the fuel as it is placed within the reactor. This is the pressure vessel for a nuclear reactor. The reactor core is the symbol, that is the fuel rods are assembeled in this roughly cylindrical array and placed within this very massive vessel. It is this vessel then that contains the water and steam at very high pressure. The point to notice there is the size of the vessel is roughly forty feet long, rougly fifteen feet in diameter has a wall thickness approximately ten inches. Assessing the likelyhood of fission products or other radioactive materials escaping from the reactor, you should bare in mind the multiple layers of containment. The fission products resulting from fission process are radioactive. The first layer of the container is the fuel itself. The fuel is uranium oxide, it is the ceramic fuel, it is essentially impermeable passage of fission products. A few percent of the fission products aren't able to escape from the fuel but are contained within the fuel cladding. Cladding is a zirconium alloy that encases the fuel bin. So, those are the first two layers of containment.

The third layer would be this pressure vessel. It is a very massive vessel with very thick walls which surrounds the reactor core. This shows the lid for the pressure vessel as it is being loaded on a barge. This is a steam generator where the water is converted to steam to pass the turbine. Again you get some idea of the scale of operations and the size of the nuclear power plants. This shows the bay in which a number of pressure vessels and steam generators are being assembeled. This shows the internal ..... (inaudible) for the steam generator and I would like to draw your attention to the care with which this is being done and if you will notice the guys are dressed in costumes that are more suitable to a pharmasuitical industry rather than a manufacturing plant. This shows the steam generator and the pressure vessel being loaded on a barge for shipment to the nuclear power plant site. These are very massive vessels and by far the most convenient method of transportation is by water on a barge. This shows the pressure vessel head being lowered on the nuclear reactor. This is some three units of a nuclear power plant being assembled. In the upper left hand corner you see the containment vessel surrounding the pressure vessel. In the center you see a second containment vessel with the pressure vessel lid being lowered into place and on the right, you see this vapor suppression system that condenses steam into the unlikely sense that there should be a steam leak from the primary containment or the pressure vessel. These particular reactors are being constructed at Brown's Fairy in the State of Alabama. This shows the dry well or the containment vessel in profile. This is a containment shell that goes around the pressure vessel so this is in some sense the fourth layer of containment surrounding the reactor. This particular vessel is several hundred feet in height and at the bottom the diameter is about four hundred feet. These elements then are assembeled in the nuclear power plant. This is a photograph of one such power plant in the State of Minnesota. The reactor building is the taller of the two buildings in the center of the slide. The Mississippi River is over on the left hand side and it is used for makeup cooling the water. The primary cooling water or the cooling water used to cool a reactor of this type is by mechanical draft cooling towers that you see in the upper portion of the slide. That ends the slides and if I can have the lights, I would like to address some specific questions that maybe of interest.

One of the things I think, in the consideration of a power plant that has arisen in this part of the country is the availability of fuel. We are very concerned there is an inadequate supply of uranium to last for the life time of a nuclear power plant. The amount of uranium that is in the earth's crust is very large. The only question is can it be economically recovered. At today's prices, uranium oxide can be obtained for about six dollars a pound. The amount of uranium that is available at prices less than about fifteen dollars a pound will last us to the end of the century. Now it sounds like a lot of money going from eight dollars a pound to fifteen dollars a pound, that is roughly doubling the fuel costs. The question is, what impact does the fuel costs have on the overall operating costs of the plant. In a nuclear plant, most of the cost is in the capital cost of the plant. The plants are very expensive to build, but the fuel costs are quite low. Fossil plants are just the other way around, it is fairly cheap to build a fossil plant, but the fuel is quite expensive. You burn large amounts of fuel in a fossil plant, but very small amounts of fuel in a nuclear plant. For example, in a thousand megawatt nuclear plant, one burns about six point six pounds of fuel per day. That is not very much fuel. Now, if you double the fuel costs, that if you double the ore costs, to a nuclear power plant, it adds something like three percent to the cost of generating electricity. So, we can afford to raise the price of the uranium ore that we buy for a nuclear power plant a large amount with out significantly affecting the cost of the nuclear power. This is an important point particularly in light of the uncertain cost of the fossil fuel for today. Another way to look at this is to compare what a price status for uranium is equivalent to for let's say, oil. It turns out if you raise the price of uranium a dollar a pound, from eight dollars to nine dollars a pound, it is equivalent to raising the price of oil six cents a barrel. Now, you know that recently the price of oil went up forty cents a barrel. That means, that if nuclear power was economically competitive before the price rise, you could afford to raise the price of nuclear fuel about six dollars a pound. The cost of nuclear power is very insensitive to the fuel costs. There is an adequate supply of uranium to last into the forseable future.

The other question that has been raised is the reliability of nuclear plants. There are some thirty nuclear plants in operation in the United States producing electric power. Add to these the number of reactors used to propel naval vessels, you have about a hundred more reactors. All of these have operated satisfactorily. There has never been a case when one of these plants have had an accident that injured a member of the general public. In addition to the thirty plants that are now in operation there are some sixty other plants that have been announced. These are plants that have been committed but not yet under construction. It is expected that from fourteen to twenty plants that are now under construction will be issued operating licenses this year. So, there is a number of nuclear power plants. The question arises as to what fraction of the time are they available? Utilities like to have power plants that are available to them roughly eighty percent of the time. It is recognized that there will be scheduled maintenance outages and things of this sort. So it will be constructive to look at the operating history of the power plants that we have in operation. Yesterday, I went to the Atomic Energy Commission in Washington and got the most recent data from them on the operating history of the nuclear power plant for 1972. In the year 1972, there were twenty-nine power plants that were classified as operational. These included power plants as old as 1957 and as new as 1972. If you average the plant availability of all these power plants, you find that they were available sixty-six percent of the time. That doesn't sound particularly good, but if you exclude those power plants that are less than two hundred megawatts, that is the power plants that are old, that were first

of a kind, and if you exclude the power plants that were started last year, that is those that are still being brought up to full power, the number increases from in the mid-sixties to seventy-eight percent. For those power plants that could be called reasonable power reactors, this is that have been on line for more than about a year and less than about ten years, the availability is as good as for a fossil fuel plant.

As you are all aware, there has been much discussion in the press recently and in the technical journals about the emergency core coolant systems. The emergency core coolant systems are systems that are designed to protect the public and the reactor plant from the loss of coolant to the nuclear reactor. As I mentioned before, the nuclear fuel is very hot, water is passed around the fuel rods and is heated to roughly six hundred degrees fahrenheit. Now one can postulate that for some reason the flow of coolant to the reactor could be interrupted. You might say then, turn the reactor off and the problem goes away. It is not that simple. The nuclear reactor continues to generate heat long after it is shut down. The reason for this of course, is the radioactive product that has built up in the fuel. They continue to generate heat even after the reactor is turned off. So, provision must be made to get this heat out. The accident that is postulated to provide for a loss of coolant is the guillotine rupture of the main coolant pipe. So most responsible people don't think this is a credible accident but it is a postulated accident. You have a pipe with a wall thickness of roughly four inches. The hypothesies is that somehow this pipe becomes ruptured and not only becomes ruptured but the two sides separate so all the cooling water is directed away from the reactor's core rather than into the pressure vessel. The emergency core coolant system is to provide cooling for the core in this eventuality. The discussions that have occurred about the emergency core coolant system center around the fact that there has never been an experimental verification of their function. People who have nuclear power plants with emergency core coolant systems are not about to cut off the primary coolant flow with a rupture of this type to test the emergency core coolant system. So, two things have been tried: First, numerical models have been devised to simulate what would happen in a reactor. These calculations indicate that the emergency core coolant system could adequately cool the nuclear reactor. A second thing was tried, it was to devise a scale model of the nuclear plant and do an experiment on an electrically heated, not nuclearly heated, scale model. The scale model was nine inches in diameter, the nuclear power plants are something like forty feet in diameter. So, you see there is a significant scaling. In the experimental test on the scale model, the emergency core coolant system failed. The critics have argued that because the scale model failed that so will the actual device. Because of this there have been extensive hearings before the Atomic Energy Commission this passed year to revise the criteron for an emergency core coolant system. Last month a revision was made which lowered the permissable operating temperature in the event of an excursion of this sort. Utilities are now being forced to go back and revise their calculations and it is likely that this will result in a few percent operating of that existing power plant until new fuel loads can be provided for these reactors. A few percent means about five percent so for the next year or so, many power plants that are now in operation will operate about five percent less than they have been. I think that the important thing here is that the Atomic Energy Commission is very conscious of these problems. This problem and the other one that has come to light recently that is on fuel densification is where it appeared that the fuel rods were compacting. That is after the reactor had opperated for some period of time, the fuel became smaller in volume and slumped in the fuel rods. Immediately when this was discovered, a number of the power plants were ordered to reduce their power while a

further investigation was done. There were seven such plants that were ordered to reduce their power to seventy-five percent. Further studies have been performed. These seven now have increased their power. One is back to full power, five are in ninety-three percent power and one is still at seventy-five percent power. So the Atomic Energy Commission is extremely causious in the operation of these power plants.

The critics of nuclear power say, "If nuclear power is so safe, why can't you buy insurance?" I would like to address that point for a moment. In 1957, congress inacted what is known as the Price Anderson Act. The Price Anderson Act is a scheme under which the utility company is required to purchase as much insurance as is available on the open market. Beyond that limit, the United States Government will indemnify the power plant. At the time the act was passed in 1957, there were no power reactors operating in the United States. The insurance companies had no way to reduce what the risks involved were. They agreed at that time to provide roughly 50 milion dollars worth of insurance through their companies. The congress then said they would make up 560 million dollars. As time has passed, history has been obtained, the amount of insurance that utilities can purchase from these companies has gradually risen to 90 million dollars. It is note worthy that the insurance companies have returned, after the first ten years of operation, to the power plants, have returned the premiums in the amount of sixty-seven percent to those utilities that have operated their power plants because they never had a claim. The reason that there is not commercial insurance available is that it has taken time for the utility industry to convince the insurance companies they are safe. But I think, as time passes the burden will pass from the United States Government to private insurance companies.

The concerns that people have raised in the nuclear fuel cycle, involved several stages and I would like to take just a couple of minutes to address these. The nuclear power plant operation must be considered in a broad perspective of not only running the power plant but also obtaining fuel and disposing of the waste products. I think we often consider just the power reactors operation and forget about the fact that fuel has to be obtained and the waste has to be disposed of. This is true in any power system. Coal for example, it is necessary to mine either by strip mining or deep mining. Coal must be transported to the power plant, burned and then the ash and residue must be disposed of. The sulfur is discharged into the atmosphere and what have you. In the nuclear power industry, much less fuel is required. That is the fuel is much more concentrated. So there are fewer people involved in mining. The mining for nuclear fuel is undoubtedly a risky operation but when compared to coal mining, it immediately looks much better. Most methods of calculation show that coal mining is twelve times more significant as far as the health of the miners involved are concerned than in nuclear mining. After the fuel is mined, it is taken to the processing plants where it is converted in form from raw ore to uranium dioxide or uranium hexafluoride. The uranium hexafluoride is then enriched, the enriched fuel is loaded in the reactor and is burnt for about a year. After about a year, one-third of the nuclear fuel is unloaded. It is unloaded for two reasons: First of all, some of the fuel is consumed and secondly in the fuel rods these radioactive materials build up which absorb the neutrons in the chain reaction. So after a year, about one-third of the fuel is unloaded, it is unloaded and stored on the plant site for about six months. During this period of time two things happen. The radiation levels from the fuel decreased because of the radioactive decay and the heat generated in the fuel also decreases for the same reason. This fuel is then transported on large railroad cars in very massive shielded containers. These containers have to undergo such tests as a thirty foot drop onto an unyielding surface, burning for

half an hour in a flame emersion for eight hours in water. They must pass all of these tests before they are licensed to transport this nuclear fuel. The nuclear fuel is then transferred to a reprocessing site currently the reprocessing site is in the state of New York at the West Valley near Buffalo. There are other fuel reprocessing plants under construction. The fuel is then chopped up, the waste materials are seperated from the unburn uranium and that small amount of plutonium that has built up in the fuel. The uranium and plutonium that are built up are then saved because they are valuable as fuels. Plutonium has a value that is roughly three times the price of gold now, ten times the price of gold two years ago. Roughly three times the price of gold now. So, it is very carefully monitored. The waste products are stored then for up to ten years at the processing site. At the end of a ten year period, it is necessary to transform these wastes into a solid. The solid wastes are then transmitted, shipped to an AEC repository. These repositories at present are surface storage vessels. These are large water filled tanks, in which these casts of waste material is kept. The casts themselves are roughly ten inches in diameter, ten feet tall and consist of a stainless steel container with a substantial wall thickness filled with solidified radioactive waste. The current plan of the AEC is to store these materials in surface storage vessels for as long as is necessary to find a safe ultimate disposal site. If necessary, they could be stored in these surface vessels in perpetuity. There is no reason why they couldn't be monitored for ever. If a leak develops, it is a fairly easy task to reincapsulate these. The desire is not to have to monitor these forever, so safe geologic sites are being sought. One such site that has been investigated was in the State of Kansas. It was an abondoned salt mine in Lyons, Kansas. Salt has the nice property that it has plastic flow in the event of an earthquake so that cracks tend to seal themselves. If there is salt present, it indicates there is no ground water permiability, or long ago the salt would have been leached out. So, salt is a very attractive place to put this waste product. It turned out that before any of the waste products were put in the Lyon site, there had been some man made drilling holes and there was underground intrussion holes from those drilling holes. So that particular spot is not suitable. Other sites now are being investigated. I can assure you that no radioactive wastes are going to put in an ultimate disposal site before a suitable site is found.

A great deal has been made of the long term disposal of these high level wastes and I think that, I would like to convince you that this is an economic question and not a technical one. I think that it is clear that we can devise long term disposal sites that will be safe. For example, the Egyptians built five thousand years ago that have stood up fairly well. We could, if we wanted to build a pyramid. I am not proposing that we do so, I think that there are better ways to do it. It is not a technical problem, it is an economical problem.

In closing, I would like to read a quotation from a paper here discussing the safety of the nuclear industry because I think that is one of the most crucial questions to you, it says, "In recent years forty-two industries for which the National Safety Council publishes accident statistics, none have had a frequency of lost time accidents lower than the AEC plants and laboratories." Thank you.

MAYOR BECKER: Doctor, before you leave, any of the councilmen have any questions that you would like to ask Dr. Draper? Doctor, I would like to ask you what is your observation and opinions of the remarks that Dr. Teller made with respect to thorium and the desirability of this Gulf General Dynamics Atomic Corporation type of plant?

DR. DRAPER: As Dr. Teller mentioned, thorium is about four times as abundant in the earth's crust than uranium. I think in our long-term projections of the energy requirements of the world, if we don't have such a system as fusion or solar, we will really have an infinite supply of energy. We will be called upon to use all resources we have available. In that regard, I think thorium may prove very valuable. Thorium as it is mined from the ground, is not a useful fuel for a nuclear reactor. It requires a breeder reactor of some sort to convert the thorium to uranium 233 just as it requires a breeder reactor to convert uranium to plutonium. The Gulf General Atomic reactor, the gas cooled reactor, is one in which a substanial fraction of the neutrons could be captured in thorium by converting it to U-233. It is not possible with the reactors that they are selling today, however, to make as much fuel as one consumes. Therefore, the thorium can be used as a useful addition to our thorium supply. But could not with today's technology supplant the uranium supply. In the long term, I think, if breeder reactors turn out to be the way of generating electricity for the next hundred years, if fusion or solar does not come along, I think we will see competitive types of breeders. I think one will be the liquid metal fast cooler using sodium as a coolant and converting U-238 to plutonium. The other alternative is to use a thermal breeder of the gas cooled type similar in spirit but not in details to the Gulf General Atomic reactor. That type of reactor would convert thorium to U-233. At this stage, conversion of thorium to U-233 from a utilities company point of view, it is not a viable thing to do. You are going to make some U-233, you will be able to sell it so there is an economic benefit, but it is not a mechanism for supplying all the energy requirements for utilities.

MAYOR BECKER: I wonder exactly what his remarks were then to indicate. I am asking because I am gropping for the.....

DR. DRAPER: I think Dr. Teller as many of us, feel that a high temperature gas cooled reactor has a number of advantages. These advantages include higher thermal efficiency as I mentioned before, it has a thermal efficiency that is about forty percent as compared to the light water reactors of thirty-two percent. Good modern fossil fuel plants are also about forty percent. So, it has that advantage. Secondly, because it doesn't contain water, but has helium gas, fewer neutrons are wasted. These neutrons do make U-233 from thorium so in the light water reactor you make a few percent of plutonium from U-238 and in a gas cooled reactor, you make more U-233 from thorium. There is an economic benefit in terms of fuel production. It is not break even operation, but it is more economical than light water reactor. On the other hand, the Gulf General Atomic Company is a relatively new entrant into the Nuclear Power Industry. They have begun really marketing their power reactors only in the last few years. The first reactor of a commercial size is going on line in Colorado this year. They sold six thousand megawatts reactors to go on line in the early 1980's. They have not yet fully demonstrated to everyone's satisfaction that they are geared up for a large scale production operation. So, against the advantages, you have to weight the experience that's occured to General Electric and Westinghouse and Combustion and Babcock of roughly fifteen years experience in the nuclear game. So, if I were in the utilities companys position, I would have to weigh the advantages, the technical advantages of the gas cooled reactor against those advantages of the experience in the water reactors. I think without knowing the details of the quotes that are obtained from the venders, it is impossible to make that sort of decision.

MAYOR BECKER: What is your opinion with respect to the advisability of keeping these units, the nuclear power plants far removed as possible from population centers?

DR. DRAPER: I think that the AEC throughout its history demonstrated or tried to demonstrate to the public that it is extremely safety conscious. Because of this and also because of the unfortunate beginnings of nuclear power, the public has grave misgivings about nuclear power. It is a new technology and because the AEC has adopted this extreme safety position, people say that it must be an inherently risky operation. My own opinion, nuclear reactors are extremely safe. I think though it is simply prudent to place the reactors far from population sites if that can be done. It doesn't indicate to me that these are unsafe devices, it is just one more step in the chain of safety features provided to the operator of the nuclear power plant. That is, put it far away if you can, if it doesn't cost greatly in terms of transmission losses, you are better off to have it far away than near by. An analogy was made not long ago by Eugene Vinner, the Nobel Prize Winner that nuclear power has become like a company building a bridge. A company might design a bridge to withstand a hundred mile an hour winds with three layers of concrete trucks loaded on the bridge. The public would say, that company is really expecting a high wind. That is not the case at all. They are just finding in an ultraconservative way. I think that is the strategy that the AEC has adopted, they are forcing people to reduce levels of emission to as low as practicable. They are placing the plants as far from population centers as is practicable. All of these things, not because of their lack of safety, just as a matter of prudence.

MAYOR BECKER: Dr. Teller indicated that the present head of the AEC, I think he said, was a lady and she was knowledgeable, extremely knowledgeable in the field of - I couldn't understand exactly what he had to say - but it had to do with lakes, waters of the floor and fauna.

DR. DRAPER: She is a marine biologist from the State of Washington, Mayor Becker and that is her speciality. I think at this time they are particularly concerned with the effect on the fishes and plant life and so forth in lakes and in the ocean and seas. That's the reason, I assume that is why she is the present head of the AEC.

MAYOR BECKER: If I may interrupt you for just a moment to comment on that. I think it is worth pointing out the destinction between Texas and a number of other parts of the country with regards to thermal pollution question. As you are probably aware, there are no lakes in Texas. The only one that could reasonabely be called a lake is Cado over on the Louisiana border and it is only a couple of hundred years old. All the rest are man made impoundments of some sort. Now, in assessing the effects of thermal pollution, one should look at the type of spicies that are living with in these water bodies. The fish of Texas for thousands of years were accustomed to living in the rather shallow slow moving rivers of this state. They therefore, are warm water fish. If you look at the temperature of the rivers in the state, it is not at all unusual to go to a hundred degrees in the summer time and many are at ninety degrees. With this in mind, one should try to examine what the effects of putting a power plant on a man made impoundment is. In the first place these reservoirs or impoundments are much deeper than the fish are accustomed to living in and therefore the water at the bottom of these lakes is quite a bit cooler. It has been demonstrated by a number of biologists working for the Texas Electrical Company in Fort Worth, that the rate of fish growth, namely cat fish and bass, in the lakes up near Colorado City and West Texas, grow much better on lakes that have power plants than those that don't. The reason for this is that our fish are warm water fish and this not to say that thermal pollution isn't an issue. If you live in Michigan where fish are use to cold temperatures, you have to be very careful what the thermal effluent from a power plant will do. But in the State of Texas, we have quite a different situation. We have lakes that are

made expressly for the purpose of cooling power plants. They are stocked with fish that are accustomed to warm water and I don't think that the charge of thermal pollution is not a relevant one in the State of Texas.

DR. SAN MARTIN: Mr. Mayor, I have a question for Dr. Draper. Are you familiar with the type of power plants used in submarines or other large vessels?

DR. DRAPER: Only in a vague way. These are pressurized water reactors similiar in spirit to those sold by Westinghouse for their commercial operation, but I am not at all familiar with the details of these types of reactors.

DR. SAN MARTIN: You couldn't give us any information as to the type of fuel that they use?

DR. DRAPER: They use uranium 235 fuel, the same fuel that is used in the power reactors that are bought by utility industry. One of the significant differences is the uranium 235 content. In a utilities power reactor, the U-235 content is about three percent. That is the uranium is enriched in the isotope U-235 to about three percent from its seven tenths of a percent natural abundance. In submarines because they are concerned with long burn up in a compact core, they cannot afford the large core, the enrichment is substantially higher than three percent. Other than the difference in enrichment, however, most of the features are the same, the fuel is uranium, dioxide, U-235 is the fissioning material and what have you.

DR. SAN MARTIN: How about the disposal of the radioactive waste? Is it pretty much the same?

DR. DRAPER: The same waste would be produced on a fission on an equivalent number fission based, the amount would be the same.

DR. SAN MARTIN: Do you have any information as to the effect on the crew? Any harmful effects on them from radiation on the crew?

DR. DRAPER: I am not a health physisist, but some others who will speak today are, so they can answer that better than I. But as far as I know there has been no harmful effects on the crew of a submarine.

DR. SAN MARTIN: Thank you.

MAYOR BECKER: Any other questions of Dr. Draper?

MR. GLENN LACY: Mr. Mayor, let me ask him just one.

MAYOR BECKER: Allright.

MR. LACY: Dr, you spoke a moment ago about a nine inch model imploying the safety factor in case you couldn't turn the thing off. As I understand, it keeps heating. Now suppose you had a normal size one and the emergency factor didn't work, would it get so hot it would melt and escape?

DR. DRAPER: I didn't address that question very carefully. Let me come back to that. In assessing the probability of something undesireable would happen from a reactor, there are really two things that would have to be postulated. First, you have to suppose that this primary coolant is lost. Namely, this massive rupture of the primary coolant's pipe. Now, the people who do fault tree analysis to try to determine the reliability have done such analysis and their assessment is that

the probability of such failure is something like one in a million to one in a hundred million per reactor per year. So, if you had a thousand reactors, and you took the least optimistic estimate, you would expect some time - the probability would be good within a thousand years - such a thing would happen. If you take the more optimistic estimate, then it would be a hundred thousand years. Okay, if that occurs, then you have to postulate a second thing, namely that the emergency coolant system won't work. So, you have two things that happen in series, what are the chances that this coolant system won't work. Maybe something like one in a hundred or one in ten thousand. So, if you compound those possiblities, it is extremely improbable, but not zero probability accident. Engineers are very reluctuant to say that anything has zero probability. Okay, if, let's say both of those things happen, what would be the results. It would be very difficult to tell what the result would be. The core undoubtedly would melt, would slump into a pool at the bottom of the vessel. If coolant were denied from that region for an hour or more, it would melt through and then there would be some release to the environment of the fission products. This would be a very undesireable thing to happen. Against, this undesireability, you have to weigh its improbability and have to compare it to the alternatives. The alternatives of burning the fossil fuel coal for example. We know that happens when you burn coal; you emit SO2 and NOX and particles. So, in that system we are assured of undesireable effects. In my opinion, it is better to have a very low probability accident than to have assured undesireable effects.

MR. LACY: Could this accident, even though the odds are so great, would it take in two or three hundred square miles of area where people would be injured or killed?

DR. DRAPER: The seriousness of the accident could take on wide range essentially from no damage to anything but the plant to substantial effect on the population. There was a study done in the mid '50's known as the WASH 740 report which postulated a massive failure of a small power reactor, two hundred megawatts, small by today's standards. In this analysis, they assumed that the reactor core melted and fifty percent of the radioactive inventory in the core was released. No, mechanism on this was provided, they just said start with that assumption and tell us what happened. They started with that assumption and assumed the most undesireable atmospheric conditions, an aversion, the wind blowing towards the large city and what have you. And they assessed the damage to be done by such an accident. And the damage was very severe. There were thousands of people killed and injured and there were billions of dollars of property damage done. However, if you do a similar analysis for something like a chlorine plant and you assume the conditions are similar, then the results are similar. We live by chlorine plants all the time. They are just something that we have been accustomed to over the years. I don't want to minimize the effects of an accident if it did occur, it would be very serious. In my opinion the probability is so small, it is a risk worth accepting. I think a nuclear power plant has sufficient benefits that the risks that are intendent should be accepted. The risks are far less with a nuclear plant than with most fossil fuel plants.

MR. ALVIN G. PADILLA, JR.: What was the range of this destruction? In other words, does it reach out X number of miles? Can you tell us something about that?

DR. DRAPER: I think if you will allow me, I'll let that question be deferred to the next speaker who is an expert on health physiscs who is much more familiar with that than I am.

MR. PADILLA: My only other comment and I hope it is in the form of a question for you. Why is the Atomic Energy Commission so conservative, if indeed we know this much about the State of New York?

DR. DRAPER: I don't know. I just think it shows good judgement. It is a new technology upon which we don't have a long operating history and therefore, it is prudent to introduce every possible safeguard. The introduction of safeguards does not imply an unsafe system in my opinion. For example, as you know, as time progressed we have gotten more and more safeguards, we had mandatory introduction of seat belts and padded dashes and things of this sort. I think it is a sign of the times for the people who are concerned, they should be concerned with highly technical things and the Atomic Energy Commission is doing everything within its power to insure the safety of the general public. In the other areas of power generation, you will see that there is a similar trend, mainly in coal plants. You have seen within the last few years, their quality standards imposed are much more stringent than any other time in our history. Particulates must be kept in certain ranges, SO2 emmission must be reduced to certain values. As time goes on we are going to continue to require an improving quality of our environment. I think that the AEC was in the fore front of doing this. If you look at the incremant of radiation that the AEC allows to be added to the environment from a power plant, it is about a hundred times less than the natural background. On the other hand, if you look at the sulphur dioxide emmissions that the Environmental Protection Agency allows to be introduced into the atmosphere through the operation of power plants, compare that to the natural background, it is about fifteen times more than the natural background. It is just a question of being ultraconservative and very cautious at an early stage of the development of an industry.

MR. PADILLA: Are you satisfied that this conservatism is not connected with some question as to just what the state of the art is?

DR. DRAPER: I think that the state of the art is that we have a mature technology that has been very successful in generating power and as time goes on there will undoubtedly be technical improvements. For example, just last year the question of fuel densification was discovered. When it was discovered, the AEC immediately told those reactors subject to this problem to cut back, let's wait and see and do a little analysis. They have done such analysis and now those power plants are back up to higher power. I think as time goes on, undoubtedly more things like this will be discovered. Always, as the technology improves, there will be further developments, but I don't think we should view the continuing further development of an industry as indicating in the past that it was inherently unsafe anymore than we should consider the introduction of seat belts in an automobile a criticism of the first fifty years of automobile production.

MR. PADILLA: You say that this fuel loading was discovered. This implys that they were not aware that this was not going to happen?

DR. DRAPER: That's correct.

MR. PADILLA: Then we don't know what really hasn't been theorized as of yet.

DR. DRAPER: I think that is a fair statement.

MR. PADILLA: Thank you.

MAYOR BECKER: Doctor, could we operate from the premise that if the atomic bomb had not been dropped in Nagasaki, Hiroshima, that the fear, the concern for the nuclear plant, the device as we are discussing here today, would probably be much less? Didn't that really set the thing off?

DR. DRAPER: I am sure that is true. I think that the effects of a large scale exposure of massive amounts of radiation from the weapon was undoubtedly a factor in the public's acceptance of nuclear power. On the other hand I don't think we should minimize the possible counsequences of a severe reactor accident of the sort. We just have to be careful to build plants carefully, operate them carefully and hope that we can convince people that they are safe to operate and in fact safer than the alternatives.

MR. PADILLA: Doctor, Dr. Teller remarked that near accidents that have occurred in nuclear plants have primarily been the result of people experimenting. Can you comment? We get the impression that the AEC is extremely harsh that engages in such practices or the methodology is such that has to be followed. Why do we have such a comment from Dr. Teller like this? Would you care to.....?

DR. DRAPER: The reactors that have experienced difficulties have been reactors specifically designed for experimental purposes. That is not reactors designed to produce electricity. In the United States for instance, there has been one reactor accident in which people were killed. This was a very small scale experimental reactor at the National Reactor Testing Station in Idaho. The accident occurred when the reactor was shut down and a man removed a control rod with uncontrolled withdrawal of this control rod and caused the reactor to go on a transient. Reactors that are designed for electric power generation are designed in such a way that the withdrawal of a control rod of this type would not cause an excurtion. That is there are many control rods to keep the power level of the control rods under control so the reactors that have experienced difficulties without exception been designated as experimental reactors built for obtaining information, not built for producing electric power.

MR. PADILLA: In other words, I didn't quite understand what Dr. Teller said, but I am glad to hear it.

MAYOR BECKER: Doctor, I don't know, are you able to see us with that light shinning in your eyes? I don't want any of you to think that this is an inquisition or the third degree or anything like that. Because it's not in that nature at all. The light is for the benefit of the television camera crewmen and hopefully it will be turned off when they are not taking pictures. I apologize for this inconvenience to you in any way. Are there any further questions of Dr. Draper? Thank you very much Doctor, we appreciate that.

MR. JOHN LOCKE: Thank you Dr. Draper for your remarks. Mr. Mayor, we call this the Theatre of the Performing Arts so the lights are all right really. We'll stand up to it. The next gentlemen we have on the program is Dr. Andrew P. Hull. Mr. Padilla, he will answer some of your questions in the course of his remarks. He is a health physicist. Most of his career has been spent within the field of health physics. And in one way or another he has been associated during this career with reactor operations. He has a number of books published. The most recent papers include some comparisons of environmental risks to nuclear and fossil fuel plants. He presented this at the Fifteenth Annual Meeting of the Health Physics Society in Chicago in 1970. It was subsequently published in nuclear safety. Another of his papers is entitled, Reactors Effluents as Low as Practicle or as Low Reasonable, which he presented at the Seventeenth Annual Meeting of the Health Physics Society in Los Vegas in 1972 and this also, was published in Nuclear News. Mr. Hull is an active member of the Health Physics Society, past president of his New York Chapter and is certified in Health Physics by the American Board of Health Physics. He is also member of the American Public

Health Association. Currently he is a chairman of a referee committee of Air Sampling of the American Public Health Association Coordinating Committee on Laboratory Methods Sub-Committee on Radiological Methods for Biological and Environmental Samples. That is a long name. Since 1961 he has been supervisor of Environmental Monitoring in the Health Physics and Safety Division of Brookhaven National Laboratories in Upton New York. Dr. Hull:

DR. ANDREW P. HULL: Thank you Mayor, councilmen, ladies and gentlemen. It is a pleasure to be here in San Antonio and good to have the opportunity to visit before and I must say I was very favorably impressed when I looked out the hotel window this morning except in my quick judgement, it may not be fair from this brief sampling that, you may have an air pollution problem. Like to start out by saying that I, perhaps it would be appropriate to repeate a joke that a speaker at a meeting by way of introduction. This was early in the morning and people were worried about the time he was supposed to operate and he was worried himself I guess, so he pointed out that he had been to a beer party the night before and he hadn't been to the men's room yet this morning so he was sure he was going to be brief. I am not sure that I am going to be afflicted by that problem but I suspect that your stomachs might begin to rumble in the course of this - as we go on here as I look at my watch and I hope Mr. Mayor, if that happens and it becomes unindurable that you will feel free to interrupt me at any appropriate point for a recess. I am sure that I don't have to point out for your benefit, but perhaps for some people in the audience, that I work in a laboratory that is fully funded by the Atomic Energy Commission. I am not here as a spokesman today and in fact they probably would disown some of the things that I may say. Secondly, I am here on my own vacation time and I am effectively acting as a consultant to the Council this morning. as I understand it to the power plant. Thirdly, is that I did not get into this sort of thing because of my present duties at the laboratory in the direct sense, but rather on Long Island, there was a proposal by the Long Island Light Company to build a power reactor about six miles from the laboratory a few years back and it looked as though there would be a very evil opposition to this and a group of us primarily who worked at the laboratory but somehow decided scientists form what is known as Suffix Scientists for Cleaner Power and Safer Environment and I became an active member in that. As we were convinced, almost from the start, that we far preferred a nuclear plant as to a fossil plant for the choice in our vicinity. I think we started, all of us, with the confidence of being around nuclear reactors for some varing periods of time and the feeling that whatever technical problems that there were, they were manageable. And the overall risks would be far less than the over all risks, as we understood it, than the operation of a fossil power plant. I might say further, just for the perception of the members of the audience, that, in general, outside of this particular context of being in favor of the nuclear power plant- being given the choice of what I see - the available choices - the practical choices,- that, in general, my record is one of desent from the established point of view.

I belong to a number of, what you may call, liberal causes, say the Federation of American Scientists who oppose the ABM Civil Rights organization and that type of thing. I was down in Washington picketing against the War in Viet Nam several times so I just wanted to make it clear to the audience that I am not generally an apologist for the establishment.

Alright, now to get into what I am going to say. I came down here on fairly short notice, so I wasn't able to prepare a paper or something to hand out to the audience or to you and the audience that was geared particularly to this presentation so I did bring down some copies

of a paper that has already been referred to - Some Comparisons on the Environmental Risks in Nuclear and Fossil Fuel Plants. It is somewhat technical. I brought along some slides and illustrations from it that I would like to talk to and I hope to since it was primarily put together for a technical audience. I hope I can translate what I think is the essential parts of that into comprehensible terms for the non-technically educated. I said already that the laboratory is, although not principally concerned with the development of nuclear power reactors, but with high energy research has operated one or more research reactors over a period of about twenty years now. And I have been involved with monitoring the effluents from these reactors and other operations at the laboratory and assuring the commission, the laboratory management, the commission and the citizens in the vicinity that the effluents were well within the radiation protection standards specified by the commission. We operate under the same ones like the .....(inaudible) do incidently and that has been the case and of course as the various arguments about the alledge risks and dangers of radiation have come up, as I helped physicists who are concerned with the application of radiation protection standards on the basis of really medical biological research against the effects of radiation. I follow these with a keen interest and we became, as I said, Suffix Scientists Group and intervention on the Shoram reactor. I had an even treater opportunity to look into many of the pros and cons of the argument and I am even more convinced at this point that on the basis of this rather extensive involvement outside of my everyday professional duties, that the, although there is nothing that the previous speaker has said that it's without risk, the balance is nuclear. If I can have the first slide, I hope these will be visible. That's the perception I think as the result of the sensational treatment that many of the questions to be raised about nuclear power, have received in the media. I am afraid this is the perception that many people have of nuclear power. That it has all sorts of problems and risks and that as a result this has generated, I think, a good deal of fear and I would speak particularly as to mention that was not mentioned, that I am a member of the Health Physics Society-Public Information Committee and have been local chairman of the New York Chapter of the Public Information Committee. That we have been concerned to try to place radiation and reactors as they emit radiation for no other reason and their risks and what we hope is a reasonable perspective. And this paper that you have before you is an attempt at that. It seems to me that many of the arguments about the risks of radiation have sort of proceeded in a vacuum on the basis that sort of an initial gut reaction. I think that everyone wants to be safe and you can't be safe of course and so there is a tendency, if you talk about the risk of radiation alone, I think, to sort of expect or demand or even ask for more safety. And somehow, at this point it seems to me that it becomes unreasonable, in the sense, that no where else in our everyday lives that most of these people that are making these arguments, expect this same degree of safety. That is what prompted me to put together this paper on primarily a comparison basis.

If we can go onto the next slide? That seems to be out of order and I can't see it anyway and I suspect that you can't see it. So, I passed out copies of the paper and brought along a lot of extra copies with me. Incidentally, if members of the audience are interested in having a copy of this paper, when it comes time for the lunch break or whatever, I will be glad to make them available to you. In the first part of the paper, that the councilmen you have before you, I merely pointed out the projected increases in - some of the projections that have been made of the demand for nuclear power or the expectations are for overall power in the coming years. And I will just mention these numbers which are not the ones before you that the U.S. population is expected to grow in 1968 from 202 million to 320 million by year 2000. The overall expectation for electricity in thousand of megawatts is from

two hundred and ninety, this is capacity, 290 in 1968, to 600 in 1980 and 1350 in the year 2000. And of this, the conventional numbers are interesting, 287 thousand megawatts in 1968 and 450 in 1980 and 411 in the year 2000 so you can see, at least in these projects that appear here that have been determined, I think they have been published by the AEC by the number of sources, expect a substantial growth in power. The Nuclear side of the picture shows three megawatts, three thousand megawatts in 1968, 150 in 1980 and 941 are over fifty percent of the capacity projected by the year 2000. Well, one can argue pro and con about how much can be provided, but it seems in just making my comment but which might be just a bit out of the area of expertise. My persep-tion having been involved in the overall arguments in the energy pic-ture is that we really need to push as many different technologies as there are practicable or available to have a variety of sources obtained. It seems to me that unless one is really convinced that and deeply con-vinced that there is a very large risk or excessive cause for some par-ticular technology, that the overall world situation, the potential fuel potential availability situation, the environmental problems associated with various technology as such, that I would be putting my bets on a variety of producing power.

The second point I want to make here is in the paper, I will read part of this: "All human interventions related to the extraction and consumption of energy. Perhaps we can have the lights and I think the slides must be mixed up in order here and I don't think you can see that anyway. I think that I can do pretty well without them. Since you have the paper before you and perhaps I will refer your attention to various parts of the paper if I may. The Second assumption here and I think it is an important one, that, "All human interventions related to the extraction and consumption of energy have the potential for both cost or risk--if you want to call it that--and benefit and some concrete, I suggested in Table 2 with regard to the alternatives as I see them for electric power generation. I won't go through all of them there because they are rather self evident but hydro-electric, of course, one has the fun of alteration of steam flow. Hydro-electric is not located conveniently near its load source. This means a lot of land consumed in transmission lines and so forth. The gas-fired plants, one has the problem of pipelines and potential rupture of pipe lines. Air pollution with some substances and of course the alteration of the local ecology by thermal waste and that is common to all of us as pointed out by the previous speaker, he isn't here, in the steam cycle pretty much. Oil-fired plants, I am sure you are familiar with, and have some of the same problems here. They have a larger amount fuel required and for logistics of getting the fuel to the oil-fired plant and all of that are much more involved. Coal-fired plant, ones comes into a particular destruction of scenery, such as strip mining and that is growing and presumes the projection of where the coal is going to come from and that means even more strip mining and I saw a figure recently where an area roughly the size of Connecticut or equivalent to it has already been involved in strip mining or very much of that area and it happens to be the area that I come from so that means something to me even though I suspect Connecticut would be lost in Texas from looking here at the map. Then transport and storage of facilities becomes even more formidable of course and the air pollution which we will get into becomes even more formidable. The nuclear power plant, again we have a destruction of scenery and mining and processing facilities and so forth. The possibility of minimal routine air and water pollution which we will comment on a little more as we go along with radioactive ash, possible leakage during long-term confinement of high-level radioactive wastes, possible accidental release of significant quantitites of radioactivity and

nd of course, the alteration of local ecology by thermal waste. ell, first of all, to go on from that, it seems to me the question gain to repeat, is not seeking some ideal of positive or rather f complete safety. It just can't be done no matter what you do in y perception. Rather, which one of the techniques are providing power is going to furnish the greatest advantage in an over-all costs r risks? I use the words interchangeably. I don't mean just economic cost if I say cost, the over-all cost benefit basis. I think at least there are substantial reasons for what is open....open-minded when we look at nuclear power and it has much to be said for on this basis.

I would like to talk first of all as previous speakers have referred to it about one aspect of malfunction and catastrophies which he dealt with perhaps not in great depth and that is....since I come from Brookhaven and substantial amount of the homework or back line work for the so-called Washington 740 report which is the theoretical consequences of a hypothetical reactor accident or incident. I forget the exact term, but notice the word hypothetical and indeed the case was hypothetical. The people who developed the consequences part of this report were given the initial boundary conditions that fifty ercent of the reactor core had somehow vapor locked and somehow got nto the air. Well, if you talk to the experts on aerosol technology nd we have some of them around the laboratory, you find out that it s not easy. It is extremely hard to get metals into vapor and get mall particles into the air. And that assumption itself seems most nrealistic. And there has been a lot of noise lately about the mergency core coolant system. I am not an expert in metalurgy or eat transfer so I won't speak on that part of the argument although t does seem to me to have some aspects of angels dancing on the head f a pin as do many of the arguments about radiation hazard. In the ense that the consequences have been vastly overemphasized and the ederation of American Scientists came out sort of in support of the eople who were expressing reservation about the adequacy of the emergency core cooling system and suggested I think recently, and I belong o the FAS, that the reactor should be derated. It somehow seems to e that this is somehow, that most of the people at least who are aking this kind of argument implicitly assume that somehow something ike the consequences of the Washington 740 report that those projections ould occur if this major incident were to happen. In my perception, n my experience, it isn't likely to happen. You can look first of ll at the Wind Scale incident in 1957. The Wind Scale reactor was n air cooled reactor, it over-heated and the air continued to go hrough....while it was shut down--caught fire and some of the fuel lements or many of the fuel elements in the reactor melted and the rincipal thing that was discharged up the stack and the air cooler as Item 131, some twenty thousand curies. And at that time the British rotection....Radiation Protection Council met an emergency and studied he situation and decided that the only preventive action that they eed take in terms of the release of this twenty thousand curies of tem 131 was to restrict the availability of milk for a while. The ause being a very sufficient transferage in between pasture in which tem has been deposited and milk getting to the human consumer and this oute turns not to be more efficient than direct inhalation of a certain oncentration of radioactive volume of Item 131 in the air by a factor f some seven hundred or so. So the inner license has some what less as it by that number of people who are breathing that air. Well, e projections as I read them or any number of people who are knowledgeble about this including my own feeling about the thing is that again ven with a larger scale realistically imaginable reactor accident for y this so called designed basis accident that one have primarily Item l and would be the real ecological problem. And there might be as ny as a hundred thousand, let's say, somewhere in one in a billion an upper limit that the experts have gastromated as one in a million,

if this were to occur in my perception, there might be as the design basis accidents studies that have to be filed with the commission that dose is something near to, let's say, somewhere approaching a million people in the vicinity of a reactor. Down to say, to pick a number somewhat arbitrarily, if that was a high population density of people fairly close to the reactor. Let's say within a factor of ten miles or something like that and if there were a million people there, some number of them might, the ones who were closest to the reactor some small fraction of that number might receive or inhale enough iodine so that they might have a thyroid exposure to something like three hundred rads. Now three hundred rads is sort of marginal to whether you would see any incidence from Item 131 but you generally expect to see a larger number of people. Any clinical adverse manifestations like cancer in particular. But so that we take, and I think this is a vast over estimate among people who were snuggled up fairly close to the reactor that the....what would happen is the possibility from what we understand now about the studies on the incidence of thyroid cancer at certain radiation dosages is some three hundred of them or so might be adversely affected by them and subsequently at some time later might develop thyroid cancer. Which is not necessarily fatal. So that we have, I'm trying to put these numbers together, we have one in a million chances of this incident happening and some three hundred of a million people are liable to develop thyroid cancer and you multiply these two probabilities together you get down to the fact that there are less than one in a billion of any one person around this reactor being adversely affected in the reactor incident. In short, this is quite smaller than ten thousand casualties that you have been advanced from the Wash 740 report and the millions and millions of dollars to property damage. In my conception, this is just not likely to happen from what real evidence we have. Much of which has been developed since the Wash 740 report was put together.

So from that I want to get over to routine effluent release and say when the situation with regards to effluents produced by the routine operation of power facilities is examined, it appears that in principle the hazardous agents from both fossil and nuclear-fueled plants are controllable at almost any level which the public insists upon or the administrative agencies mandate. The closer to zero this level is set, the greater is the economic cost ultimately passed on to the consumer. In practice, of course, effluent control seems largely governed by the state of the available technology and the economic cost of its application. And from both standpoints, nuclear plants appear to have an advantage; that is, the technology for the control of radioactive emission is more developed and, as probably in the long run would be less costly than that for the comparable. And notice the word comparable because I think we are a long shot from comparable control of effluent conventional plants at the moment; although, it is on the horizon from the thrust of the Environmental Protection Agency, The Clean Air Act and so forth. For the comparable control of the several conventional pollutants emitted from fossil-fueled plants, particularly, this is particularly so in advanced states in reactors. What this means is that by suggested comparison of respective fuel requirements and of the principal types and amounts of atmospheric pollutants released from various megawatt plants using coal, oil, gas or nuclear fuel and this is shown in Table 3. I scaled up, these are the actual numbers scaled up to make them on a comparable basis of a hypothetical 1000 megawatt plant which is about the size of the nuclear plants that are being proposed today. I won't go over all these figures today, I'll just pick out a few highlights that impressed me. You will notice the annual fuel consumption that you have. This is in (inaudible) shorthand for a million. They have 2.3 million tons of coal required for this. For oil, 460 million barrels. For gas it says 6,800 million cubic feet and for Nuclear over a ton, 2,500 pounds. That, of course, is the uranium

35 and that is available as the fuel in conventional light water plants at something like two and a half percent uranium 235. So, this means that you need a total of some fifty or so to give or take tons of uranium oxide that are consumed each year in this thousand megawatt reactor. And incidentally, as we go back to the comparable insults from mining that you can look up in the figure that fifty thousand or so tons of ore needs to be extracted to produce this much uranium. That is a heck of a lot less, of course, than the number of tons that you have got out of the ground and transport in order to fuel a coal-fired plant. It seems to me a substantial plus for the nuclear side of the picture. Well the oxides of sulfur here are again set out for different plants in millions of pounds and they seem to be the number one problem at least in conventional plants. At least they're getting the biggest attention, 306 million from coal and 116 million pounds from oil and thirty thousand pounds from gas. And on the opposite side, nitrogen is rather comparable. I won't go through all the rest of them here except to call your attention to little further down the table. It has been commented on from time to time that especially for a coal-fired plant, there is radium in coal, goes up the stack when the coal is burned. So, the conventional plants are not without their releases of radioactivity and it turns out since radium is somewhat more toxic, I say by a factor of a thousand or so, then radio gases that are emitted through nuclear plants. That actually when you go through all of these numbers, you find out that their releases of radioactivity from a coal-fired plant are comparable in their potential. Now this is only a hypothesis, this doesn't mean if it happening but in their potential if you do some calculations, that their potential, their biological potential is rather comparable in close to gaseous releases from pressurized water plants. The boiling water plants have somewhat larger gaseous releases on the average where are for reasons that I will point out in a moment. It is apparent to me from Table 3 that projected to meet power needs from fossil fuel plants would need millions of pounds of obnoxious agents, including some radioactivity, to the environment for years to come during the operational lifetime of these plants.

The clean-air advantages of nuclear plants are even expressed more clearly in Table 4, which I detail the principal pollutants from the different types of plants and repeat the discharge quantity in pounds that appeared in the previous table. There is another column that shows the standards and then the last column I show the dilution in billions of cubic meters and a cubic meter is about the same as a cubic yard that would require to dilute down to the standards. Now I will have to make a few corrections on the Table as I put it together before the Environmental Protection Administration formidable regulations for acceptable amounts of radioactivity, for I mean acceptable amounts of radioactivity, for I mean acceptable concentrations of conventional pollutants in air and so for the sulfur dioxide you will notice that the lower one is .025 parts per million that should be 0.03 which the EPA finally decided upon. And so that dilution that I have indicated there of some two million, two million billion meters needs to be raised a little bit and for the sulfur dioxide plants the same would be true for their 810 thousand billion cubic meters. And for the gas-fired plant, the EPA came out with a standard which raises up the number of nitrogen dioxide instead of two parts per million as I have shown there for the gas fired plant. I am filling up the most restrictive pollutant for each plant for coal and oil. It is a sulfur dioxide and for gas-fired plant it is a nitrogen dioxide instead of two parts per million EPA standards is 0.05 and so instead 3330 thousand.(inaudible)...cubic meters you need a hundred and thirty thousand.

Then we go to the nuclear plant and there is some corrections there for later information. I am working on a paper which I have analyzed the actual performance of the plants that have been on line for the past five years some they have the continuity for being on line for the last five years or so, several have come on line since then from '67 to '72. On the average, those numbers are up and normalize them as those plants have been operating on a thousand megawatts. It is one basis of inferring how much we expect from a plant that would be built tomorrow with the technology that has been applied during the last five years. I should point out at this point that newer technology is coming along all the time and releases I think from the boiling water reactors that would be built prospectively, if you decided to build one today and designed it, would be a good deal lower than numbers that appear here. But the emissions from the nuclear plants are pressurized water reactor, scale up on the basis of this five year experience and the plants that are on line to eight thousand seven hundred and sixty curies. One curie for your information is a number of decentigrations in a pound of radium, it is merely an index of a number of decentigrations that one has to throw in the energy and other factors in order to determine the biological potential so curies by themselves don't mean very much. But eight hundred and sixty dilution and to get that down to standard becomes about ten times the amount shown or about twenty-five million billion cubic meters. It is a good bit lower than any other that you can see, than the hundreds or thousands or millions cubic meters that are required for many conventional plants. And for the boiling water reactor, this study that I have done, suggests that the average number for our scale thousand megawatt plant becomes about two million curies and so we need about six thousand or so billion cubic meters. Still, a good deal lower than the amount of dilution that we need from the amount of any of the conventional fossil plants. And I think that is the point that I want to make is not to worry too much about the arithmetic on this table. To point out that relative to the mandated protection standards, this larger requirement of dilution of air from any fossil fuel plant. Then means on the average, if you live around the plant that the air concentrations are going to be closer to if not at or above the EPA standards than are the concentrations of radioactivity are going to be close to the permissible concentrations of upper limits of the permissible concentrations of radioactivity and this is back some fact a hundred or thousand. I am sorry about the slides but they are not all that essential. As was pointed out that the standards of radioactivity are set at a much lower level relative to health effects about one one-thousandth or one one-ten thousandth below what you would expect any health effects where as the standards for sulfur dioxide for the moment. There is some data put together by Chauncy Starin published in Nuclear News a few months ago and a group working under him did in California comparing an oil-fire plant and a nuclear plant and they pointed out that the standard for sulfur dioxide is set at the lower limit where on a chronic exposure basis you would expect some health effects and indeed every reason to think that they are occurring in many of our cities where the concentration of sulphur dioxide are at and currently above the EPA standards. As I said, what is important is not so much what is coming out of this type of plant but are their radiation doses at the boundary of the plant and the larger distances of the plant. At Brookhaven, the air cooled graphite reactor that we operate for a number of years, no doubt about it the equivalent of about eight million curies a year or so on an energy basis, that the radio gases that come out of a nuclear power reactor, about eight million curies and the largest releases are from boiling water reactors. I mentioned that if you normalize the plants that have been running today, this would like to a thousand megawatts, it would like some two million curies a year. I think that the application of the improved controlled technology without getting lost in details but additional charcoal filters, a mechanism for combining the gases,

hydrogen and oxygen that are associated in the core of the reactor as the water passes through the reactor, will mean that the volume of gas is reduced and therefore, the requirement for relatively early discharge. There has been about a thirty minute holdup on the average between the time the gases were formed in the core and the time they were discharged from the stack in the boiling water reactor. And this partly a consequence of the direct cycle using the boiling water reactor. I don't have the picture I had in the slides but I think an explanation will suffice. If by reducing the volume of this gas, you can hold it up for ten hours or if you pressurize it, for a matter of days, most of these gases have relatively short half-lives and in about ten or so hours you reduce the activity in the gases by at least a factor of ten so I would expect that the boiling water reactors of the future might. A thousand megawatt one, might have more on the order of two hundred thousand curies a year of noble radio gases which only constitute an excess of external exposure to people who live near by the reactor that this would be in the order. Our exposure from Brookhaven are from eight million were on the boundary and the most exposed position earned somewhere around a hundred million ranks a year and so if we go from eight million to something in the order of two hundred thousand you would expect on the average meteorology we have and similar meteorology that we have at a nuclear plant that you have reduced the exposure to a few milli ranks a year. Well, just to put that in perspective, the lowest, I mentioned a few numbers about what you expect and what the biological affects and I expect some of the other speakers will get into this so I will not go into a lot of detail. But if you give a person the radiation of heat, or somebody for instance, the bomb victims, a good deal comes from the bomb victims and other sources of inadvertent exposure, the bomb victims in Japan, the present data that we have suggests that exposure all at once about three hundred rankins is, at that point, about fifty percent of the exposed people would be fatally exposed in a matter of days to weeks. You get down to a hundred and you produce classical radiation sickness, from which they rarely recover, you get down to around ten or so and you can see some perturbations in the different constituents of the blood and this is after a matter of weeks to a few months go back to the normal base lines in blood but presumably have no other direct early affect. Now, also from the Japanese victims to put one number that is very useful here and have an occasion to refer to it in a few moments again that the best number we have from a rather limited number of people in obsolete numbers that were affected on the long term that survived but were close enough to the bomb that they received fairly large doses in the order of hundred of rankins. The entrances made from that date plus some other data that I will not go into detail suggests that over the long pole at the moment now we have some a little more than twenty years data since the World War II and the use of the atomic weapon that we would expect, if a million people were exposed to a rankin each from lower level radiation where none of them were affected on an earlier basis that in a matter of days or weeks that over a long term over the next twenty years there will be long term delayed effects of something like twenty to forty; somewhere in that vicinity, cases of leukemia would develop in that population of a million people over the next twenty years. That is one rankin each, human exposure, a rankin each. We have five or so times that number of other types of cancer, principally lung cancer, breast cancer, thyroid cancer, and a few other associated miscellaneous types of cancer at lower incidents. These are the ones that have been identified so we have a total of some two hundred or so, give or take two hundred cases of this population of a million people, exposed to a rankin each. This would be long-term, you would have to study this population over the next twenty years or so in order to have this happen. Leukemia would be delayed somewhere from five to ten years and the other cancers would not start showing up until the late period, perhaps ten years or later. The Japanese

population is still being followed and there maybe some refinements to this data as time goes on but it doesn't look as though the numbers or entrances made from them will change substantially. Well, so we are talking now to get back to the reactor situation to exposures of the boundary. The releases from the pressurized gases or nobel gases are pressurized water reactors would have been much less in the order of thousand of curies rather than hundreds of thousands of curies. The exposure at the boundary of the hundred thousand curies or two hundred thousand curies might be a few milli rankins, you know that is a thousandth of a rankin and you can do some quick arithmetic. I don't want to lose you in numbers, but you can do some back of the envelope arithmetic and conclude that if you have a million people and expose them to a rankin each and you have in the order of two hundred cases in a million people and you exposed them to a thousandth of a rankin each, you are not even going to have one full case. And the numbers show the study done by Carl Hemisfelter in the Department of Licensing and Regulations in Washington as the underlying basis for the revision for the effective limits supplied by the AEC show that the highest exposure to the few people who live, or that to a hypothetical person living at the boundary of nuclear power reactors and this study was done in 1969 but the releases are comparable to those. The releases might be somewhat comparable to those you would expect from future reactors which will be larger in the sense that the future reactors will have better control technology. The average exposure including the couple of bad reactors that are gutted up with stainless steel fuel, the average exposure to the boundary was fourteen milli rankins are fourteen thousandths of a rankin and that if you take out these two stainless steel reactors, it gets down to the number I think either three or four milli rankins at the boundary. The average exposure to people living within four miles of the reactor was in the order of a tenth about two-tenths of a milli rankin, that is about two tenths of a thousandths of a rankin and the average exposure to people living fifty miles from this reactor was in the order of one-ten thousandth or less than one ten thousandth of a millirankin, of a rankin. I'm sorry, well I am losing you in numbers perhaps, but these are vanishing small numbers with regards to the dosages using the data from the Japanese bomb victims who were exposed to what was thought to be therapeutic doses of x-rays for in large exposures for treatment of a medical condition some years back and there was a fairly large number of people who received exposure there. When we take this biological data and start talking about exposure in terms of a millirankin or a tenth or a thousandth of a millirankin in a year. They indeed seem trivial. It seems preposterous that one would expect in this collective population exposed at these average levels that you find any discernable phenomena. And indeed they, the background level of radiation has already been mentioned is something in the order of a hundred millirankins and the natural background radiation you are fortunate maybe in Texas here to be in a relatively low background area but the average terestial background exposure is around a hundred millirankins a year. Are the numbers that I recall for down here, are around forty from actually the ground and another thirty cosmic radiation millirankins a year so the total is around seventy-five to eighty millirankins a year here in Texas and the Coastal Plains. Average U. S. terestial background is somewhat maybe a little more than a hundred from these sources, cosmic and terrestial. I might point out however, that if you go into the Rocky Mountains and I don't know if people from here vacation up in the Rockies or not, but if you go up in elevation, the cosmic radiation dose increases and also there is more radiation in the ground there partly because that is where uranium comes from and so forth so the people who live in states like Colorado and Wyoming, we see an average background of two hundred millirankins a year.

Well there is a very interesting study that has come out recently and I don't have any illustrative material in my paper on it by Dr. Norman Fajerrio over at Argon Laboratory in Illinois. He used the opportunity presented by a monograph the National Cancer Institute, which Dr. Fred Burbank took with the assistance of a number of people who are knowledgeable in programming and so forth took all of the cancer mortality data from 1950 to 1967 some eighteen years of all the U. S. population and broke it down by all the different international classifications that doctors use for cancer, some fifty-six. Took, broke down the data by each class for males and females for whites and non-whites and he was doing a detailed study to really test the accuracy of Dr. Gofman's predictions that if everyone was exposed to one hundred seventy millirankins, there would be thirty-two thousand extra cases of cancer a year. And he concluded that, of course, that is a hypothesis that Dr. Gofman has made, and he concluded from his study that there are too many cases which there were different kinds of cancer in which there were almost no observed cancer at all. To that, Dr. Gofman suppositioned that all types of cancer were raised uniformly by given exposure to radiation, that this level of radiation around a hundred and seventy milli rankins a year which happens when you throw in...I forgot to mention, that when you throw in medical exposures will run around, I am going to use a very loose figure, somewhere around fifty millirankins a year. And if you add that to the hundred and twenty or so hundred, a little bit better than a hundred from background you add in the fifty or so from medical radiation, you are up to about a hundred and seventy millirankins a year which was the standard for large numbers in the population that Dr. Gofman argued a lot. So, you have an equivalent figure from natural background. And he tested on the basis of natural background which varies from state to state as I have already mentioned. This breakdown in figures, incidentally, was done by Dr. Burbank state by state so you can compare state by state of the cancer incident versus mortality, mortality versus background, the cancer incidents versus background, in all these different states. He concluded from that whatever the risk is you can eliminate it by statistical techniques. You could conclude that it was one one-thousandth or so the risk of background radiation of cancer mortality must be one-one thousandth or less or something in that order that is suggested by Dr. Gofman and also suggested incidentally by the BEIR Committee report. You know that the committee, the so-called BEIR Committee--I am not used to this short hand I apologize--The National Academy of Sciences on the basis of allegations made primarily by Dr. Gofman and Dr. Kaufman and Dr. Sternglass appointed a study committee, it was a federation council that did this in 1970 and by the time it was done, the responsibility of the Environmental Protection Agencies....But anyway the FIC appointed the National Academy of Science to study the effects on the population to the exposure of all levels of ionizing radiation. On the population to see if there were new data gathered since the last study was made in about 1957 or the late 1950's. And I think this made the large response to the attention in the media and so forth that the claims of the Dr. Tampman and Dr. Sternglass received and they came out instead of thirty-two thousand, they came out with the number six thousand and I think that if you take this background study that Frejerrio made that you can divide that number by perhaps a thousand or so as being the number that you would really expect. It was the six thousand, I am throwing numbers around again, the BEIR Committee, the so called, on Biological Effects of Ionizing Radiation. The advisory committee on the Biological Effects of Ionizing Radiation concluded that instead of thirty-two thousand that the number was really around six thousand if the people among them were exposed to one hundred and seventy millirankins and extra cases of cancer and I think you can divide this number by something like a thousand and you take

this background study seriously which is the reason that I bring that up. Secondly, of course, I would like to say in regards to Dr. Gofman's allegations that he went around talking about this one hundred and seventy millirankins a year as though it had some relevance to nuclear reactors. Well, I have all ready pointed out and I remind you that the highest exposure to anybody from nuclear power reactors to anybody that might be living right next to the boundary has not been one hundred and seventy millirankins but something like a tenth of that or less per year and this is to only a few people and if you get into the millions of people that might have been exposed to a fraction of a millirankin a year rather than a hundred and seventy from nuclear power reactors. So the entire argument whatever substance it has, has nothing to do with nuclear power reactors in my perception.

I would like to move over from that, I am taking some time here, to the liquid releases....Oh I would like to say, I dwelt on this exposure in connection with the gaseous releases cause this is about all that you can quantitate in the way of a measurable exposure above background from power reactors effluents, so, also liquid effluents. And these are detailed in the paper, and in the interest of time, I am not going in to a ....on table six I am not going to go into a lot of time on them, principally because I don't think they deserve the time that there are a number of studies conducted around power reactors. First of all the power reactors themselves have to monitor all the different pathways in which you would get radiation to the people whether by direct dose from say the sky shine, from the reactor, the exposure dose from the noble gases that are emitted from the stack which constitute the principal exposure from what is let out of the stack. Any possibility of radio....getting out of the stack of either getting inhaled or getting on the grass and getting into the milk route. Milk is monitored by the plant operator. It is customary to practice in as far as I know and around the country for either State Health Agencies, State Environmental Agencies. I don't know what you have around here, but I know that one, I have seen the data, that one goes out and monitors these same pathways of radioactivity to see....every nuclear facility in the state. And the Environmental Protection Administration also conducts sort of counter part audit. In addition, they have conducted some large scale studies around several very detailed studies that take a large amount of money and a lot of research talent so that the State Agency could not reasonably mount a study of this scale. They mounted studies of this sort on several reactors around the country. A boiling water reactor, pressurized water reactor, in particular. They have concluded, this is particularly in regards to the Dresden reactor up at Morris, Illinois, that there was just no pathway from either deposition on the ground or from the liquid effluents which were in the order of a few curies a year that were released from the miscellaneous leakage pads in the plant even though the primary in the plant is sealed up and is effectively contained. That either when various process steams have to be examined for control or when the reactor is opened up, it creates contamination within the plant that has to be washed down and the various other operations that contribute miscellaneous small scale escape routes of the radioactivity in the scale, too. To the...through the...to the hold up tanks in the plant and after these have been monitored, there is a million gallons a minute in a thousand megawatt plant. There will be a million gallons a minute going through the discharge canal of water from wherever it comes from, a lake, a stream or the ocean or whatever, and this furnishes a very substantial dilution for these few curies a year of radioactivity to have been released in liquid effluents from operating reactors and the result is that when you actually look at all the..... (inaudible) that you can imagine for radioactivity being consumed by people by this release either in fish, or on crops that may be irrigated or whatever path you want to choose, you come up with the conclusion

that there is just no exposure, not even as much as one millirankin a year of exposure from the....other than the direct route of what ever gets up the stack, small as that has been, so you can read the numbers in the table. It is just ten to a third is a thousand and ten to a six is a million and one of the things that is in that table that I will point out is that you generally find when you look at the natural radiation present in water that the releases are relatively small compared to the.....if you have any sizeable body waters that is present in the water by natural processing.

Well, I want to spend just a little more time talking about risk estimates.....the latter part of the paper here. And read some of these numbers for the benefit of the audience who don't have the paper, here, in Table VII and I mentioned already and I will just repeat again. This is just about the same number as I said before that if you have radiation at one millirankin a year, you can multiply that by whatever factor that you think an average number of people will be exposed to and take a risk to a number people. But somebody, and this might be if you lived near the boundary reactor, that you might be exposed to a few millirankins a year and if you are a further distance the available data suggested as I already said and I will remind you again, to some fraction that if you were a few miles from the reactor, it would be a tenth of a millirankin a year and if you were further out, like fifty miles, it would be something like a hundredth of a millirankin a year. If you were exposed to one millirankin a year, you have one chance in ten billion that you might develop this is from the high dose rate, high level exposure rate that the risk estimates is developed from that kind of data which if you will apply it to these low measurements, then there is every reason to think in the biological data that we have a conservative overestimate of what is really going to happen. But, if you are exposed to one millirankin a year, you have one chance in ten billion of an adverse affect. From natural disasters this..... that is a theoretical number there, it is not actually happening and there is no way to observe it, if it is happening. But you get the things that are happening by way...and I am trying to put the risk in perspective from a few millirankins a year. This is important in the context of the argument that we have had so far and may develop today, that from natural disasters, that if you take the actual mortality from across the country, and divide it by the number of people who were killed by the total population, you come out with the rest of these numbers here. And so there are two chances in a million from earthquakes, tornadoes, etc. that you will be fatally affected each year. From the effluents from fossil fuel plants and this is a calculation by Chauncy Sair again. There are four chances in a million that you will be adversely affected. This is sort of a theoretical estimate but it is based on the actual.....some projections of the actual excess mortality from pollutants emitted from fossil fuel plants. The chances to be electrocuted are two chances in a hundred thousand from....that you will be shocked is two chances in a hundred thousand and I make a very sodonic comment here in terms of gun control legislation.....it won't cost a nickle except to people who make guns maybe, it won't cost a nickle to have gun control and we can't seem to pass gun control legislation nationally. If we make reactors safer and safer and safer, it is costing millions of dollars. Like, I am on an excursion here for a moment but I am a critic of the AEC at times like I said. I happen to be critical of this recent proposal to lower the effective designment that is for nuclear reactors from one hundred and seventy millirankins a year, at five hundred

millirankins a year if you are individually living at the boundary rather to five millirankins a year to the hypothetical individual living near the boundary. I don't really think anybody will really be any safer because no one is being adversely affected now and it is going to cost them a million dollars a year for each reactor to capitalize and maintain and operate the extra equipment that will be installed in these reactors in order to be able to do this. I happen to think this is throwing away a million dollars a year for each thousand megawatt reactor that is installed or the best part of it will just be thrown away because we will not be safer in the real world rather they will be theoretically safer but in the practical, they wouldn't be any safer. When I think of health affects what a million dollars a year times a hundred or thousand whatever number you want to take of large reactors that means essentially a lot of money. We are worried about health affects, I suggest that there are a lot of other ways to spend that hundred million dollars, I mean that million dollars a year of course times the number of reactors that exists and on more safety, making what is already quite safe, even safer.

Particularly, you have your radiation exposures. Jim Tell, who was the former director of the National Center...the National Center for Radiological Health made a projection that if you took that same million dollars a few million dollars a year and applied it to the reduction to the unnecessary exposure from medical x-rays. Now, I am not saying that you should be afraid of x-rays. If I....if something is wrong with me and I need an x-ray and I am somewhat knowledgeable, but I am not going to hesitate about going to the doctor and getting an x-ray. But on the other hand, there is a lot of fat, so in the difference between what is necessary and the exposures that occur. Witnessing the fact that if we have an average exposure from x-rays here of something like fifty millirankins a year. In Great Britain for example, the same quality in medical x-rays technology is accomplished with something like fifty millirankins and the British aren't that much smarter than we are. I think they might spend a little more money for control and so forth. If you want to reduce x-ray exposure and if Dr. Sternglass and Dr. Tamplin and Dr. Sternglass and Dr. Gofman are really concerned about reducing exposure, I can suggest that expertise and their powers of persuasion that are far greater than mine, that they would accomplish far more in terms of reducing exposures by large numbers of (inaudible) a year if they were to try to reduce medical exposures. Let me get back to this table again. Air pollution over all, the projection is like one chance in ten thousand for fatal affect from smoking five chances in ten thousand, from automobile driving, one chance in a hundred. With this you have to divide this by... if you were in the car all year long, twenty-four hours a day so you divide that one chance in a hundred by whatever fraction of hours in a year you actually spend in an automobile to actually come out with a risk. Not that many people are being killed.

MR. PADILLA: Mr. Hull, Mr. Hull, may I interrupt you for a moment. I may take advantage of your kind offer to permit us to recess during your presentation. Can you estimate about how long you will be through?

DR. HULL: I am just about through now, sir.

MR. PADILLA: You're just about through. Go right ahead then.

DR. HULL: Just a couple of more minutes and I will be done. I want to apologize for taking your time, but I think I will just summarize by saying what it says in my Summary here, but for the benefit of the audience here, from the evidence today it seems to me what I have produced and what I haven't been able to say that the hazard potential of nuclear plants have been greatly overexaggerated by adversaries of such plants. The risks that do exist have been guarded against to a degree that is unparallelled. I might comment that rather than worry about our nuclear plant whether they should be located outside of a city, I am inclined to say as did the previous speaker, it is prudent away from large centers of population. I would advocate the same psychology the same degree of safety might be properly exercised about other technologies that have the potential for large scale disaster if the right circumstances or wrong circumstances happen to prevail and maybe we should apply the same thinking. The same careful thinking to nuclear technology. It is new, let's face it, like the new boy in town faces a challenge but I think there is a lot of technology that you would approach with the same attitude. We would say you should be twenty or thirty miles away from the center of the city and not in the center of the city. And I think otherwise a degree of backup if something goes wrong, you have a backup and if something else goes wrong, you have another backup that Dr. Draper just bragged about nuclear power plants. I think this same attitude could quite possibly and we would be indeed far safer from both small insults and large scale....this potential for large scale disasters but we applied this same sort of large scale ultraconservatism towards safety, toward many other large scale technologies which we don't do at the moment. So, I am not saying make nuclear any less safe than it is, I am saying make the other things as safe and I think we all would be a lot better off. With regard to routine effluents, nuclear plants produce less air pollution, relative to applicable standards, than do their fossil-fueled cousins. And I think that even after the ETA standards are in effect and millions of dollars are spent, that the nuclear plants will still be safer. The concentrations of radioactivity in the liquid effluents from nuclear reactor plants are controllable at levels well below radiation protection standards and pose little threat to the environment. Contemporary nuclear plants are somewhat less thermally efficient than modern fossil fuel plants. The new generation will be thermally as efficient. And finally, I think that the waste management, long-term waste management, problems as the previous speaker has suggested. Although, not completely solved yet do not appear to be unsolvable and in particular, people tend to get a big picture because when you talk about millions of curies, and millions sounds like a big number to people, but in actual quantity if we burned a hundred tons of uranium a year in a thousand megawatt reactor, we have some small fraction of this as long term...long half life constituents like maybe something less than ten tons. The size of ten tons that we have to store somewhere and if you convert this, that in liquid form after you dissolve it and so forth...if you convert this to a solid form (inaudible) or what not the actual most obnoxiousness ones select out, you will have even less than that. These volumes are relatively small.. If you take all the waste that is going to be made by all the nuclear power reactors and you solidify it and this is condensed form, it is going to be made by nuclear power reactors and for the year 2000 would store it in one place. You are talking about eight large warehouses, I forget how many feet tall but it impresses me, maybe a hundred....I'll just pick a number or something like that covering a large football field and that would hold all the volume of waste that is involved here. So we are not talking about a large volume

that is going to require that degree of large scale barriers against us not getting out from somewhere. Of course, the smaller the volume (inaudible) so it won't get abroad. Well, I think the next generation of power plants, now being designed and tested will be as efficient as the best fossil-fueled plants.

And I think in conclusion, the AEC and plant operators and utilities responsible for the utilization of nuclear plants have been proceeding in a manner that has the public safety and welfare as prime considerations. To date, despite many recent allegations, there is little hard evidence on which to question the judgments of these parties.

MAYOR BECKER: Mr. Hull, we appreciate that presentation. It was most informative and I will certainly say this to you that you couldn't be accused of being ill or poorly prepared. You know your subject and that is rather apparent. Does anyone have any questions to ask of Mr. Hull? Alright, thank you very much sir. We are going to adjourn now for approximately an hour for lunch and we will be back here, let's say 1:30 and proceed with the rest of the.....

MR. PUFILLO: Pardon me but before we adjourn, will all those who are entitled to speak be given on this program today?

MAYOR BECKER: I would like to think that all people will be given a chance to speak.

MR. PUFILLO: I will come back at 1:30. I particularly took off time to...out of my personal time to come down here and make a few remarks and I would like make do so if I can be given the privilege.

MAYOR BECKER: We are going to try to give everyone allotted, sufficient amount of time, Mr. Pufillo, to register their views barring unforeseen acts of God, power shortages and so forth, you know. So let's recess and we will convene at 1:30. Thank you.

(The meeting was recessed at 12:30 P.M. and reconvened at 1:50 P.M.)

A motion picture entitled "The Future of Britain's Atomic Industry" was presented by opponents.

MAYOR BECKER: I don't mean to be facetious, but I wonder if working around those atomic power plants does that to your voice?

DR. LEVINE: I was just going to say that the quality of that film compared just about to the quality of Dr. Teller's on the tape. It was difficult to understand.

MAYOR BECKER: I am afraid there is a similarity.

DR. LEVINE: Right. We must apologize for the quality of that film and its sound effects because it evidently had something to do with the auditorium because we played it earlier and it was much better in a smaller area. I assure you whatever the film lacked, our speakers today will make up for and I would like to proceed forward and introduce our first speaker if this is agreeable at this time.

MAYOR BECKER: Yes.

DR. LEVINE: Okay, fine. Our first speaker for this afternoon is Dr. Ernest J. Sternglass, Professor of Radiology Physics at the University of Pittsburgh School of Medicine. Dr. Sternglass has a Ph.D. in Engineering Physics from Cornell University. For fifteen years, he served with Westinghouse Research Laboratories as Research Scientist in Nuclear Instrumentation and Medical Instrumentation relating to Radiation. Since 1967, Dr. Sternglass has also been directing research in new techniques for reducing the diagnostic dose from x-ray examinations and research on low-level radiation in man---at the University of Pennsylvania School of Medicine. In addition, Dr. Sternglass has a joint appointment at the Graduate School of Public Health at the University of Pittsburgh. He is the author of the book entitled, "Low-Level Radiation". Mr. Mayor, Council members, ladies and gentlemen, Dr. Sternglass.

DR. ERNEST J. STERNGLASS: Thank you very much, Mr. Mayor and distinguished members of the panel. I thought that perhaps at this time there is one other subject that we need to discuss. A subject that was not taken up in the film that we have just seen. And that is the subject of the Effects of Normal Operation of a Nuclear Reactor such as the ones that we have seen described in this film. For many years, I worked in the field of nuclear physics and nuclear instrumentation. I have patented disclosures in the field of gas cooled, MHD gas-cooled reactors and I devoted myself to the peaceful applications of the atom for most of my professional life and yet here I stand today having to urge that we end all further construction, licensing and operation of nuclear reactors until we have learned how to build them, if we can ever do it, in such a way that the public cannot be harmed. How can I, having devoted my life to this problem, be standing here and denying that all our hopes and dreams for ending fossil fuel pollution, all our hopes and dreams for saving the landscape from the ravages of strip mining, all our hopes and dreams for ending man's ever-expanding need of energy, how can I stand here and say we cannot go on in this direction. Until a few years ago, I firmly believed that the only real hazard of low-level radiation existed from the testing of nuclear weapons in the atmosphere which unfortunately is still going on despite the fact that the United States...uh Britain and Russia decided to stop. Until just a few years ago, I thought that nuclear reactors that were being built by my friends all around me was the safest and the cleanest way to secure man's safety in the future. What has happened in these last few years? And I would say that the first things that have happened that changed my whole outlook on this situation was the report published by the Environmental Protection Agency in March of 1970 and then the Bureau of Radiological Health of the Public Health Service was entitled, "Radioactive Discharges to the Environment from Nuclear Power Facilities". Until that time, I did not even realize that nuclear reactors discharged anything significantly into the air. Why was this so? Because I had worked with the people that had designed and worked with the nuclear submarine where the engines were right next to the crew's quarters and I knew that those men were not dying over night. That something was being done to protect them and nothing was too good to protect their lives. And so I believed that when a nuclear reactor would be built for peaceful purposes that, indeed, we too would be protected as well as Sailors in our nuclear submarines. But this report disillusioned me and in that report it became apparent for the first time that instead of negligible doses comparable to

what we give in the course of ordinary medical procedures, a few thousandth of a curie. That indeed some reactor like the Dresden reactor had emitted hundreds of thousands of curies equivalent to grams of uranium in their radioactivity into the air of the people of northern Illinois in Chicago. Such was a shock that I could not get over it that when I flew home with that report on my lap from Chicago to Pittsburgh and it was only in early 1970, twenty-five years after Hiroshima, twenty-five years after or more than the first reactors began operating that it began to become apparent that it was not possible to build commercial reactors competitive with a coal burner sitting on a mine mouth and make it as leak tight as a submarine reactor. It was such a shock to me that it just couldn't be described and I got some of my students to look and see if there were any detectable changes in health around that reactor in Dresden. And only a few weeks later they came back and showed me the statistics on Grundy County where this reactor was located. And it turned out that within the same year, that within a year after the emissions arose from a very small value to a very large value, of a hundred thousand or more curies, infant mortality in that country rose one hundred and forty percent. And the further we looked away, the less of infant mortality there was and when we looked at all of Illinois, we found that there was a peak in Illinois that did not occur in Ohio or other states upwind to the west. And then we found and looked deeper. And we found not only were the babies dying at a higher rate, but we found that the rate of prematurity, the rate of babies born too little, underweight, premature, unable to breathe properly, developing pile-lined membranes disease. These babies, their increase in numbers of babies that died followed up and down the leakages and the decline in leakages from that reactor and that was the beginning. When I first testified on this matter before the State of Pennsylvania Senate, together with Dr. Gofman and at that time, we held hearings in October of 1970. It was totally incredible to us that any government agency could permit such large discharges to take place. But how would it have happened?

Unfortunately, it happened this way. Our radiation standards were formed in the fifties and formulated then. On the basis of what we knew about external medical x-rays which were given to us during diagnostic procedures and sometimes during therapy for treatment of cancer. And those levels appeared to show that man was relatively insensitive to radiation especially the adult. That we could fight it off. That we could repair ourselves the way we repair from a burn. But tragically enough, what we did not know are two very important things. Number 1, that the newborn or the baby in utero is hundreds of times more sensitive than the adult to the same amount of radiation and this was discovered, only accidentally and oddly enough, not from fall out but from the use of diagnostic x-rays in England and Wales by Dr. Alice Stuart. And so we have learned one thing that we had misjudged. We had never thought that small amounts of radiation could be as serious. Another thing we had not understood is that the chemical acts which are formed and created in the fission process do not act at all like external radiation from an x-ray machine. For when the x-ray machine is shut off, the radiation stops, but when I take in Strontium 90 in my milk or the milk form any individual animal, that Strontium 90, which is a chemical like calcium, goes to the bone and stays there, almost for the lifetime of the individual. And so we have tiny x-ray machines built into our body and they will radiate us gradually over the years. They concentrate in the bone marrow much more than in the body as a whole and the

same is true for radio iodine. X-rays do not seek out any particular organ, but iodine, ninety-five percent or more goes right to the thyroid gland and in the tiny fetus that does gives it a dose some one hundred times greater even that of a small child and so once again, we totally underestimated biological concentration mechanism exactly the way it happened in the case of DDT. When we discharged DDT into the water at a few parts per billion, nobody thought that it was very serious, but the food chain multiplied it and the plankton and the big fish and the little fish and the birds and finally when the hunter got a bird; that bird may have had thousands or tens of thousands as much times of DDT in him as we had dumped into the water.

That is the same tragedy that occurred in the case of other environmental factors. Mercury, DDT is only one of them, but another thing that happens is that we never anticipate the sensitivity of newborn fertility problems that is so serious. But that is what happened with thalidimide. The mother to whom we gave thalidimide did not show any symptoms at all. She felt fine, but the tragedy was that if it was given during pregnancy and at the right moment that child would be born with missing limbs or stunted growth of its limbs. And that is precisely the kind of unexpected effects that has now been established over the last few years in the case of radiation. It is not so much us, you and I, we are relatively radiation resistant. We can literally have ten thousand millirads and barely increase our chance of developing any kind of aftereffects but only give one hundred millirads to the early embryo, one-fifth of the minimum permissible dose under present regulation and you will get a doubling of the number of children that are going to die of leukemia and brain tumor and other cancers before age ten. And when our reactors were designed, none of us, not one, not myself, not Dr. Gofman, not Dr. Tamplin, no one anticipated this kind of a tragedy was waiting for us. That is how we got into this terrible situation. A situation where we have committed billions of resources, dollars, hundreds of thousands of people to a technology that we may yet have to end. I am not the only one who believes it needs to be done. Only, on May 15, the Swedish Parliament passed a resolution to end for the time being, for one year, all further commitment to nuclear reactors until a totally independent study was to be carried out. They could not and did not stop the reactors that were already under construction. And Sweden expects to be about sixty to seventy percent nuclear by about 1985. They were going to be the most heavily nuclearized country in the world and yet as the result of the latest findings they have temporarily drawn back and said HALT, we must take a look. We must look at the safety aspects of a major core cooling accident that we had never dreamt could ever happen. We must look at the facts that have been kept from us about the true corrosion problems and the emissions from those reactors and the new findings of ever greater sensitivity of not just man but of every living thing. Because in the last few months, we through a series of accidents in Pittsburgh, we learned to our great horror, things were happening to us in our back yard that we could never have expected if we had dreamt of a science fiction nightmare. As a result of our intervention, few environmentalists taking a look at the new reactor which was to be built next to the old Shipping port plant in Beaver County, we learned that the new reactor according to the Ducane Light Company's own environmental statement was scheduled to emit six hundred and fifty thousand times as many curies into the air on the average as Shipping port over the last fifteen years of operation.

When I took this information to the Mayor of the City of Pittsburgh, he said, "We must stop this and intervene". And today Pittsburgh has become the first city, the first major city in the world where its city government is intervening against the completion of the operation of a reactor costing $350 million, now seventy percent completed. And we are also intervening against the construction of a third reactor on the same small site one mile up stream in the city of Midland. A town of five thousand people drinking the water that comes out of that reactor. Since we found out what happened at Dresden and since we learned from our inspection of the enormous amount of radioactivity that were being kept from the public. There being and going to be discharged we began to become suspicious of the truth of the figures that had been published about Shipping port. By the meerest miracle, we were able to obtain four quarterly reports prepared by the NUS Corporation hired by the Ducane Light Company to carry out an environmental monitoring study. And in that report when I opened it in November, I found that the Strontium 90 in the milk around six dairies within eight miles to ten miles within that reactor showed Strontium 90 levels three to four hundred percent of the rest of Pennsylvania as high as during the height of nuclear testing. To the people of Midland, the bomb had not stopped. And when we looked at the statistics and I wrote to the Health Department of the State of Pennsylvania and they sent me the statistics, they sent me the statistics on the death in Midland. I began to see the full dimension of this atomic Watergate. In the City of Midland as you will see in the graphs that I have given you, one mile downstream that respiratory cancer, mainly lung cancer increased six to seven fold in exactly the length of time in figure 2, exactly the length of time that it took for the Uranium miners to start developing lung cancer after they started working in the Uranium mines of Colorado and New Mexico. When we look at the total cancer rate, we found that for the entire county of two hundred thousand people, cancer had gone up thirty-nine percent between 1958 and 1968, where as in the rest of Pennsylvania it only increased 9%. And when we looked at leukemia in Beaver County, we found it had gone up seventy percent where as in the rest of Pennsylvania, it had only gone up 15%. And when we looked at another city to make sure that there couldn't be some fluke or other that produced such horrible things. We turned to the statistics of New York State and the city of Schenectady, New York. When atomic laboratories got under way at the end of the forties and small nuclear reactors were being tested for the future, and we found, as shown in Figure 3, that respiratory cancer in Schenectady, New York after being two-thirds of what they were in New York City sharply rose to three hundred per cent of the previous values. From sixty to hundred thousand almost fifty percent more than dirty-polluted New York City. And when we look at total mortality of all causes as we had seen it rising in animal population given low levels of radiation. When found that in the City of Schenectady, a city of some eighty to ninety thousand people in upstate New York, far from any coal plants or big steel mills total mortality rose from being near that of New York City around eleven per thousand people in 1955, it rose to seventeen to become the second highest of a hundred and fifty some listings in the New York State vital statistics. When we presented these findings, the Governor of Pennsylvania has appointed a nine member select scientific committee, which will meet July 31 in the town of Alequipa next to that reactor. Eight miles away, about as far as you are from the site that is planned for you near Lake Calaveras. Right? About ten or twelve miles away. And Alequipa showed that in return for the tax release that people in that county got infant mortality from 1964 when the new reactor, when the new core was put in doubled by 1970. To reach

the highest infant mortality rate of ninety-eight listed in the Annual Vital Statistics of the State of Pennsylvania. And in that city on July 31, the Governor of Pennsylvania will hear our testimony, that of Dr. Gofman and that of many other eminent scientists from all over the country, the evidence that we have grossly under estimated the danger not only to ourselves but to the very children whose protection we seek to protect. Thank you.

MAYOR BECKER: Do any of the Council members have any questions they would like to ask Dr. Sternglass? No one? I have some questions I would like to ask if I may please, Doctor. And, I am going to have to ask you questions that....I don't mean to be insulting or embarrassing by answering them, but it helps me to determine my own conclusions on these matters. You say you were formerly with General Electric or Westinghouse?

DR. STERNGLASS: Westinghouse Research Laboratories.

MAYOR BECKER: Westinghouse. May I ask and if you don't care to answer these questions, you are certainly within your prerogative. Under what conditions did you leave Westinghouse, may I ask?

DR. STERNGLASS: Very nice conditions simply because I was offered an unusual opportunity to become a full professor at the University straight out of industry to pursue my work on the dose reduction of diagnostic x-rays which I had begun at Westinghouse and just to show you under what excellent conditions I left, I was retained on a consultant contract for two years after I left Westinghouse.

MAYOR BECKER: Fine. Now, I don't exactly have these questions in proper order, but I ask what means, what type of instruments or measurements are available to science or the public at large to measure the amount of radiation, if there be radiation emitting from these various plants. Isn't there any type of instrumentation that is available to substantiate the claims that you make with the respect to the amount of Strontium 90 and whatever these other chemicals....you will have to forgive my ineptness on this matter because I certainly don't profess to be an authority on that. Isn't there any way that these claims can be substantiated, factually and scientifically?

DR. STERNGLASS: That is precisely, of course, the substance of the report which I sent to the Governor of Pennsylvania showing the independent measurements carried out by the NUS Corporation which by the way contains a number of people including Mr. Deneuno who used to work for the AEC who is very well versed in the measurement of the radioactivity around that plant and I sent this report to the Governor with a pound of basis on those findings of Strontium 90 in the milk. A copy of which will be given to each of you at the end of our meeting here and I have a copy with me and in her it shows the actual measurement of Strontium 90 in the milk carried out in early 1971 by the NUS Corporation showing very clear three fold greater value than for rest of Pennsylvania and in fact after the plant was shut down, in September or August for repairs, Strontium 90 levels in the milk were shown by their own measurements to have come down to the rest of Pennsylvania. So these measurements are quite accurate and I might say that in a report just issued by the Environmental Protection Agency which I have with me here and will be glad to have you look at it. It says here in the report that there is no other explanation for these high levels of Strontium 90. In fact, I will read you the sentence that applies Strontium 90 in the milk, page 8. A suitable explanation cannot be made of the

higher than average Strontium 90 levels reported in 1971. So the answer is yes, unfortunately such measurements were not carried out by the State Health Department and when I checked with Mr. Tom Jewruski, the head of the department of radiological health for the State of Pennsylvania, he told me that the Naval Reactor Branch which operates the nuclear part of the Dukane Light Company's plant, frowned upon the state snooping around that plant and no previous environmental measurements of Strontium 90 had ever been carried out by the State of Pennsylvania.

MAYOR BECKER: In other words, the presence of Strontium 90 in your opinion did coincide with the operation of that plant?

DR. STERNGLASS: Not only did it coincide, but we have the following facts that outline the report to the Governor dated January 21 and this is what it shows: Number 1, Strontium 90 in the milk in early 1971 declined in distance by a factor of fifty times north, south, east and west away from the stack of that plant. Further more for the early part of 1971 as shown in figure 5, the Strontium 90 in the cows, in the milk going around that plant, within eight miles of it went down together with the power level generated in that plant. Furthermore, the decimidus dosimeters which were placed around it, which are tiny chips of some crystal which absorbs radiation and can emit light and one can use this to measure it. We found by detail study of the measurements carried out by the environmental consultant for the Duquesne Light Company that the dosimeters upwind two miles in Hookstown and Georgetown showed much less radiation than the ones on the sight. The ones downwind showed an in between level. Exactly consistent with what everything says here at these high levels, fifty-thousand times higher than they were reported to the Environmental Protection Agency were indeed attributal to that plant and no other alternative explanation has been offered.

MAYOR BECKER: Well, Doctor, you made reference to comparing these commercial reactors to submarine reactors.

DR. STERNGLASS: Yes, that is correct.

MAYOR BECKER: What was the point that you were trying to make in that comparison?

DR. STERNGLASS: I would like to make the following point that a submarine reactor has a fantastically greater degree of inspection and quality control than can be afforded by a machine that has to compete with commercial gas or oil or any other fossil fuel burning plant. When Admiral Ricover wants a nuclear reactor, he wants it to operate without fuel change for five to ten years, but we, in commercial reactors, now have to design them so that the core is changed every quarter year. A quarter of it is pulled out and replaced. It is because the nuclear power plant in a submarine or ship can be allowed to operate at much lower efficiency of the order of twenty to twenty-two percent in such a way that the thermal loading, the density of energy per unit volume is much lower. Therefore, the heating is much lower, the risk of corrosion is much less, the risk of leakage into the primary and secondary coolant is much less. Therefore, these plants you might say are the Rolls Royces of the Industry. Unfortunately, an economy of an automobile nation could not be based on Rolls Royces. Tragedy is that people are taken to that plant, show this Rolls Royce and the delivery is a Corvair.

MAYOR BECKER: I was curious about the effect of corrosive effects on stainless steel and not being a scientist, I was under the impression that stainless was almost impervious.

DR. STERNGLASS: That also was our impression, in fact, I remember many of my friends hoping that our newly developed stainless steels could resist corrosion. But, I have with me reports by the Environmental Protection Agency that show that each and every reactor, whether it had used Zircaloid 4 or Stainless Steel or any other alloy that has yet been imagined including the British reactors, each and every one including the gas cooled reactors have suffered from corrosion problems. The terrible tragedy is that we are dealing with a new phenomena that had not been looked at enough and we don't know how to solve it. In fact, at the research lab at Westinghouse, a great deal of research has been going on in materials and many of my friends have been engaged in that problem. The tragedy is that under the flux of high intensity neutrons and high temperatures, the cracking and the tiny development of corrosion cracks is much accelerated. Much beyond what we find in an ordinary situation without this intense radiation field. And this is, therefore, the nature of the problem that man has gotten into. On paper, and I believed it, nuclear seemed to be the answer. There were two tragedies in a sense that interferred with our being able to realize that great hope. One is the reality of materials, properties, corrosion, corrosion, corrosion. The other one is the great and unanticipated sensitivity of the developing organisms. I might just add one thing that has great bearing on our concern, not only was Strontium 90 high in the milk of those cows but in the last few months, we learned from a veterinarian that has been studying some of these dairy herds that reproduction of dairy herds, of cattle herds has dropped from sixty percent to ten per cent, spelling tragedy and disaster for the local dairy industry.

MAYOR BECKER: Let's just take a hypothetical situation that you have a nuclear plant that is operating at whatever percent of capacity that you care for it to operate at fifty, seventy-five or even a hundred, I don't know which figure to use, what would be the life expectancy so to speak of that plant, were it operating say at fifty percent, seventy-five percent or a hundred percent capacity? Would it reduce its life expectancy by half if it were operating at a hundred percent if that is such an obtainable figure, which I don't know?

DR. STERNGLASS: As you can see, I don't know. I can give you an approximate estimation based upon the submarine experience. There it is possible to keep fuel elements operating for at least five years. Operating, let's say, at twenty-two percent efficiency compared to almost thirty percent for commercial machines where fuel rods have to be regularly replaced at least every year or two. So we are talking about something like two to five fold reduction in life by going from a twenty percent efficient operation to about a thirty efficient operation, but that would be just a very crude estimate. There are many factors involved. As you perhaps know, as the result of fuel densification which turns out that the fuel rods, the materials in the fuel rods, tend to densify and collapse down the tube. The Atomic Energy Commission has had to order fuel rods manufactured by some manufacturers to be operated at much lower temperatures and lower efficiencies and this is, of course, a factor in the present discussion of the core cooling accident system. Because if this were not done, core cooling accident's might be more likely or serious in consequence. Now, when the plant is operated at seventy-five percent of its normal ratings, then, of course, much of the economy that the nuclear plant represents begins to vanish.

Because not only is it generally plagued with many problems as all new engineering and high technology systems are, but it also has the other problems of unexpected fuel densification and the problem of core cooling accidents which have forced a drastic reduction in many plants of the theoretically expected power performance. So economically these plants turn out to be disasters for some of these utilities.

MAYOR BECKER: Doctor, if we are to accept the fact then that nuclear power at this point in time is not to be accepted generally, then what are the alternatives? We know that we need energy.

DR. STERNGLASS: Absolutely!

MAYOR BECKER: What are the alternatives?

DR. STERNGLASS: Well, I believe we heard this morning by representatives of the Light Company or the Board that we do not have the great potential for the next few hundred years to meet our needs with clean gas made from coal. A plant in Germany in Lieudenam now operating, much larger than Shippingport, operating on clean gas from coal. That will tie us over for the next twenty, thirty, forty years until even Dr. Teller finally admits that we should have developed fussion. And also, we should have tapped into the great geothermal resources. You will have to realize that half the power in San Francisco is now being supplied by underground geothermal energy just from a few plants north, seventy, or eighty miles north of San Francisco. So the geothermal has an enormous potential for the entire western part of the country including Mexico, New Mexico, Arizona and California, especially because the heat sources in the earth are relatively shallow and can be trapped relatively easily. In fact, the government is now leasing land for the exploration for geothermal sources. Finally, you are blessed here with a lot of sunshine which we don't even have in Pittsburgh. And there are numerous methods of utilizing solar energy, some of which that can be put into practice on the basis of three to five years, others on the basis of ten to fifteen years. But until these things come about, we have ample coal, ample ways of cleaning out the sulfur, ample ways of cleaning out the dust, the dirt, even some traces of natural radioactivity in coal which does exist. In which I believe is in no way negligible in effects on man, but we have the potential for a clean gas plant and the study by the ETA has shown no changes in radioactivity around natural gas plants and no health effects either on the infant or cancer from the burning of clean natural or other gas from coal.

MAYOR BECKER: Are there any other questions, Council?

MR. LEO MENDOZA: Mr. Mayor, I would like to ask Dr. Sternglass or any of the other gentlemen who are here--is there any information available on the findings of the AC or Atomic Commission to the general public at this time?

DR. STERNGLASS: Could you repeat that question, I am very hard of hearing.

MR. MENDOZA: Is there any information on the findings of the Atomic Commission at this time that is available to the general public?

DR. STERNGLASS: Yes, I believe by writing to the Division of Operational Safety or the EPA that it is possible to obtain this report which made an investigation of the NUS findings around the Shippingport plant, if that is what you are referring to. And it shows that, although some people were thinking that some of the dosimeters might be due to some extraneous factors like flying the dosimeters down to New Mexico. Basically, the reports show and these are public, that Strontium 90 in the milk could not be explained in any other reasonable way. In addition, other reports are available and I have them with me. These reports are of this type. They are available from the Environmental Protection Agency called Radioactive Waste Discharges to the Environment from Nuclear Power Facilities, BRH, DER 70-2. And it shows for all the plants that have been in operation, how they have been leaking, how much radiation has gone into water, how much has gone into the air, how year by year the amount of leakage into the people's food and diet has gone up as the corrosion has took place. All this came available twenty-five years after the dawn of the atomic age.

MR. PUFILLO: Doctor, may I ask you a question? I don't know anything about it of course. You say that the condition that you claim going on around Pittsburgh was caused by the ways that that plant was operated or do you claim that any nuclear plant would have the same effect?

DR. STERNGLASS: I would, I am afraid to say that the plant until recently in this publication was claimed to be the cleanest of all having, in fact, claimed only one one thousandth of one percent of the permissible dose in 1968 for instance. If this plant produced such serious effects, it seems to me that there is almost no hope that any other plant could possibly do much better.

MR. PUFILLO: Uh.....do you think that this is a false statement?

DR. STERNGLASS: At this point, it is an open question. We cannot, at this moment, prejudge the findings of the committee appointed by Governor Shaft. I firmly believe that since 1967, the reports were falsified and abnormally low emissions were reported for the plant because the yankee reactor which has the same emissions per kilowatt generated prior to that, kept showing rising value where they dropped ten thousand times per kilowatt per Shippingport. I personally believe that we have a serious problem in terms of proper reporting because the people cannot smell it, they cannot taste it, they cannot feel, they cannot see the dirty plume coming out. It is too tempting when you are trying to sell zero release reactors not to fully report them. Even before that and in other reactors, there were rises in infant mortality, rises of prematurity, rises of cancer which we now see. So I believe even at the limits, if they were correctly reported, even then we cannot be sure in fact, as we must, if we are going to completely depend on this form of energy for the future. We cannot be sure that all the reactors, manufacturers and the utilities have been lying to us and that they were really quite different. I think that we have to assume that in some cases, they were reasonably close to telling the truth. Certainly some of the reactors that were reported to have as much as fifty percent of the maximum permissible of five hundred MR's a plant, certainly they seemed to have reported at least the external dose reasonably correctly. So we can only say the following, that from everything that we have seen from the fifteen plants that we have inspected, we have looked at the data, we cannot feel that any would be adequate for me to want to raise my family next door.

MAYOR BECKER: Yes, just a minute, Dr. Hull.

DR. HULL: I was invited here and to my rights, I did not know who would speak with a contrary point of view. I wasn't able to anticipate what might be said. There was some rumor that you might be, Dr. Sternglass, and I realize that I have had more than my share of your time already. I have brought a few slides with me and I handed out some information and I will just say simply right now that in my judgement, there is no scientific information to backup any of the allegations that Dr. Sternglass has said and I think that it might be worth your while to see the scientific evidence on this matter.

MAYOR BECKER: Can we do that at the proper time? You will have a chance for rebuttal after Dr. Sternglass has finished his.

MR. PUFILLO: I want to say one thing before he has his rebuttal. I want everybody else to have a chance to speak on it, to speak on it before he has his rebuttal.

MAYOR BECKER: Mr. Pufillo, we have a form of an agenda here and I would like to stick to it if humanly possible.

MR. PUFILLO: My name is on it.

MAYOR BECKER: Yes sir, I know, I have seen it. Dr. Sternglass, I am going to make one further observation and further expose my ignorance on this. I know man is guilty of a lot of crimes, there is no question about that. I find it hard though to believe that we would knowingly visit this type of condition upon our own people. Now, if it were some foreign nation, this would be entirely possible perhaps. But upon our own people, our own neighbors, indeed upon our own relatives in certain cases perhaps, even ourselves. The dollar is a great attraction in the United States. That goes without saying but to perpetrate misinformation or crimes on our own society knowingly, is almost difficult for me to understand. I just, really, with all of our imperfections, I find it is hard to accept and I am not saying that I discount everything that you have been saying, but it would seem to me that some responsible people some where in the nation, perhaps you are one of those, would be challenging these conditions even greater, to a greater extent perhaps than let's say you are and I am not singling you out singly, you are following your.....

DR. STERNGLASS: I would be glad to comment on that. I too believed exactly as you did and in fact when I wrote my book, "Low Level Radiation", which was published about a year ago. At that time, I cited the Shippingport plant as the kind of clean plant that I thought would be an example of the kind that could be done if we were willing to put our money into. That is how much I too had believed what you believe. And the tragedy that I believed came about not by any intent to kill or mame our own people, nothing like that. Any polluter who lets the smoke go during the night as you well know, does it because he thinks it doesn't matter that much anyhow. The people are too excited and a little bit of smoke from the stack won't hurt them anyhow. Do you understand, it is that feeling. You have to realize that for the major part of the last twenty years, we were detonating bombs in the air that gave us five or ten times as much radioactivity than these plants did. You see and we did in order to protect the security of our country and, therefore, it was excusable and necessary under the circumstances. And the people who were involved in the control of radioactivity levels said, my God, how much could it matter, if I let

this little bit of radiation go and don't tell my boss if down the Ohio River there is twenty times as much coming during the time of nuclear testing. You see and so the rationality was that of the Cold War, of the bomb coming, and in fact, even the Chinese and French are continuing to test and you can argue what is Dr. Sternglass so worried about a small amount of release when the French and Chinese are about to detonate huge amounts of fission products into the atmosphere. That is true and that is how people rationalize releasing a little bit. They didn't think it was such a crime. In fact, at that time when this was going on, it was widely believed and many people still do, that small amounts of radiation probably produce no detectable effect at all. But there is some safe threshhold or practical threshhold below which nothing happens. That has been the doctrine of the AEC. It was announced for many years until recently when the critics like Dr. Gofman finally brought this question out into the open, that there really is no evidence for a safe threshhold. Many people who design the plant, did so with the best of belief that a little bit of radioactivity release is not going to do such serious things. I do not believe that the people who made those releases and those decisions years ago did so knowing that tens of hundreds of people in Beaver County, a year and it is now about a hundred per year in excess of expectations and not a small number, that had no idea. I think we grossly underestimated it and I was just as guilty as everyone else and I would have said, there can't be any harm in letting a little bit of radioactivity go and it is easy to close your eyes to something like a little puff of smoke coming out of the stack. How much could it hurt you? And it was under these conditions that we have to look at it, you see. It is not an intent to kill your own family. I mean that obviously did not take place. What took place was ignorance, a belief, a self deception which people who wanted to see a good technology come about who thought they were doing the best for society. And I think we see the same thing in the Watergate situation where people thought they were acting in the national interest in the best interest in the country and we have to put ourselves in that psychological position. That under certain positions, people feel that it is necessary to do something that might be against the law because of the greater necessity of providing and assuring power for the end, for all over, for decades, and for melinier to come if we could only prove this technology. You see, the temptation to want to see one's own brain child live and produce all of the necessary power for the world, is so great that I do not believe human beings can resist that temptation and therein lies the greatest danger of atomic energy. Namely in the frailty of man. That is what I am so afraid of.

MAYOR BECKER: Are there any further questions of Dr. Sternglass?

Someone in Audience: I would like to ask Dr. Sternglass, Why the members of industry do put up fraudulent....I just cannot accept that as fact and to me it is a misleading statement. It is uncomprehensible to believe that anyone would falsify reports of that nature.

DR. STERNGLASS: Well, this of course will be decided, I hope at least investigated in the court and by the Governor's fact finding committee that will meet July 31.

MAYOR BECKER: Thank you Doctor, thank you very much.

DR. LEVINE: At this point, we would like to introduce our second speaker. He is Dr. John W. Gofman who you have just heard many references to. Dr. Gofman is a Ph.D. and an M.D. He received his Ph.D. in Nuclear Physical Chemistry from the University of California in Berkeley in 1943 and an M.D. from the University of California in San Francisco in 1946. From 1947 to January 1973, Dr. Gofman was professor of Medical Physics at the University of California in Berkeley and research associate at the Atomic Energy Commission, Lawrence Radiation Laboratory at Berkeley and Livermore. He was co-discoverer of Uranium 232, Uranium 233 and Kotactinium 233 and co-discoverer of slow and fast neutron fission ability of Uranium 233. He co-invented the uranial acid test process for plutonium separation and co-invented the Columbia Moxide Process for Plutonium separation. He has done research on low level radiation, chromisones in cancer and has been group leader of the plutonium project at the Atomic Energy Commission's Lawrence Radiation Laboratories. Dr. Gofman received the 1972 Stuper prize for pioneering work in the Cause, Treatment, and Prevention of Arterial Scorossis. Dr. Gofman is an outspoken critic on Nuclear Power. He wrote several books, published over two hundred scientific papers. Dr. Gofman.

DR. JOHN W. GOFMAN: Mayor Becker, members of the San Antonio City Council and citizens of San Antonio. This is an unusual occasion where the City Council decides to, at least make an effort to be fair in having evidence presented so that you have invited some people that are not proponents of nuclear power. And I would like to express my appreciation to the City Council for its wisdom in doing this. It is wise on further grounds because the time is here now, that citizens want to know who specifically among their government leaders put us into one situation or another and I hope when your action is taken and the action of City Public Service is taken, on a decision with respect to nuclear power that the voting on this matter will be a matter of public record because there are going to be very serious questions asked down the line with respect to nuclear power. I consider that inevitable. I have provided you with three papers that I wrote and I won't go into them in detail but I provided them for your background. Number 1, On The Hazard of Radiation as presented by a statistic symposium by invitation. The second, on the reprocessing plant in South Carolina which is a necessary part of the nuclear industry at the invitation of South Carolina State Legislature in which I pointed out to you the problems of Plutonium. A reason for turning off the nuclear power industry long ago and which I consider for man to go forward with this industry in the face of plutonium is unthinkable. It is clearly spelled out for you but I will go into the highlights. And lastly, an article which I wrote at the request of Environmental Action magazine entitled, "Moratorium: The Solution to the Nuclear Power Problem", that expresses my views. In each of these papers, everything that I have stated there, whether it was a year ago, half a year ago, or today, my views have not changed one iota. Mayor Becker, you suggested that we might want to consider in making our presentations what Dr. Teller has to say. I not only listened to Dr. Teller's tapes this morning, but I might point out to you that for seven years, Dr. Teller and I were co-associate directors of the Lawrence Livermore Laboratory. As such, we met at directors meetings once a week and we met many many times in extensive detailed conferences. So that, Dr. Teller's views are very well known to me and mine are very well known to Dr. Teller and while he is one hundred percent for nuclear, I am one hundred percent against nuclear. Both having heard Dr. Teller's opinion before and again this morning, but I would like to point out something. I would urge you to listen to that tape very carefully because while Dr. Teller tells you he is one hundred percent for nuclear, he also tells you why

you should be one hundred percent against nuclear. And what is more, while you heard presentations this morning, presentations that I might say lack only one feature, a bit of human humility. While you heard presentations that told you why you should go ahead with nuclear, there were also presentations that should have taught you why you should be one hundred percent against nuclear. Let me go into those points in detail. Dr. Teller said he recommended to you that the plant should be away from populated centers and that the plant should be heavily guarded. Now, you must understand that the nuclear industry doesn't begin or end at the nuclear power plant. That is only one little part of the problem. It begins with the mining of uranium and it then goes through the processing of uranium in milling and refining. The final preparation of enriched uranium, the shipment to a fuel plant after fabricating it into fuel rods. The removal of the rods as Dr. Draper pointed out, that after a year of operation their cooling off then to a reprocessing plant and as he pointed out so well the recovery of plutonium and uranium and then the storage by methods not yet worked out of the radioactivity. The astronomical quantities of radioactivity. What Dr. Teller is telling you about heavily guarded doesn't apply just to the nuclear power plant. Indeed, I am sure it has got to apply far more to every one of the other steps after the nuclear reactor as well as the nuclear reactor. Indeed, if we are to have nuclear power, we might just as well now decide at this point that any idea of having a democratic society is uninteresting to us. We want to have a police state because everybody involved in the nuclear power industry is going to have to, or the power industry is going to have to be searched, guarded, watched over and this is to say nothing of nuts, psychotics, saboteurs, and potential guerrilla, people who are disaffected for whatever reason. Everybody in the industry is going to have to be watched because unless it is heavily guarded that way, we face putting into our city thousands of trojan horses of the worst imaginable kind. You must really think of what kind of repository of poison that you have in a nuclear power plant. One one-thousand megawatt plant operating for one year and this is a matter of physics and not conjecture, produces the amount of long lived radioactivity. I am not talking about short-lived about long-lived thirty year half-lives, Sesium 137, Strontium 90 as one thousand Hiroshima bombs, a tremendous amount of radioactivity that has to be guarded for the next six hundred years or eight hundred years for the Strontium 90 and Sesium 137 and guarded at every step along that way to that ultimate repository that doesn't exist. That is part of the problem of guardianship. The quantity of radioactivity is supplemented in a production of Plutonium roughly in the amount of six hundred pounds of plutonium each year in a thousand megawatt plant. Plutonium is going to be extracted from the used fuel rod at this fuel reprocessing plant and as many speakers pointed out to you today, unless that plutonium gets used, then you have lost ninety-nine percent of your potential fuel and uranium. And the same problem by the way, the thorium doesn't solve anything, it just adds to the uranium 238. I happen to know this problem since I hold the patents on the discovery of U-233 which is the product of thorium fertility and I would consider the most useful use of my discovery of U-233 and thorium cycle would be that it would never be used at all. Now, that is the kind of guardianship you need. For plutonium which 600 pounds of it and if we have a thousand reactors, breeder or non-breeder, the breeders will make it a little worse, we will make six hundred thousand pounds of plutonium per year. We are going to have to transport that plutonium after it is purified back from the plants. These fuel reprocessing plants that I described for you in the paper entitled "Some Important Unexamined Questions Concerning the Barnwell Nuclear Fuel Reprocessing Plant". We are going to

have to transport that plutonium on our highways. The proposal made by the Allied Gulf Nuclear Corporation was that they would transport it in trucks. Twenty-five to fifty killograms of plutonium per truck. Now twenty-five to fifty killograms of plutonium is about fifty to one hundred pounds of plutonium. Dr. Donald Geisalin has estimated the toxicity of plutonium and he has estimated, as the best estimate that he could make, that one particle, for ten thousand particles of plutonium oxide inhaled, you get one human lung cancer. That translates into one pound of plutonium, being enough for nine billion human lung cancers and it is going to stay on earth wherever it distributes itself and be active since its half life is twenty-four thousand years. It is going to be around for two-hundred fifty thousand years to five hundred thousand before it is adequately decayed. Now, Dr. Carl Z. Morgan, is in my opinion the greatest Health Physicist in the world. He founded the Health Physics Society and Dr. Morgan, at a recent meeting in California at the University of California in the engineering department, said he thought Dr. Geisalin's estimate that one pound of plutonium was worth nine billion lung cancers, was reasonably consistent with his own estimate. You know that we could go down a factor of ten or a hundred from Dr. Geisalin's estimate and it is still very bad, very, very bad. Can you visualize how we are going to handle six hundred thousand pounds of plutonium each year, ship it on our high ways, back and forth and not have a pound of it get out? Do you truly believe that you would like to put your stamp of approval on the development of industry, an industry that requires human perfection, and by the way, also requires protection against acts of God, earthquakes, sabotage, nuts, cranks, foreign spies or whatever such that one part in a hundred thousand won't get out for the next twenty-four thousand to hundred thousand years? Is that the kind of thing you would consider responsible behavior to say that something that will be conducted to within one part in a hundred thousand? By the way, that six pounds of plutonium put out per year, fifty-four billion lung cancers doses that are going to be there for the next several thousand generations of human and there is no way to put that jinni back in the bottle. You think that is reasonable to think we will do ninety-nine point ninety-nine percent perfection. I don't think that is reasonable or ninety-nine point ninety-nine percent.

Now, there is a little other gimmick and that is why Dr. Teller tells you about the guarding of plutonium. Plutonium is a very desirable element. The same six hundred thousand pounds of plutonium is going to be a very desirable element in the illicit channels of commerce. It is going to be a far bigger problem than heroin, far bigger. Let me tell you why. It takes something of the order of about ten to fourteen pounds of plutonium to make an atom bomb. And anyone who doesn't have atom bombs, even below the governmental level, is going to find this plutonium attractive. And so, not only do you have to watch against failures such as accidents and so forth, but there is going to be a hijacking problem that is going to be of major proportion in safeguarding this six hundred thousand pounds of plutonium traveling on our highways. If you like the prospect of converting our highways, our railways, our ships, our cities and everyone of our lives from a democracy to a total police state, that's one thing. I don't think that is what most citizens of San Antonio, of Texas or of the United States think that is what they are buying with nuclear power.

Now, a little more on the issue of hazards and the guar-ianship. This morning Dr. Hull presented to you, he said Dr. orman Frejerrio had presented a very interesting paper in which e essentially blasted Dr. Gofman out of the water. That was very nteresting for me to hear that Dr. Frejerrio had written a paper hat showed I was a thousand fold wrong and that Dr. Hull is so ut of date as still to be quoting that paper because something f the order of about a year ago, somebody gave me a copy of Dr. rejerrio's paper. I looked at it and couldn't believe my eyes, he calculations. So, I wrote to Dr. Frejerrio's, a copy of which etter and his reply are readily available, if you like it to very member of the City Council of San Antonio and every member of the City Public Service and to Dr. Hull, if he is still here. I would be happy to give you the exchange of correspondence. I sked Dr. Frejerrio, how could you ever reach this conclusion ased upon any paper that I had written? And I pointed out to im where his calculations were totally erroneous. Dr. Frejerrio rote me back the most apologetic letter, a copy of which I will e delighted to send you, in which he expressed his deep and pro-ound apology. He said I never bothered to check what you had ritten, I used what somebody had said that you had written. And said, I am sorry, how can I make amends? And we have had a ry lively correspondence in trying to get him back on the right ack in his calculations. But, Dr. Frejerrio has withdrawn every-ne of the statements that Dr. Hull blandly presented to you as pinion as of today. I find that very interesting. But, as I ay, if you would like, I would be delighted to send you a copy of he correspondence between myself and Dr. Frejerrio. This isn't he first time that this came up. I might point out that Health hysics Society President, Dr. Dave Muller, has perhaps influenced r. Hull. Dr. Dave Muller, in his presidential address to the ealth Physics Society, said "I advise health physicists to put heir mouth where their money is." That is part of the problem hat you are facing. Too many scientists are putting their mouth here their money is. That is part of the answer to one of the uestions that you, Mayor Becker, raised, unfortunately.

Now, with respect to emergency core cooling. By the ay, concerning radiation hazard then, I think that the comments r. Hull made are just irrelevant this morning. Concerning radiation azard, I stand precisely on the numbers I quoted before. And Dr. rejerrio admits he has no refutation of those. As Dr. Hull pointed ut, the National Academy of Scientists has now come up within the factor of five of my numbers or a factor of four or five. Now with respect to the emergency core cooling problem. You heard this orning in answer to a question, raised by one of you, you heard ell. First we take the probability that there is going to be a oss of coolant accident, then we nullify by the low probability hat the emergency core cooling system won't work. And we come ut with a terribly small number. Sheer and absolute nonsense. obody, as Dr. Jordan pointed out in that film, nobody knows what he chance of a loss of coolant accident is. And I was rather urprised that the members of City Public Service in making their resentation, who surely have available to their engineering staff ontrary opinions to those presented today, made no mention to you hat many people think that the risk may be very much higher than as quoted today of the first part, the loss of coolant accident. wonder how it is that they managed to miss this in their pre-entation to you. But since they did miss it, let me comment that obody really knows the risk of the loss of coolant accident and oreover as Dr. Henry Kendall as we saw in the movie, pointed out hat risk may arise from mechanisms, that the AEC even refuses to onsider such as rupture of the pressure vessel. And one of the

reasons that they refuse to consider it, is that we have no way to cope with that situation. It is like the AEC's position on sabotage. They don't ask you to cope with sabotage because it is incalculable. Well, a risk of loss of coolant accident on engineering grounds is incalculable and on experience grounds, we have no experience. Somebody asked, oh yes, Mayor Becker, you pointed out that Dr. Teller had suggested that trouble comes in an experimental reactor but not in those that are set up and operated the way they ought to be. Mayor Becker, we are talking about building one thousand and eleven hundred megawatt reactors. Are you aware of the fact, there is no experience in such reactors. That this highly vaunted numbers of years of experience is from small reactors. We are getting toward such sizes and we are building such sizes now, but in truth, every one of these reactors is built different. There are no two alike and as Milton Shaw, the head of AEC's reactor development, in testimony before Congress said, "The companies that are building these reactors are sort of cutting their teeth on these reactors. They are learning as they go and each operator is sort of learning as he goes", and the citizens of Texas and San Antonio will be the experimental guinea pigs of that learning process. There is no experience with eleven hundred megawatt reactors. There is no experience worth talking about with one thousand megawatt reactors. Everyone of those are experimental and that is going to be the case for a long time.

So, when you say we should only be worried if we are using experimental reactors, we should be worried about those being proposed for power generation because there is no experience. And the old experience with the small reactors is irrelevent with respect to a melt down accident because they didn't have enough contained heat within them to melt through. Back to that question about emergency core cooling. It is amazing to me that somebody says, there is a one in a hundred chances, let's say that it won't work. I am surprised at the City Public Service people didn't tell you today that there are people like Dr. Kendal and perhaps fifty to a hundred other competent people in this country who don't even think the thing will work at all. That is a rather interesting thing. A nine-inch scale model was set up of this cooling system and it failed on six out of six trials. After the failure, the AEC said, "Well, really it wasn't a full-scale reactor, it might work when needed." It might, but that if all you have, is hope that it might. And then we heard this morning that there are calculations, and computer models that tell you how it might work, but we didn't hear this morning that there are between twenty-five and a hundred very competent experts in this field, whose names I could obtain for you as many of them were listed in the movie who have said they have no faith in those computer model calculations. Mayor Becker and members of this Council, the Atomic Energy Commission has no right to be licensing any one of these reactors today and nor does anyone have a right to build them. And the reason I say this, when a reactor, we don't know the risk of loss of coolant accident and now I am leaving out such issues as sabotage which we must not leave out. We don't know the chance of the loss of coolant accident when we have no idea that this emergency core cooling system will or won't work and so many people and the experimental evidence is against it. By what right does someone have to license something along the terms of Atomic Energy Act of 1954 which states, "Licensing shall proceed if consistent with the public health and safety". They have not proved that this is consistent with the public health and safety. And Mr. Nader and the friends of the earth have brought this now to a legal suit to shut down twenty of these reactors. It may very

ell be that your money is going to go down the drain if you put in this project because the courts may decide that these re-ctors have no right to be built. I personally see no future for uclear energy but I might not oppose some research and development n it, but certainly not going ahead with the nuclear power industry nd above all not in the State of Texas. There is just no right o license these things, we don't know the chances that cooling ystem will work. And when Dr. Teller tells you we should have many of these together, but far from a population center so we will have better expertise when it is seen that something is going wrong. Do you realize that when something is going wrong in a loss of coolant accident which could be provoked by a saboteur or whatever, that you've got between ten and thirty seconds left that that system might work or have to work. Or what any expert sitting there is going to do in a system of that temperature and where it is in the lap of the Gods and the possibilities, I don't know. He can sit there and pray and that's all. So I don't see that there is any solution by getting more of them together; although, obviously, the solution of getting them far from populated centers is a good one. The appropriate distance might be about the distance ninety-three million miles to the sun. That is a good distance. So, hen somebody tells you that a hundred miles is safe or fifty miles s safe, and when Dr. Hull tells you this morning, I don't even ee how this could get airborne and makes light of the 1957 study f the AEC itself. It would take an enormous amount of competence o predict when a thousand megawatt reactor melts down and with ater molten zirconium interacting with water and producing hydrogen nd hydrogen explosion and steam explosion and molten material at ive thousand degrees melting through every container into the arth. When he is willing to predict for you that ten percent or wenty percent won't get out, he is way ahead of the rest of the orld in prediction ability. Just way ahead of the rest of us and am not in that field, but I can assure you that engineers who e competent in such matters would not step out that far as to redict under a set of circumstances that have occurred wrought th all kinds of unknowns he predicts it won't be a problem. thers feel that the Brookhaven report is sensible conservatism at was for a small reactor. The situation could be much worse ow. No, there are lots of reasons to believe if we have a loss f coolant accident and a failure emergency core coolant system nd we don't know we're not going to, we may lose a major city. I ould hate to see the City Council of San Antonio contribute to the ay we are gonna probably find out about how to stop nuclear power. would hate to see you contribute to the hastening of the day when e lose our first major city. I am very convinced that will happen nless we turn away from nuclear power now. But, the consequences f a disastrous accident have certainly not been over-estimated. ou could easily have to evacuate cities like San Antonio or ouston or Los Angeles or New York or Philadelphia. And if you ant to look at some of those calculations, look at my Barnwell eport where I've indicated that under certain types of accidents t a place like a reprocessing plant, you could evacuate New York ity, Philadelphia, all of New Jersey half of New York State and alf of Pennsylvania, all at once, depending upon meteriologic onditions. I find it incredible that we think of going ahead with his industry in the face of all the unknown, all the uncertainties.

Now again this morning, you are asked about insurance. t was pointed out to you that everything is going to be hunky oree. We are getting back money on the insurance premium. Let's ace it. This industry is uninsured and uninsurable. First of ll, the City Council of San Antonio should take cognizance of the ct that most Home Owner's policies have a specific exclusion clause

for damage caused by radioactivity, they are not responsible. Now, I have had a homeowner's policy since 1947 and in answer to some of my nuclear friends recently, they said, well, they're worried about a nuclear war. Now, the insurance industry is a very competent industry, they have made money year after year for a very long time. They put in their policies just what they mean to put in their policies. I have high respect for any industry that has an unbroken record of making money because they have used their investment. They used to have a clause in there about nuclear war but the insurance policies don't say that any more. They say radioactivity. The insurance industry saw the nuclear power industry coming along and they said, we don't like it. So, we are going to cover ourselves. When the insurance industry deletes that clause from every homeowner's policy in Texas and every state in the United States, then I think you might look up a little bit at the potential safety of nuclear power plants, but that clause is still in most homeowner's policies, little known about, little talked about it. I am rather surprised that City Public Service Board didn't bring that out to you today. Next, you are told that the reason the insurance industry wouldn't insure for the full 560 million dollars per accident was that they didn't have any experience in 1957. That is true. If you ask the difference between somebody who has dollars to lose and lives to lose. When dollars are to be lost, you take precautions. When lives are to be lost, you hope that everything will go well. But the insurance industry didn't have the experience so they said we won't insure. What they said is, what we say is, if they won't risk dollars, why should we risk lives. It is that simple. If industry is safe, it ought to be insurable. If it is insurable, why isn't it insured? And if it isn't insurable, then it is not safe enough to be in our populated or unpopulated area. I don't think...I don't think that residents of the farms in Texas of the small towns in Texas are going to particularly appreciate the thing put near us because we don't count. San Antonio's light demands and energy demands are enough to put us at risk. What isn't safe for San Antonio, isn't safe for any rancher or farmer or anyone else in Texas. So, you have five hundred sixty million dollars of insurance in the Price Anderson Act and that 560 million dollars using the Brookhaven report, let's say, seven billion dollars in potential damages and a hundred fifty thousand miles of land, square miles of land rendered unusable. That potential for free payment is seven cents on a dollar. So the Texans, so if we ever have this disaster in Texas, if they can hobble in after that accident, they can ask for their seven cents on a dollar of insurance. Why isn't the Price-Anderson Act repealed tomorrow and why don't you of the San Antonio City Council say when the nuclear industry is responsible enough to take financial responsibility for all the damages they can cause, you'll be interested and financial responsibility means elimination of this 560 million dollar ceiling. Let them bear the full brunt of any damages thet they cause to citizens of Texas or any other state. That is the issue on insurance.

Now, lastly, Texas needs energy, the United States needs energy. I don't happen to belong to...I am very concerned about environmental matters, although the human health is my primary concern since I have worked in it all my life. I don't happen to belong to the group that wants to go back to the caves. I do believe we are going to require energy. And I do believe that both you of the Council, I believe all governmental bodies, City Public Service and others, and people doing research like myself have a responsibility as citizens to try to realize that we do need energy produced, but we want to produce it in ways that are ecologically sound.

ow, you heard an excellent report today, I think it was the third peaker, whose name I did not catch, from City Public Service that howed you a chart that pointed out to you that coal and coal gasi- ication could meet our needs well into the next century. All of ur needs, although we really don't have to have all of our needs et because we are going to have other solutions. But coal gasi- ication is clean and therefore, you need not have any of these idiculous problems that go with outmoded, antiquated fossil fuel lants. Dr. Hull's comparison of fossil fuel and sulfur dioxide ersus nuclear is just simply irrelevant. We don't need to have hose plants and in fact, I would do all the fighting that I have one concerning the nuclear issue against fossil fuel plants of the dirty variety and I have. There is no need to do that. Coal gasification is going on stream, it's available in other countries, that is not a question. We are going to have it. El Paso Natural Gas is up to its ears in building coal gasification plants and that's fine. It can solve our problems well into the next century and beyond for that matter. But I think there are better solutions coming along. Dr. Teller pointed out to you that on a small scale, solar power now can fulfill a large part of our needs. On small scale uses at the home for example. That is even pessimistic, it can do a lot better than that. There is no doubt whatsoever and no physicist or engineer can challenge it, solar power is workable. usion, we can't be sure yet, it is a maybe. Solar power is orkable. What Dr. Teller said though, at individual level, solar ower is competitive now. At the large scale level now, it is hree times maybe fold as economically costly as other forms of ower. There are two things about that. On the large scale, olar power at three times the cost of nuclear power will be the iggest bargain the human species could ever buy. Second, in ontrast to the engineers and physicists who have given up on merican science and technology, I haven't, they are willing to ccept the dirtiest possible process for making power, they are illing to accept the possible contamination of the earth for untless generations and they give up on the genius of American chnology. I say, you tell American technology that you want the ice of solar power to come down that three fold factor or more the next five years and give them a green light on it and you ll have solar power for less than any form of power that we are nerating right now. Thank you. I would be happy to answer any estions.

YOR BECKER: Thank you, sir. Are there any members of the City uncil that have any questions that would like to ask the Doctor.

. SAN MARTIN: Yes, Mayor, I would like to ask a question. e fact that you are here, Dr. Gofman, sharing the same symposium Dr. Sternglass does not necessarily associate you with his ews. Do you share any of his views on the research that he has one on the infant mortality and the methods he used, the methodology e used at arriving at his conclusions?

R. GOFMAN: I don't happen to do research of that particular ype. I use other methodology. Dr. Sternglass has recently given e the findings in Pennsylvania and I am studying them very care- ully. I know this, I have not seen a responsible response to Dr. ternglass's statements. I have not seen a responsible response. hat has bothered me until recently about Dr. Sternglass's findings, nd I have discussed that with him at great lengths by mail and by ersonal conversation, is that I am surprised that the affects are o large that he has seen for the small amount of radioactivity hat was supposed to be released. But now he produces evidence hat the amounts that were released were a lot higher by very

reliable people, nuclear utilities service. It is supposed to be a red hot organization on how to do these measurements and they come out and make the old reports look erroneous. So, you see now, if when Dr. Sternglass points this out to me that the amounts released are so much higher, then I am beginning to be less skeptical about the findings. I was skeptical earlier because with small releases, how could you get such big effects? But now that he is showing these larger releases, I am really concerned about that. But let me say this. Dr. Hull said this morning, oh you are going to get a millirad, less than a millirad in the future from all of these reactors. I have only one statement to make on that and that is hogwash. And I will tell you why. You go through the physics of this calculation of what it amounts to in radioactivity per plant produced per year and then say you have a thousand plants and you can show that unless every step along the way is going to be ninety nine point nine nine perfect day in, day out, year in, year out with every possible accident spill, that we are going to get not the doses of one millirad, we are going to get the doses of hundreds of millirads or thousands of millirads per year. So, I consider all these calculations meaningless because I don't find it credible that humans and machines with their fallibilities, including the corrosion that Dr. Sternglass talked about, are going to do ninety nine point nine nine percent perfection from now to eternity and that is what it takes. Including sabotage, accidents and everything else.

REV. BLACK: Doctor, I was particularly interested in the social implications of the creations of such a plant regarding the way in which it has to be protected and this general change in the pattern, of course, showing it from the time you...the origin of the substance to be used for energy on to the production. Do you...we do not hear of a great number of expressions of social change that comes with this kind of plant. Do you visualize any other social changes that might come with this kind of production of energy. I know there has been indicated, of course, the human harm, the harm on the person, but I am simply...I was not aware...it seems to me... introduce a new kind of idea to me and I can see how it is possible that a change of a dangerous element placed in a community then began to change its format, its operation, this kind of thing. Are there any other social implications that you would like to enlarge on?

DR. GOFMAN: These are very large ones when you consider the fact that they may mean....For example, we all heaved a big sigh of relief with the nuclear non-proliferation treaty. Now when you begin to think the social implications of plutonium being stolen from this industry a little bit. Therefore, any two bit underworld organization beginning to have plutonium available, let's suppose they don't have a quarter pound of plutonium in their hands. A quarter of a pound, that is a hundred grams, about a tablespoon full, a very small fraction. This man says look San Antonio, I want this or that done or else. I am going to release a quarter of a pound of plutonium in a fine dust over San Antonio. You are going to do what he says or you are going to evacuate San Antonio or every one of you are going to get lung cancer many times over even though you can only die from it once. Now, our society is going to become total prey to terrorists of all sorts with the advent of a plutonium economy. It is any rational thinking group would immediately reject an energy economy built on plutonium for that reason alone. That is one of the social problems.

The other thing is to avoid such becoming a victim of ...ch terrorism you must go over to a total police state. Even ...hen, I don't know how you are going to do it. But you are not ...oing to let people walk out of nuclear reprocessing plants with-...ut searching them. They can take a little bit out each day. You ...re going to have a total system of search, watching people. When ... talked at the South Carolina legislature about these trucks with ...lutonium, I said what are you going to do if someone attacks that ...truck? Either with an explosive that just spreads things around ...or terrorists purposes or to acquire the plutonium? They said we ...re going to have radio communications with the main plant. Isn't ...hat great? They are being hijacked or a bomb is being exploded ...n them, they are going to have radio communication with the main ...lant. You know, there were some guys that had communications in ...he Watergate apartment and it didn't do them any good, they got ...aught.

...AYOR BECKER: Any other questions?

...EV. BLACK: I was just wondering. The party that might steal ...his, wouldn't he be dead?

...R. GOFMAN: No, well, yes and no. Plutonium...the toxicity is ...hen finally divided and inhaled. And you could carry around with ...ou some plutonium and not be hurt by it. But get it finally divided ...nd inhaled and as I say about a pound of it is about a nine billion ...ung cancer dose worth. There was an interesting article in the ...an Antonio Light that bears upon your question. Last night when ... came into town, I read it. What it did was, this article talked ...o a number of people who lived near nuclear power plants. I feel ...reat, I feel fine, I love it here, couldn't be better, I would ...ke to move closer if they would let me. Well, the point is, sir, ... the ten years, we have called the laten period between the time ... radiation exposure and when you develop a fatal leukemia or a ...tal lung cancer, you will feel fine and you will show no outward ...nifestations and that is the subtle danger of this type of thing. ..., when those people say I feel fine having been exposed, there ...s an accident in Rocky Flats and one fireman that's a plutonium ...ctory for weapon, one fireman got several body burns in his lungs. ...ey asked him on national television a couple of weeks later, he ...id I feel great, but that is the point. He feels great, when he ...ts lung cancer, he won't feel quite so great and then when he dies ... it, he won't feel at all.

...YOR BECKER: Thank you Dr. Gofman.

.... LEVINE: Mr. Mayor?

...AYOR BECKER: Yes.

...R. LEVINE: I just want to say that concludes our formal speaches ...nd we appreciate both of them being here. Thank you sir.

...AYOR BECKER: Now the agenda shows next, Mr. Rowan Harwood, President ...f the Greater San Antonio Chamber of Commerce. Is Mr. Harwood still in ...he audience?

...R. ROWAN HARWOOD: Mr. Mayor, I am Rowan Harwood, President of the ...reater San Antonio Chamber of Commerce and I am here to give you a ...esolution. The Board of Directors of the Greater San Antonio Chamber ...f Commerce at its board meeting on Monday, June 25, 1973 has unanimously ...dopted this following resolution which I would like to read to you now. ...aving considered the various options available.... (copy contained with-...n reports submitted) Thank you very much.

MAYOR BECKER: Thank you, thank you Mr. Harwood. Next, is Mr. Richard Balmos - San Antonio Manufacturing Association.

MR. RICHARD BALMOS: Mr. Mayor and Council since May 10, 1973 our City has been experiencing a critical energy crisis. (copy contained within reports submitted)

MAYOR BECKER: Thank you Mr. Balmos.

MR. PUFILLO: Honorable Mayor, may I make a statement on the point of order? It seems to me that in a democratic meeting like this, the pros and cons should have alternating turns at the microphone here. You have had two pros, it seems to me that you should alternate. One pro and one con. That is the democratic process.

MAYOR BECKER: Mr. Pufillo, I am following the agenda as it is prescribed. Now the next part of the agenda is the City Public Service Staff and their consultants to have a rebuttal to the talks that were made by Dr. Gofman and Dr. Sternglass. So, that is the next order of business on the agends. Then we will have citizens to be heard.

(Someone spoke from audience - inaudible)

MAYOR BECKER: I would assume and cannot speak for Mr. Deeley, but I would assume that the City Public Service Board and their staff and the people that are representing them today, would be open to questions by Dr. Sternglass or Dr. Gofman, Mr. Deeley.

MR. DEELEY: Thank you Mr. Mayor. First, I would like to read a piece of information regarding Dr. Sternglass. I will take only a part of these statements identifying the source. The first is the Health Physics Society. Part of this statement reads, his, this is Dr.Sternglass, "His allegations made in several forms have in each instance been analyzed by scientists, physicians and bio-statiscians in the Federal Government, and individual states that have been involved in his reports and by qualified scientists in other countries." Without exceptions these agencies and scientists have concluded that Dr. Sternglass's arguments are not substantiated by the data he presents. This next statement is by the American Academy of Pediatrics, a Committee on Environmental Hazard, "A valuation of the data, that is Dr. Sternglass's data, an evaluation of the data has convinced the committee that his conclusions are completely unfounded and unsubstantiated." Another by the Michigan Department of Public Health, "Sternglass paper has not been based on scientific tests but rather on a statistical data evaluation of infant mortality rates and reactor plant emisions. Selecting and rejecting figures to arrive at an apparently bias conclusion and by the same party the three independent tests with which Dr. Sternglass claimed to verify his tests, were not tests at all, but other papers written by Dr. Sternglass using the same irresponsible methods interpreting and selecting figures to fit his conclusions." This statement by the U. S. Atomic Energy Commission, "it should be noted that while this plant," and they are speaking of the plant in Harrisburg, Pennsylvania, "continued in operation, the infant mortality for Illinois began a steady decline in 1966 and reached twenty-two point four in 1969. Dr. Sternglass made no mention of this reduction. And this statement by the Pennsylvania Department of Environmental Resources. It appears that Dr. Sternglass even using selected data to fit his theory has not proven that any relationship exists between the proximity to nuclear facilities in Pennsylvania and infant mortality rates." This by the U. S. Public Health Service, "this critique has resulted in a failure by us to agree with the scientific approach used by Dr. Sternglass in evaluating the data that he has utilized in his report." The University of Missouri, "however, ten years of study has not convinced me that statistical juggling such as Sternglass has presented in the April bulletin, will serve either the cause of peace or of science." Dullhouse University in Halafax, Canada, "it is

vident from the plot that among these, that is the Canadian providen-
es, a large rise in Strontium 90 does not tend to go with the large
ise in excess mortality. If anything, the reverse is true." The
merican Public Health Association, in the May issue of the "Journal",
these letters appeared in the May issue of the "Journal" and clearly
dicate there is no basis and fact for the claims made by Professor
ternglass." Science Magazine, "Sternglass contends that the fallout
rifted eastward from New Mexico and that by 1950 there was substantial
cess in infant mortality in those southern states over which it had
rifted." To top it off, the AEC contends that fallout cloud from
lmagorda did not even go eastward. Dr. McDonald D. Round in a letter
ritten to the New York Times, "we indorse his right as a scientist
advance such a theory but are compelled to note publicly that his
onclusions do not follow from the evidence presented and in our
inion, are falacious." Dr. Leonard A. Sagun, Dr. Sagun is Associate
irector of the Palo Alto Medical Clinic, "I found no evidence in the
stimony of Dr. Sternglass to support his contention that fallout or
diation from nuclear facilities has a dullaterious affect on human
alth." Dr. Arthur R. Tamplin, who incidentally is the co-author of
e book that the gentleman here has. Dr. Arthur Tamplin, "in this
ticle a point by point criticism of the Sternglass manuscript will
presented. It will be shown that the data do not support his
nclusions and that the major factors influencing infant and fetal
rtality over the past fifty years have been improving socially econ-
ic conditions and the introduction of antibiotics." Dr. Alice
uart, first of all it, a Sternglass paper based largely upon her own
rk is riddled with mistakes. So I present that in evidence and see that
e council will get copies of this information. I am now going to call
Dr. Hull. Dr. Hull for a rebuttal to....

. HULL: I want a chance to answer that personal attack which hardly
ts to be testimony in an attempt to attack a person's character. Let
try to understand what is going on here. There has never, I would
y, at any hearing that I have been at.

YOR BECKER: If you would forgive me please sir. Limit your re-
rks to five minutes please sir. Would you do that please sir.

. STERNGLASS: I think the public needs to know what efforts are
ing made by the Atomic Energy establishment in the industry and the
ople that have supported it for years and years to try to fight the
ta. Since they cannot answer the data, since they cannot explain
y seven or eight years after the reactor started at shipping port
hundred more people a year are dying suddenly in Beaver County.
nce they cannot answer this, they choose to attack the accredability
stead of the fact. Let's just take a few examples. The Health
vsics Society, fourteen past presidents signed a statement, thirteen
them do now or have in the past belonged to the Atomic Energy Com-
sion or the Organizations that have set the standards which are now
ng questioned by the National Academy itself. Among them was one
ividual, the head of the National Radiation Protection Council. The
ncil on Radiation Protection, Dr. Taylor. Under oath, questioning
council for the national interveners last April, early spring in
hington. He was asked if he signed this attack and unprecedented
nt and he said yes and then council asked him, did you read the
terial on the basis of which you signed this attack and he admitted
I did not. This is the nature of the criticism that has been left.
is the American Pediatric Association? A committee on which Dr.
nard Sagun was executive director. Dr. Leonard Sagun who has been
king for the Atomic Energy Commission in one way or another for the
ter part of the last twenty years was the author of that report.
EPA the author of the report that attacked my findings on the effect
fallout was the Disalina Tompkin was the wife of the former Deputy
ector of Standards for the Atomic Energy Commission who was moved
o the EPA as a director of the Federal Radiation Council who say
permissable level of Strontium and iodine from accidents in 1964
65 of a factor of about ten times. These are the people who are
ing used by the industry to try to discredit critics wherever they
ybe. I can go on like this all the way through. Who is Dr. Round?
Round happens to be employed, was working and is in fact a member

of the Chapter, the New York Chapter of the Health Physics Society and in deed has been supported throughout his career by the Atomic Energy Commission. Dr. Leonard Sagun, I mentioned was presented as an independent critic working for the Palo Alto Clinic, but it turned out that when I first met Dr. Leonard Sagun personally at the German Town Headquarters of the Atomic Energy Commission where he had been working for years trying to minimize the effects of radiation on man. Gentlemen, you have to decide who has a greater financial stake and a greater stake protecting, years of keeping information from the public, or these gentlemen associated with the industry. Thank you.

MAYOR BECKER: Thank you, Mr. Hull. I think Mr. Deeley requested that you speak next, is that correct?

DR. HULL: Do we need the television light on now? I don't see anybody running anything now and it is sort of bothering me. In the interest of time, I am pretty near to having that beer problem, I am not going to show the slides that I intended to but I brought along some written material and perhaps if I can get these copies up to you, we can follow through a few diagrams and you can see for yourself the evidence and decide whether or not Dr. Sternglass is being personally attacked and maligned or evidence, the scientific evidence just doesn't agree with his allegations. And at some expense to my muscles, maybe it's good for them, I brought along copies for what turns out to be the number of people in the audience and so I will be glad to share these with you. So while you are turning these to figure two which says on the top of it, Mortality Rate in the U. S. for Infants Zero to One Year and there happens, they got put together in an awful hurry and there are two of those but the second one says figure one. It came from two different papers and so it is about nine in I think While you are turning there, if I can just comment on Dr. Sternglass's allegation that he just made. That some how there is a conspiracy here to, shall we say, get him, I quess is what he means. I must say that I am embarrased. I find it difficult to cope with things on this sort of personalistic level. Maybe to depersonalize it a little, I have had an opportunity, being the author of a paper with Dr. Shuer who is at Queens College and a consultant admittingly at Brookhaven and perhaps work came two with this brush because our, indirectly our money comes from the commission. That, never the less, we took and examined all the papers that we could get our hands on, at that time, of the scientific questioning or reputation of what Dr. Sternglass has had to say. I have been doing it since. I must have done some fifty or that are in print especially of his scientific reputation and I find it hard to believe for example that Dr. Stuart who was in Great Britian at Oxford University, that Dr. Rockflat and.....Great Britian.....the.....I can't think of his name in the Swedish Academy of Science who denied that Dr. Sternglass for instance from their strontium 90 data applied to Dr. Sternglass's work. I find it difficult to believe that they are all part of this giant conspiracy and as the editor of Nature said in the Profits of Pollution, which is an editorial that they published, sort of questioning whether Dr. Sternglass accused them of being a part of this conspiracy because they wouldn't print a refutation of an article questioning him that was printed in Nature. The editor of Nature, the British Scientific Publication, said something like this, It may be, you know, Dr. Sternglass is lodged in a conspiracy as he has in this time. It may perhaps not be a conspiracy, but rather the weaknesses of his scientific arguments that make it difficult for editors of scientific journals who, I am paraphrasing now, who are intent in preserving the body of scietific evidence and who in general don't turn down papers they don't think whose evidence would really stand up. They generally turn them down. It is not just Dr. Sternglass, many people have had papers turned down including myself, on occasions. So I.....You can draw your conclusions as to whether there is a conspiracy or not. I don't think so. Let's take a look at this first one. It says, "Mortality Rate in the U. S. for infants 0 to 1 year." And you gentlemen and woman on the council will see that.

I want to say here that I think the whole crux of Dr. Sternglass's argument with regards to reactors, certainly sort of stands in the way of whether or not he has made a case in regards to fallout. Because that is where he spent most of his time and effort. And Dr. Gofman has already said that the doses from reactors are perhaps at least on the average of a hundred times less than those of fallout to any large numbers of popu-

ion. So if it doesn't stand up for fallout, it is very difficult it stands for reactors. The first one there, you notice on the top, indication Dr. Sternglass, that shaded area on the top of the figure is Dr. Sternglass for instance the excess infant mortality over what would have occurred, projection of that line over what whould have occurred in 1950 on roughly, there been no testing. Then you see on the bottom, our measurements Brookhaven of the changes in background that attributable to the fall- during those same years. And his arguments hold, that there simply ght to be something like the corresponding bumps on the top line like there on the bottom line. You just don't see them. And I said it seems to me ther difficult. Now, if you will just fold over the very next page, cause it got in there twice again, which 1966 infant mortality Near the esder I Reactor and the next one says, Leukemia and Aleukemia Rates A 1940 1967.

YOR BECKER: Mr. Hull may I interrupt you for a second, I don't seem to able to find the corresponding information.

. HULL: Are you on the same thing? I think I started on about the nth page and I am going on from there. The first figure was in twice so t.....The figure on leukemia is the next one, you started at the wrong ce. This is data on leukemia and aleukemia rates in the United States. important part of that is, although, the total has been going up over se years that Dr. Sternglass talked about is fallout, 1940. This pened to be 1970, that the one to four group, certainly the most sen- ive in the population. I think Dr. Stuart's work shows that infants ayed....radiated in utero have an excess mortality over nine. Other infants were not radiated while they were in their mother's womb. One of the ults of this external radiation is certainly....primarily....predominately ost an excess of leukemia in the some where one to four year group. ll notice that....part of influencing this group in the United States and s is all of the infants in the United States zero to....that have been licted. All the infants at risk and these are the actual rates here. deaths per hundred thousand in the age group. You will notice from 1950 that the one to four year group has been down consistently, rather than nd there certainly aren't any bumps there that have any correspondence the access of fallout. So, it makes it very difficult to believe on general basis that fallout has not influenced the infant leukemia e over that time somehow had any other influence of the sort that Dr. nglass has described to us. Let's look over to the next one which says table nine, these are various sources and are just thrown together so they not in numerical sequence, "Indicated Excess Risk or Mortality and culated Effluent Doses to Populations in the Vicinity of Selected lear Facilities". Again this is a repetition of some of the information t I gave you this morning, but it includes the nuclear reactor, nearly of the nuclear reactor sites at the time we put this together that Dr. nglass had paid attention to. I relay all the numbers to you except point out the important part of this again. The effluent doses within ty miles. The average there and you will notice the highest one icated around Humboldt is 1.1 millirem a year and that they go down from to some fraction of a millirankin.

HARVESTY: Mr. Mayor are we going to give him unlimited time for re- al? This is seven minutes already.

HULL: I indicated that I would like to go on for about fifteen tes and I think I can cover in about fifteen minutes, if I may.

R BECKER: Mr. Harvesty,

HULL: I am sorry that is an expost facto rule that if someone had that I had only five minutes I might have....I obviously wouldn't tried to cover this much ground.

R BECKER: Mr. Harvesty and members please. What we are trying to do

ere today is conduct an intelligent objective hearing and I for one would ppreciate it if it wouldn't deteriorate into some sort of shouting match. excell at that also if called upon. Now, let's please contain ourselves nd proceed in an orderly fashion and I will give equal time if anyone ares to, that is in a position with the same degree of intelligence to re-ut Mr. Hull's discussion when is finished. Mr. Hull would you proceed lease?

R. HULL: Dr. Sternglass indicated that a hundred millirankins or so, f I can remember what he said, and it has been in his papers of X radiation ccording to Dr. Stuart was a doubling dose for the excessive infant mor-ality and remember that is....leukemia and cancer, there was infant ortality from other sources, as far as Dr. Stuart is concerned. So that we ....that is in one shot and we are talking here about exposures based over some long period of time. And again there is every reason to think that if you space the exposures out over a year, that many effects, not necessarily everyone are far less effective than if given at one time. More doubt about whether this thing holds. It is a radiation effect of a magnitude versus ost that there is no other support for in scientific literature by a hundred, thousand ten thousand times something of that sort. Is that a heckler over there or something? Then just notice just, very briefly, the total number of man....rankins and this is a calculation from Calculations by Carl Gamosfelter of the AEC, but at any rate, these are very small numbers compared to the fact. Let's take something like a million man rankins total before you would expect to see a few hundred cases in the population. It is hard to believe that this effect that Dr. Sternglass claims is so. The next one here is figure four, Dresden I Infant Mortality and when I call your attention to the shaded areas, are the areas that Dr. Sternglass selected. You will notice that in the tope figure, the solid line, is adjacent counties to the reactor and there are relatively few number of people there. And I want to try to educate you in statistics, except to say that if you have a sense that is going to happen with a certain probability, the smaller number you have, the wider the range of probability you get and as you get large populations, the isolatins are about a mean trend and much less. Notice when you get to the state line, which is the x line there, it doesn't jump around very much even though on the average it is not far below the average of the adjacent and controlled counties. But the important part about that is that Dr. Sternglass happens to pick 1964 and 1966 there. So, he picked a relatively low year to start and a relatively high year at the end and said, this was a hundred and forty percent increase in Grundy County. These....If you look at the middle line, the trend there, it doesn't support his argument. It is almost level, it has been decreasing over a period of time and those bars that go up and down are the statistical errors and you would say none of the points lie statistically, significantly, outside of the mean trend.

More important if you will turn to the next figure, which is sort ....figure two as it says, "1966 Infant Mortality Near the Dresden I Reactor" with the bars on it. The first one there that presents the 1964 rates and I will call your attention to the very bottom where the gaseous emissions in 1964 are compared to the gaseous emissions of 1966. You will notice that Grundy County is where the reactor is and as you go away from it, these peracentages seem to....the '64 rate seem to sort of fall off as you go away from the reactor and that first one, one hundred percent is what Dr. Sternglass claimed was the '64 rate was obviously and '66 it was two hundred and forty or an increase of a hundred and forty percent like he said, right. Okay, let's look at the next figure and compute 1966 to 1960 when the reactor wasn't running, so we whould have a much larger effect in a way. Relative, if this holds it's own, the bars don't have any relationship to Grundy county where the reactor is and the other areas. The geography of the bars just fogs up completely. Okay let's look at '63/'66, the reactor just started up then. Again you see the difference in effluent. If you will look at the bottom is very great. There was almost no effluent in '63 and a large amount in '66 and the bars are just not consistent with the increase. They just scatter around.

Skip the next one if you will. That's Mortality Rate in the U. S. for Infants 0-1 years....I am sorry that got in there twice. Now look at Hum-boldt which is the reactor with the largest amount of effluent in the U.S.

And I call your attention again, Dr. Sterngalss compared, first notice the is-olations there again. The Humboldt County is a solid dot, it's a solid line

has a very few people, it isolates around a lot, up and down. Notice
n you lump California as a whole, has a very few isolations and the adja-
t counties isolate less because you have lumped together more people in
adjacent ones. Well, notice Dr. Sternglass picked the lowest year of all
infant mortality in Humboldt County and compared it with, what looks
e to me, an isolation with almost the highest isolation of any and
nouces that there was a very big percentage increase between those two
rs. But notice the very bottom, the reactor effluent kept going up after
55 and in fact in 1967 and '68 they were more than doubled than what they
re in 1964 and yet the infant mortality rate in Humboldt kept going down.
d in fact by 1968 it was down around the state average. Now somehow,
ere is a major inconsistency here. If there is an effect in 1964 to 1965,
should be the reactor effluents have the effluents doubled by 1968 and
e infant mortality doesn't attract them, it is very doubtful that this is
ause and of fact as Dr. Sternglass aledges on just that ground alone. Well
u see the same percentage business here which I needn't belabor. You can
ok at it yourself the problems of percentage are comparting near the reac-
r and away from the reactor. However you get the picture that Dr. Sternglass
nted you to get in 196....when you compare 1965 to 1964 of a large percentage
crease in the year and then it falls way off as you go away from the reactor,
t just look at the top one for example. The effluents kept going up in
7 and twice since they were in '64 and there is no geographical pattern at
l. In other words, Dr. Sternglass just hasn't been giving you all of
e data and critic, after critic, after critic has said that Dr. Sternglass
selected data, only that data which shows the case he wants to make
conveniently not show his audience what he didn't want them to see.
t might be alright for propaganda, but scientists resent this and I am
aking rather resentfully now, because it is non science. It is a be-
yal for what science stands for in my estimation. One has the obligation
t scientists show all the information, that is difficult. That doesn't
w your case and someone brings that out, you have an obligation to answer
t information or your scientific case falls and Dr. Sternglass has not
wered effectively any of the charges that have been made against him. He
ld rather cry conspiracy or some other thing.

Alright, I will go on very briefly here. Infant mortality rates
ected European Countries and White Infants in the United States. The top
You will notice that this is over a period of time and this is if
lout has caused infant mortality it hasn't and I want to get on to the
t that I want to lead to. There are more probable causes and I think I
show them rather persuasively, if you will just stay with me for a couple
more minutes. Alright, notice the next line down is the non white infant
tality in the United States as compared to European trend. You will notice
m about 1950 on, which is the figure that Dr. Sternglass worked on, is a
d deal more flatenning of non white infant mortality in the United States
n of white infant mortality. That is sort of a clue that we will go into.
sort of wonder if fall out had anything to do with this. What is this
ective affect on non whites for? Very questionable in my mind. Let's
e to the next figure. The next figure, Dr. Sternglass and we and most
us have taken his base line on infant mortality between zero and one year.
t is the top line of the next figure which says infant and prenatal
tality. This is from the American Health Association monographed by
piro Publishers, 1968, and the rate trend from 1935 to 1965, which happens
be the period that Dr. Sternglass chose as a base line. He chose '35 to
on and you will notice, indeed, under zero to one year they had a
ttening out after 1950 and stopped decreasing as fast as it did before
n and Dr. Sternglass said that was due to fallout. Then you will look
what contributed to that. It is broken down by pieces and you will
scover that the reason it flattened, that almost all of that major
ttening was Under The One Day Infant Mortality and that makes you wonder
t affect of fallout is this that works on zero to one? One day infant
tality which is the major contributor of the zero to one year infancy
tality. Alright, let's look at the next page and this is out of the same
rce and we will get a little clue about what it is. And I call your
ention on this page again, because I think this is a major point. I
l bring it up in a moment about Alequipa and Dr. Sternglass's allega-
n there, that is infant mortality related to Shippingport. And you

will notice that under one year, the non white infant mortality rate consistently from the period of 1935 to 1965 has been about twice the United States white infant mortality and it had gotten worse from 1950 on. The white rate, although it slowed down a little bit decreased where as the non white flattened. In fact, if you will look under one day, that next figure over there on the top, you wull notice that the non white infant mortality actually increased after 1950. It had a good deal to do with its flattening of the infant ....now one of you have to be social economic experts to make some gueses as to why the non white infant mortality is so much higher than the white infant mortality. And I say to you again with a certain amount of vehemence that if Dr.Sternglass was really concerned about infant mortality, that he is intelligent enough and far more persuasive than I am, and this is something that out of humanitarian concern, he might well attack, instead of dealing with this frivious escapade about radiation having something to do with it. It is just complete nonsense, I am sorry.

Okay now, look at the next table down, to get back to science again. I am sorry to get carried away. The next one down is the breakdown of causes of infant mortality and we will stick to the relative under twenty-eight days which is the important one. And you will notice that, if you can read that, it is not too easy to read, they give the total infant mortality that is number one. The next one down is number nine, which is certain diseases of early infancy. Now I suggest to you that there is not a bit of scientific evidence for Dr. Sternglass's wild conjecture. No other scientists that I know agrees with him at all and several have disagreedly vehemently that the source he quoted did not include possible radiation because as cause of the events within the certain diseases of infant mortality as being why this trend occurred. And I call your attention further that if radiation had anything to do with this you certainly could have certainly expected congenital malformations to have been similarly effected as congenital malformations are known to be one of the classical effects of excessive exposure to radiation if high enough levels. And so look at the line number seven there and you will notice that line number seven had no effect after 1950, has decreased a little bit, but it certainly didn't have any upward change after 1950. No, I think that this in my mind just completely demolishes you know, if something we know happens in radiation, did not increase after 1950 it is just sheer nonsense to say something that we have every reason to think has nothing to do with radiation was increased. This is not scientifically sensible. This is the reason why scientists in general have had so much difficulty with Dr. Sternglass's argument.

Now about Alequipa. Alequipa happens to have a very large non white and economically disadvantaged population and you can....it's a small place, a very small place, the percentage isolations are very great in terms you know.If you have two cases of infant mortality one year and five the next, you have a big increase percentage wise and Dr. Sternglass loves to talk about percentages as he is in this case. I suggest again, I haven't plotted the numbers yet because I don't have the raw data yet, but I am willing to bet you some money, that if you plot these over a long period of time, you will find that a small number like five one year and ten the next, two one year and five the next and over a long period of time, these are the isolations I mean, of a trend that you would expect for a population of this sort of composition which would certainly have a larger infant mortality rate than Beaver County which doesn't have any percentage wise non whites as Alequipa does. So, that is so much for Dr. Sternglass in my estimation.

I would like to make just a couple of brief comments about Dr. Gofman's statements, particularly in regards to Dr. Norman Frejario because I think this is a major paper if it stands up. It has been read by a number of people besides myself at the laboratory and I must say Frejario writes in a somewhat difficult style and it is not always easy to get what the points are, he is making. Nobody else has had this sort of difficulty with the paper. And I have been in fairly continuous correspondence, not every day, one letter a month for the past several months trying to understand Frejario's paper, to make sure I understood his argument. I have been on the phone with him a couple of times and what I got out of it was that he was convinced, after talking to Dr. Gofman, that the additive model, and this is a technicality, that Dr. Gofman never really advanced, an additive model

d therefore Dr. Frejario had in one part of his paper demolished an addi-
ve additive model and maybe he apologized to Dr. Gofman, but Dr. Gofman
d never claimed that here was an additive model. So much for that, but
Dr. Gofman didn't advocate an additive model, I don't want to get lost
technicalities, he had to advocate a modificated model and Frejario's
per shows that if you assume this, there are difficulties. The evidence
just not consistant as if there were statistics, but it is the reverse of
at you would expect on a modificated model. So, I don't think that Dr.
ejario's paper is non sensor, influkeable and further more, I am more up
date on what's going on than a year ago in regards to Frejario. So
at I still think that the....there is much reasonably that radiation low
oses and low dose rates like that from background rates as Dr. Frejario's paper
uggests that the even lower doses and dose rates in nuclear reactors is just
imply not something that deserves very much of our attention in all the rank
rdering of hazards that we should be worrying about in this life. Thank you.

AYOR BECKER: Thank you very much Mr. Hull, Mr. Deeley, if you will bear
ith me please, I did tell the opposition, if that be the term, that they
ould have equal amount of time to answer Mr. Hull's rebuttal and then we will
roceed to your next speaker after who ever this might be. It is the only
air way to allocate the time.

R. STERNGLASS: I appreciate this courtesy very much. I know it must
difficult for you as non scientists to try to find out. For two apparently
qually competent scientists with equal backgrounds can come up with ter-
ibly contradictory interpretations of what is supposed to be a very clear
ut scientific matter. But I think you would have realized that what we
re dealing with such enormous emotional implications for the people
nvolved that you must give this some consideration. You must realize that
ong other things, Mr. Hull was responsible for the operations of the
ookhaven reactor with regard to its gaseous releases. And our study has
own that apparently, and of course, none of this is absolutely certain,
re was a rise and decline in infant mortality in Long Island where he lived,
nected with the operation of the reactor. If I were in his position,
would feel equally upset. And therefore you must understand that
are dealing with a tremendous emotional problem and therefore we must
n to other people who are not involved and trying to get some balance
gement.

STERNGLASS: Now, you were told today that there is not one scient-
in the world who agrees with the kind of findings that I have. Un-
tunately, and I regretted this is not the case. I will just try to
icate to you what other people, other than Mr. Hull, or other people
thought radioactive releases would not have such terrible consequences,
t they have found. Then you like the jury in every trial must try to come
your own judgment as to whom to believe which is always a difficult thing.
ber 1,-Morris Degrut head of the Statistics Department of Carnegie
on University, after learning of these findings and their potential impact
the City of Pittsburg, under took a totally independent study of the
dings of infant mortality that I had come up with. And he looked at four
ctors. The brookhaven reactor, for which Mr. Hull was responsible, the
sden reactor and the reactor in Indian Point West Chester County, New
k. For Brookhaven, Indian Point and the reactor in Dresden, he found a
ll, but clear positive relationship between the changes, ups and downs
releases and the infant mortality changes. He did not find it for the
ppingport reactor where we have recently found it. Interestinly enough,
would now expect no such correlation because as I indicated to you there
every reason to believe that within the last five years the two releases
m that reactor were not reported properly so that of course he could not
d such a correlation. Next, Professor Herman Symber, professor of
lth Physics, author of the present widely used text book on Health
sics at Northwestern University, had one of his students, Mr. John Sang to
ertake an independent study of seven nuclear sites and three fossil fuel
es and for each of the nuclear sites Mr. Sang and Dr. Symber found an
ward trend of infant mortality in the county where the nuclear facility is
cated compared to the state where it kept on going down. When he looked

t the coal burner, he found no such change of the trend in the county ontaining the plant relevant to the state in which it exists. Dr. Lester . Lays, head of the Economic Department at Carnegie Melon University, School f Business Administration, examined the correlation on a multi perimeter tudy between sixty-one metropolitan areas of the United States and the levels f Stronium 90 and Seisium in the milk. And corrected it for the average rdinary pollution of the air. He corrected it for differences in population, ifferences in altitude for cosmic rays and in his conclusion of this paper, e said that he finds a clear correlation between Strontium 90 levels in he milk and infant and total mortality of the adults which their cause in- luded the kind of cancer and heart disease mortality we have now seen around eaver County, around the shipping port reactor and in Synectody. And he aid the correlation was stronger than for ordinary air pollution. urthermore, it was on the basis of all of my evidence that the Governor of ennsylvania appointed a committee which includes Dr. Carl Z. Morgan who ccepted to be on the committee on the basis of these disturbing findings hat I have been making. And among the scientists some of the top scientists n the country who have agreeded to examine this material, if it could be rushed off as easily as Dr. Hull would have you do it, do you really elieve that it is a good politics for the Governor of the State of Penn- ylvania in the home state of nuclear power to question the safety of nuclear lants? Thank you.

AYOR BECKER: Mr. Deeley would you please proceed with your next speaker? e are going to conclude this hearing at 6:00 and I am taking it upon myself, will bear the full responsibility for having adjourned it at 6:00. We ave been here since 9:00 this morning or there abouts and think we have iven sufficient amount of time to hear the experts in their fields, to hear he people who can speak with authority, to hear the people who are know- edgeable on their subject and I have here twenty-seven ladies and gentle- en who signed up to speak in favor of the nuclear power plant. I would be appy to read the names, if they so desire. I have in this hand eighteen nd one -- nineteen that wanted to speak in opposition to it. Now, I am ex- ercising this prerogative because of my own determination and my own judge- ent. As much as would like to stay here all night, I don't think with all ue respect to those who have signed up to be heard in favor of or opposition hat they could possibly add anything to what has already been said here oday by Dr. Draper, Mr. Hull, Dr. Gofman and Dr. Sternglass. So, with that bservation and with that belief in mind, as I said I do apologize, this ust be brought to a halt some time today because this City Council will en- age in another one of these sessions tomorrow, in all probabilty, and here is just so much that we can accomplish in a given amount of time. So, r. Deeley will you proceed please?

R. DEELEY: Mr. Mayor, if we could please, Dr. Draper would like to say few words, he will be short and then I believe Mr. Locke ultimately would ike to close after you hear your other speakers.

R. DRAPER: I think your observation, that little can be added at this oint is very astute, I doubt that much will be added, I want to address the uestions of the nuclear plant except in two regards. I think I said what I ad to say this morning about the design and careful construction of the uclear plant, but there are two points I think that are worth brief comment. ne is the question of insurance which was raised again by Dr. Gofman. n particular, he raised the point about the exclusion of liability in home wner's policies and just like one sentence to say, the reason for the ex- lusion is of course that exclusion is of course that sort of guarantee is fforded by the Price Anderson Act. That was the purpose of passing the rice Anderson Act, to protect the general public in the case of any kind f nuclear incidden. And at the time the Act was passed, the upper limit n the coverage, the indemnity was 560 million dollars but they left open he option of raising that, should the need arises. They have not yet done o. If there were a need and if there were claims in the excess of seven ents on the dollar or something of that sort, I am sure that restitution ould be made.

The second question is one of corrosion. That seems to have become important issue and the most salient feature on the corrosion question is at part of the nuclear plant that is most subject to corrosion damage, mely the fuel elements are replaced very frequently. Unlike the fossil al plant, that part of the fossil fuel plant that takes the greatest wear d tear is the fire box and, therefore, you would expect it to wear out more ickly. It has to last for the life time of the plant or be replaced. a nuclear reactor, it is scheduled that these parts are subject to corrosion fuel elements, are replaced on about a three year basis. So that is not ch a significant factor that it might appear.

Finally, I would like to discuss the alternatives that were proposed both Dr. Sternglass and Dr. Gofman. They both seem to have little faith. little faith in today's technology, has vast faith in tomorrow's. They ggest that we could use coal gasification. It is certainly true that coal sification is a wonderful idea and it is in process. El Paso Natural Gas in the process of constructing a large coal gasification plant, but it is rtainly not something that one could purchase today. I guarantee that e City of San Antonio could not contract for gas provided by coal gas- ication for delivery in 1980. In closing, I would like to make a bet with Gofman, he said that solar power could be obtained for a price of roughly ree times that for nuclear power. My bet is that he can't find anyone who ll give him a quotation for three hundred and fifty megawatts of central ation solar power within the next year at a price of four times the price a nuclear plant. I'll bet you a hundred dollars eventhough I am a poor derpaid University Professor.

YOR BECKER: Dr. Gofman, would you like to answer that? You might even nt to lay some odds on it.

GOFMAN: That is not a bet that I would take on who would quote on thing in the next year because we have so underfunded solar power that ere is no body in position to bid on it. It is interesting about the nuclear wer advocates, they face the problems that have been raised. Fantastic oblems they say we will solve it tomorrow.

With respect to sunshine, green plants have been making storeable urces of energy which is probably where fossil fuel has come from. We ld make energy from green plants now by solar power, by methods of con- rting it either into gas or oil and when they look at that problem, they say, that might take a hundred years to work out. The green plants have been ng it for millineya, for millions of years. But look at it and say. t looks impossible. I would like to quote that if you want references on tations, Professor William Haronovan, Professor of Civil Engineering of University of Massachusets, Amherst, Massachusets has published papers in ch he has made direct economic calculations per killowatt installed and pointed out for ocean thermal which is an indirect form of solar energy, cost per installed killowatt should be known if we were to build plants h that, less than the cost of per installed killowatt of nuclear. Second has pointed out, for large scale wind power, which is also indirect ar power and enormous resource that the cost per installed killowatt uld be now very much less per killowatt than installed nuclear power. And ould be delighted to take Dr. Draper's address and provide him with those erences. They are really not that hard to find.

YOR BECKER: Mr. Locke.

LOCKE: Mr. Mayor and Council, I assure you that I won't speak long. merely wish to, if possible, give some idea about the position of the blic Service Board on this. The first, - well, I'll put it this way. I am na try to look at this strictly from a practical standpoint. We have the cision that we have to make tomorrow. I want first to remind the council, at we do not decide tommorrow whether we build a nuclear plant either at n Antonio or anywhere else. The plans that we are talking about will be ilt in Matagorda County somewhere over one hundred and fifty miles from

an Antonio whether we participate in it or not. The decision that we have o make tomorrow is whether we will pay thirty percent of the cost of that plant nd get thirty percent of the power. The only thing we would be building would e a transmission line from the plant down there to here in San Antonio. Accordingly, even if you believed everything that Dr. Gofman and Dr. Sternglass aid, even if you agreed with that theory, there is nothing we could do to eep that plant from being built. Now, I think this. I think the people of an Antonio want their lights turned on. I think they want their industries perating. I think they want to use their air conditioning equipment, run heir tv's and radios and to use their electrical appliances. We can't do hat unless we have power. It is going to cost us money to get the power ut I think the people are willing to pay for it as I think we need the power nd I think we want what we use the power for. Now it is pretty well nderstood I think that there is not going to be oil or gas. Neither one s sufficent to handle any future plants. We would be pretty lucky if we are able to get enough to keep the plants that we now have in operation running. ccordingly, we have to go to something else. We are going to coal for two lants, possibly three or four plants, between now and 1981. We could ossibly do nothing be build coal plants but there are questions about coal. oal is objectionable in a good many ways. Many people will be after coal. he prices will be going up. We have to bring it from long distances, probably rom Wyoming, Montana and it would seem to us that we ought to try to get ny power that is safe and practical. Now, despite everything that Dr. Gofman and Dr. Sternglass say, there is no question, but that the overwhelming ajority of the experts on the nuclear question, believes that the nuclear lants are safe at least safe enough to justify having them built. Now, f course, this may be that the Atomic Energy Commission and the big companies have all of these scientists subsidized but I just don't go for that. The only specific thing that these opposing gentlemen have named here, is this question, that Mr. Sternglass thinks has arisen around Pittsburg. As far as I know, it hasn't happened anywhere else. Obviously it has not been proven there. It is merely a theory on his part and from what Mr. Deeley read to you, the bulk of the other scientists have not accepted that theory. The majority as I have said before, believe in atomic energy, they believe it is the coming thing, they believe that it is what we will have to have to carry us over at least into the late '80's. The great majority of the major utility companies have either already built and are operating plants or, are actually building them. They are all up and down the Atlantic coast. They are around Chicago and Detroit. There are some in the Northwest, there are some in California and there is one to be built in Phoenix, Arizona. Texas Utilities will build their plant for the Dallas - Fort Worth area. Gulf States Utilities will build a plant in east Texas to serve, the Beaumont area. Houston Light and Power in addition to the plant that we are considering on going in is building their own plant in Austin County to serve Houston The plant in Matagorda County will serve Corpus Christi. If we stay out of the South Texas Project, we will be one of the few major points in Texas that will be without nuclear power. And, in fact, one of the great inorities of areas in the country without nuclear power. We have no nvironmental problem here. The plant will be built as I said before hether we go into it or not. It is over a hundred and fifty miles away from us, surely it can present no problem to the city of San Antonio. We do need the power and from that thirty percent that we will get in that plant, e will get six hundred and ninety megawatts of power which is almost eighty ercent as much as we are getting from all three plants as our Braunning lant station. It is the responsibility of the Public Service Board to make this decision. Personally I think we would be derelict in our duty to the ity of San Antonio, if we did not elect to go into the South Texas Project. hank you.

AYOR BECKER: Thank you Mr. Locke

R. PUFILLO: Mr. Mayor, May I make a few remarks at this time?

AYOR BECKER: Mr. Pufillo, will you please let me conduct this meeting? would appreciate it very much sir. It would make it more pleasant for both f us. I appreciate your enthusiasm and I can certainly understand, but am trying to do this as equitably as I can. Now we have approximately ifty minutes left, say forty five minutes. There were twenty-seven signed p for and nineteen signed up against. If we take forty five minutes, hat is approximately a three to two ratio, if I have it figured correctly, t would take forty five minutes, that would be twenty-seven minutes alloted o the pros and the fors, and eighteen minutes alotted for the against. On ive minutes each that would permit approximately five speakers for and

three or four speakers against. If you want to try to do this thing as expeditiously as possible, I would suggest that you take three minutes and you will get nine speakers in the affirmative and six speakers in the negative. So, you know who signed up here for and you know who signed up against, I would suggest that you do it as rapidly as possible so that you can utilize as much of your time as you can and the first speaker that we will take is in the 'for' group. That is Mr. Wes Bonifey, then we will alternate to one of the 'against' group and that is about as fair a way I know of doing it. Is Mr. Bonifey here? Mr. Bill Finck? Mr. John Lyons? Well, that is three there. I am going to keep calling these out until we get a winner. Bill Worth? Tom Van DeWalle? Larry Garcia? If you are in the audience and care to speak, I'd appreciate it if you would yell out Ho! or something. Walter Pope? Theodore Spiers?

MR. THEODORE SPIERS: Here!

MAYOR BECKER: The first one on the 'against' is Mr. Stephen Harvesty. I imagine you are acquainted with the fact Mr. Harvesty? Now, you have your clock set for three minutes, Jake?

MR. THEODORE SPIERS: Mr. Mayor, Councilmen, ladies and gentlemen of the audience. As president of Texas Pharmacal Company, which is a totally owned subsidiary of the Warner Lambert Company and employing over two hundred people at the San Antonio location with a payroll in excess of $2 million, I would like to make the following comments. I have been a resident of San Antonio for the last five years. My family and I find it a most charming and delightful community that we have ever lived in. However, I do believe that the City faces some very serious problems at this time. Several years ago, with the blessing of the City Council and business organizations within San Antonio, the Chamber of Commerce launched its campaign to bring non military, light, clean businesses to San Antonio and this is an obtainable goal. We have a good labor market, we enjoy excellent cooperation from both the Chamber and the City Government and we have a year round pleasant climate. However, when you pick up the Wall Street Journal, and, in this case it is the July 22nd issue, and read about San Antonio's critical power shortage, I cannot believe that any corporation would be interested in locating in a city that not only did not have a current adequate supply of energy available to it, but equally important had no current long term plans to serve their standing needs in the future. To me, the proposal of the City Public Service Board entering into an agreement with the Houston Light and Power Company, Central Power and Light, certainly seems to be a step in the right direction. To demonstrate to people outside of our area that we do, in fact, have plans to solve our future energy needs.

There can be no question that in the future we must rely upon sources of energy other than natural gas and oil. If this country is to grow and prosper, if this community is to grow and prosper, one of the most practical sources has got to be the use of atomic energy. With the July 1st deadline facing us and knowing that not only that the City Public Service Board investigated this proposal thoroughly, but that the other companies involved have also investigated it thoroughly and are all in agreement that this is the proper direction to take. I think that the City Council should support the City Public Service Board in entering into such an agreement. In addition to supplying us with an alternative source of energy, it would also be the beginning of regional cooperation to fulfill the needs of more than one community. A direction which we must take, if we are to best utilize the sources of energy available to us, I believe I speak not only for the employees of Texas Pharmacal Company but also for the majority of San Antonians when I am saying, not to act in a positive manner on this proposal, could only demonstrate

to the people of San Antonio that we might have a nice river and a unique city, but we certainly are not very progressive in our thinking.

MAYOR BECKER: That is three minutes, sorry Mr. Spiers.

MR. SPIERS: Thank you, Mr. Mayor.

MAYOR BECKER: Thank you very much. Mr. Harvesty, three minutes please.

MR. STEPHEN HARVESTY: My name is Stephen Harvesty and I am representing involved Texans. As a concerned citizen, as a concerned informed citizen, I am being graciously allowed five minutes to pour my heart out as to why we should not go into this nuclear fission type of power plant.

MAYOR BECKER: Three minutes, Mr. Harvesty.

MR. HARVESTY: This is an impossible task, but the zero hour has arrived, a decision must be made. This opposing effort is being made by those of us who have been studying and watching the progress of this expensive, dangerous, and very fickle device, nuclear fission. To bring some resemblance of reason to this discussion, those of us who oppose this program are not selling anything, we find nuclear power plants throughout the country costing hundreds of millions. Completely built and the builders find either they do not operate at all or they work only part time because of constant breakdowns. One plant had seven breakdowns since last December. These plants are mute evidence of man's ignorance over excitativeness to join the nuclear band wagon. These plants as a result of prolonged use of radioactive materials, are doomed to complete obsolescence after twenty-five to thirty years. Being too expensive to rebuild, they will remain dangerous, white elephants for ever.

Paul Thompson's column reported yesterday that five thousand street lights were not being turned off at the right time in San Antonio to conserve electricity because of the failure of Photoelectric cells. A comment made by a City Works Department employee is worth mentioning. He said, "I suppose there is nothing invented by man that the fates and bad breaks can't foul up." How true and tragic, because on that slim thread hangs the welfare of the people of this state. Rates, bad breaks, accidents, carelessness. Our technology can't even control photoelectric cells. You have heard that exposure to nuclear radiation, causes cancer, causes babies to be born mentally and physically defective, and increases the incidence of many serious illnesses such as heart disease. No one has ever really denied these statements. In January 1961 issue of the Readers' Digest was an article, "We Are Winning The Battle Against Birth Defects." This article states that one unlucky baby out of sixteen was condemned to misery of inborn illness or deformity. Radiation from nuclear fission power plants presents this danger. We heard over the radio on March 3 of this year that today one baby in ten is born with mental and physical defects. Are we winning the battle against birth defects? We are not only losing that battle, but we are promoting birth defects by our insane rush to nuclear fission power plants.

David Lilianthaugh, the first chairman of the Atomic Energy Commission, stated in the New York Times, July 20, 1969, and I quote, "Once a bright hope shared by all mankind, including myself, the rash proliferation of Atomic Power Plants has become one of the ugliest clouds overhanging America."

MAYOR BECKER: Mr. Harvesty, I am afraid your three minutes are up. I am sorry. All right, Mr. Orval Slater. While Mr. Slater is coming to the microphone, the speaker for the opposition will be Mr. David L. Davidson, if he is here, Mr. Jim Moffett, Katherine...I am trying to alert them, here.

R. ORVAL SLATER: Mr. Mayor, members of the council. As a citizen f San Antonio and as an employer of some one hundred San Antonio citizens, wish to register my strong protest (presentation is contained in notes ubmitted verbatim) against interfering with or delaying the plans of he City Public Service Board to join with Houston Power and Light and he Central Power and Light in building a nuclear power plant. My comments re based on the following points: One; objections of the environmentalists are not going to stop construction and operation of the proposed unit. The other two companies are going to go ahead with this plant on an urgent basis whether San Antoio is a party to it or not. Power from this plant shall be available in 1981. For this reason, if no other, I say the current discussions are based on a fallacious base. Two; current energy crisis, nationally, is the result of and only the result of political pressures through, since World War II for cheap energy. Three; this is somewhat true of our current local crisis, though I personally believe our problem goes somewhat deeper. Four; the press and television are quoting City Manager Granata as saying, "Jobs must come ahead of Comfort". Yet we are dragging our feet on supporting the planning of competant engineering over a period of years to insure the continuation of adequate electrical power.

Five; an adequate power supply is dependent now and for the foreseeable future on some type of fuel, the cheaper the better, but a source of fuel that is adequate to meet all demands. Six; it appears hat fossil fuels are not inexhaustable. Of the three available, gas nd oil are now in critical short supply within the confines of ontinental U.S. Overseas supplies not only are becoming increasingly ore expensive, but let's not forget, extremely dangerous to our National ecurity and therefore, to our freedom. Seven; coal supplies are subject o two serious drawbacks: Certainly most objectionable to ecologists, et as a temporary expediency, the City Public Service Board is prearing to employ coal as a stopgap. Coal is subject to the vagaries of ransportation and a constant supply of willing workers. Eight; this ould seem to emphasize our need to be a party to the first nuclear nergy plant for the production of power in South Texas.

Nine; while we follow the time old custom of talking, and alking, Oklahoma City is moving. Let's look at jobs. It is generally ecognized that Kelly Field is our largest employer of labor; so let's xamine Kelly as an example. How many of you realize that at one air orce base in Oklahoma City there are currently employed approximately he same number of workers as at Kelly? How many of you realize while e talk about helping Kelly, our competitors are up there doing things? ow many of you realize Oklahoma City Citizens have already passed a izable Bond Issue to buy the land and wreck the houses beginning to encroach on the Air Space vitally required for the run ways at Tinker ir Force Base? How many of you realize that in Northern Arkansas, now, not one but two, nuclear plants are under construction? This in spite of the vast reserves of oil and gas under their soil. This in spite of their closer proximity to great deposits of coal. I am informed these two plants insure adequate electrical energy for Northern Oklahoma. en; all of us should know that Kelly's work load is tied to National ecurity. Its schedules must be met. Our National Security can't wait n stoppages or even slow down. I've mentioned only Oklahoma City. We ave other hungry competitors--the C5A facilities standing underloaded t Marietta--to say nothing of new civilian facilities in Oakland, alifornia. Without the C5A work, Kelly shrinks to a disasterous degree. leven; the political football known as the B-1 has been delayed for ome ten years. This necessitates a big job of rebuilding our aging -52-D Fleet. Kelly field has the facilities, knowhow, and trained ersonnel to take on this big task. It requires electrical energy. elve; We have been striving for expansion of industry. Do you think y sensible executive would approve a major move under current rcumstances? Thirteen; my own business as well as those of other ople of San Antonio requires electrical energy.

AYOR BECKER: Thank you Mr. Slater, your time is up.

MAYOR BECKER: Mr. David L. Davidson.

MR. DAVID L. DAVIDSON: I guess I am listed on the list that you have as being against nuclear power, that is not true. I am neither for it nor against it, nor is the organization for whom I represent, which is the Sierra Club, for it or against it. The situation has to be taken, I think, into account in each case. I suppose our statement which has been carefully prepared, there is insufficient time to hear it, so, I will try to speak of some of the points that are involved in the decision that you have to make within the next period of time, very short period of time without some of the background information that I was planning to give you. It seems to me that the problem that you have is making the decision that prudent men would make under the circumstances that exist. Unfortunately, today has seemed to have been some sort of exercise in listening to all of the technical comments on pro and con to nuclear power. I think that it is time the City Council and the City Public Service people begin to look at the broader picture that must be considered in the decisions that must be made not only about electrical energy generation but about all the resources this area has.

We have to decide sometime when it is that we are going to call a stop to increasing population in this area so that we can support them on the resource basis that we have. One of the interacting functions or things, one of the interacting resources that are involved in power generation be it nuclear or non nuclear is water. That is also a necessary effluent for life and so it has to be considered simultaneously with electrical power generation. One of the problems that we are going to be facing in the future is having enough water to do the things that we want to in this part of Texas while we are able to support a good quality of life. I think that it is time that the electrical energy people begin to talk to the people that are involved in water resource planning and land use and transportation and all the other areas that must be considered when you are making decisions on the resource base and how you are going to use them. If we don't do this, we are going to see the quality of life that we like in this part of the country be degraded seriously. And so, I think that these are the kinds of things that you must consider in addition to whether we are going to be involved in nuclear or non nuclear.

I would like to point out also, to you or read to you, one paragraph from Mr. Bird's experience with Frederick Refrigerators. He says from our experience with Frederick, we are convinced that most commercial and residential energy uses can be reduced significantly without effecting efficiency comfort. I think that there are other ways out of the box that you find yourself in, besides deciding to go nuclear or non nuclear.

MAYOR BECKER: Mr. H. B. Zachery? Are you speaking for Mr. Zachery?

SPOKESMAN: Mr. Zachery regrets he had to leave. I have a statement of his but in the interest of time, I will hand it directly to you.

MAYOR BECKER: All right, sir. Thank you very much. Mr. Robert Gragg? While Mr. Gragg is coming down, Mr. Dick Kuenstler, Mayor of Somerset, wanted it to be known that he endorses the Nuclear Plant. He asked that his feelings be announced publicly.

MR. ROBERT GRAGG: Mr. Mayor, members of the City Council, ladies and gentlemen. My name is Robert Gragg, I am president of the Greater San Antonio Builders' Association which has over eleven hundred active builder and associate members. Presently, we are the third largest

uilder's association in the nation. Like all other citizens, our members of the Builder's Association have been deeply concerned about the local shortage of fuel. This shortage has resulted in curtailment of local industry whose continuous operation is necessary for sustaining the building industry and approximately fifty thousand related jobs in this community. Steps taken by the City Public Service Board and the City Council to aleviate our immediate problems have been commendable. However, in the long run, we must work for a sure supply of cheap electrical energy so that the citizens of San Antonio may continue to enjoy the same standards of living that we are enjoying today.

It is the concensus of the Builder's Association that nuclear energy will be cheaper in the long run. If Houston Lighting and Power and Central Power and Light find it advantageous to use nuclear energy, why not San Antonio? And if there are plans for building nuclear power plants to serve virtually every large city in America, why not San Antonio?

From what I understand, the Uranium that is used to make nuclear fuel cannot, as a practical matter, be used for many other purposes. Why not take advantage of this natural resource to solve our fuel shortage, particularly when oil and natural gas will continue to be in short supply. It is a well reported fact that this plant will be built with or without our participation. Obviously, we need additional sources of power, this is our opportunity. San Antonio already has been hurt by our power crisis, but the damage can be overcome if we will show the people of this state and nation that we are planning for the future of San Antonio and Bexar County with foresight. There is one specific way we can show that we have the foresight and this is to join with the Houston Light and Power and Central Power and Light in building the nuclear plant at Bay City.

On behalf of the Greater San Antonio Builder's Association, I would like to ask that you recommend and support the City Public Service Board's plan to participate in the South Texas Nuclear Project. Thank you.

MAYOR BECKER: Jim Moffett?

MR. JIM MOFFETT: Mr. Mayor, Council, and those of us left. I am representing myself. Let's say I am a concerned citizen. I have heard the pros and cons today. The question of safety devices on the plant coolant, the liability of insurance, the disposal of waste. I haven't heard any answers. There is $270 million that we are going to sink into this nuclear power plant that might not work. I think we need more than twenty-four hours to decide about this and if you want to, you could probably keep the nuclear power plant out of Texas, if we sought... forsought as a threat to San Antonio and the out lying areas. I don't want to keep you any longer, I don't envy you making any decisions. Thank you.

MAYOR BECKER: Mr. Harold Herndon? Theodore Spiers? Amos Wente?

MR. AMOS WENTE: Mr. Mayor, members of the Council. I am executive secretary for the Associated Subcontractors of San Antonio. We represent approximately ninety subcontractors and material supply firms in San Antonio. At a meeting of the Board of Directors, yesterday, the Board passed a policy statement whereby we encourage the City Council to support the City Public Service Board in their venture in joining the Houston Light and Power Company and Central Power and Light Company of Corpus Christi in the nuclear power plant project. A copy of this policy statement, I will give to you, Mayor, for your records. Thank you.

MAYOR BECKER: Thank you, sir. Katherine E., I am sorry I can't read that, 1806 Hicks Avenue. Apparently she is not here. Dr. Herman Levine?

DR. HERMAN LEVINE: Mayor Becker, members of the City Council. Austin has rejected nuclear power and is presently planning the use of garbage for the generation of its electricity. In New Mexico, a coal gassification plant is being build and is expected to be operational in three years. If New Mexico can build a plant and have it operational in three years, why can't we. Coal gassification has been shown to be a clean and efficient source of energy. One that we can readily obtain in San Antonio. In California, part of San Francisco's electricity is being supplied through the use of geothermal steam and could be fully supplied by 1975. In the Imperial Valley of California, many drilling companies are leasing large tracts of private land to drill for geothermal steam. It has been called the Gold Rush of the 1970's. Experts in this field have stated that excellent sources of geothermal energy are located in fourteen western states. This includes Texas, especially along the Gulf Coast. It certainly would not be more costly to build transmission lines from geothermal plants than from nuclear plants and the production of electricity in geothermal plants would be far more economical.

There are other alternate sources of energy that have been mentioned such as solar, wind, synthetic gas, and synthetic oil. With the proper incentive and inititive these could be made available. If nuclear reactors are kept out of San Antonio and out of the State of Texas, we would soon quickly develop these cleaner, safer, and more economical sources of energy. It is my opinion that it would be unjust, unfair, and unwise to have four members of the City Public Service Board who are not elected by the people of San Antonio to pose the hazardous, irrational, and moral nuclear fission technology upon our community.

I therefore, respectfully urge the Mayor and this City Council to deny funds for any nuclear fission venture.

MAYOR BECKER: Thank you Doctor. Frank T....7314 Oak Manor Drive? I can't read the last name, it could be Barong or something. Apparently he is not here. Ira B. Baccus? Ena W. White? William J. Wallace,Jr.?

MR. WILLIAM J. WALLACE: I'll say good evening to the Mayor and Council.

I don't envy the job that you have ahead of you. I would like to make several observations. One; regardless to what route you take, you should educate the people. When I was in the service, they gave us about four weeks of atomic energy and that was...I went through that at Fort Sam Houston out here and imagine some of that is available. It should be shown either through the educational television or regular television so the people would not be so afraid of atomic energy. It is not as dangerous when handled correctly as everyone seems to think it is.

Also, when I was in the service in '61, we were shown training films where people had run meat through some sort of radiation and you could set it on the shelf for three weeks without refrigeration and they had a whole base of people living off of this. I do not know the results of any of that, it had been going on for some time since I got out of the service that year.

Another thing; whether or not you accept the energy, we would be in just as much danger, if we take it or if we don't. What matters is, we want the danger without the comforts, should there be any, or are we going to die in agony and comfort, either way we are going to be just as dead.

Economic factors must be considered because, this week I have

already tried to help one family who was put out of work in the construction business due to curtailments thus far. He has missed one payment on this house, he has automatically missed the second and he is about to be put out of his home. This will affect the poor people first. Now, I have heard a lot of talk about the great doctors that were up here as to the killing of embryos or better known as babies in the fetal stage and so forth. How can you put so much concern, if this is the only people killed when the Federal Government, State Government, and other Governments have passed laws that you can kill babies at will be abortion, if you so desire. I don't see any difference in killing at will, morally, or being killed accidentally. Of course, I admit you are just as dead when it happens. This is another thing I think you should consider. Anybody can be on the ego trip to answer any of those questions, maybe one of the doctors that was here.

MAYOR BECKER: Thank you Bill. Mr. Herbert G. Uecker.

MR. HERBERT G. UECKER: I would just like to point out some of the falacies in the statements of some of the members of the City Public Service Board, in the past and today. First of all Mr. Newman, if you will look back at the transcripts of whatever went on last week, in witness of all these gentlemen, told you that all the experts agreed that nuclear energy was the only way to go. You have seen dramatic evidence in the form of Dr. Gofman and Dr. Sternglass today that is not the case. Now Mr. Locke tries to tell you that the majority are in favor of nuclear energy. Well, I would like to say that, that remains to be seen. To say that the plant will be built anyway is irrelevant. This is like saying someone is going to shoot John Smith so I might as well go ahead and do it anyway.

Regarding accidents, if we could have the sinking of the Titanic on its maiden voyage, if we can have two air liners collide over the Grand Canyon, if we can have six hundred and twenty-five thousand gallons of fuel oil leak into the San Antonio River right here in San Antonio, Texas, and if we can have three astronauts burn up in a space ship after all the precautions that the National Aeronautics and Space Administration and various industries working with them have taken to protect such people, we can have a major nuclear accident in this country and it will happen. Dr. Ralph Lap, with the Atomic Energy Commission, has said that it appears a certainty that there will be a serious major nuclear accident before the year two thousand. I would like also to say that there is no way in my opinion with all due respect for your reliability and competency as a Council that you could make a decision which would be the right decision or even an informed decision based on the short period that has been allowed to the presentation of evidence on the side of the opposition with regards to nuclear plants and if for no other reason you do not make your decision for nuclear reactors, you should not make the decision for nuclear reactors because you are just not in a position yet to do so until you hear more evidence and like I say, there are many scientists, in addition to Dr. Sternglass and Dr. Gofman who could come here and match point by point anybody the City Public Service Board or that anybody else could bring here. Thank you.

MAYOR BECKER: W. W. Magill? Charles E. Garit? L. B. Connell? Kenneth R. Hendrix?

KENNETH R. HENDRIX: Mayor Becker and Council. This is a rare privilege for me to get to speak to you and the other citizens here. I would like to, first of all, I am speaking, privately speaking, for myself as an individual customer. I took it upon myself, I am a teacher, I have a little time in the summer to come, because I felt that there probably would be quite a bit of organized opposition where as the so called silent

majority may not bother or wouldn't be able to represent themselves. So, perhaps I could be speaking for the silent majority. I would like first to give three, just brief, explanations as to why I think I have a little insight into these things. I certainly don't claim to be an expert, or up to par or same calliber to the men that spoke this morning. I was very interested in listening to them, both sides. However, in three years, of commission service with the U.S. Army, I was given special training in chemical, biological and nuclear warfare. And my brother, with whom I have a close relationship, works in non destructive testing, primarily at examing these reactor facilities for their safety. Actually going inside the componants when they are shut down to examine their safety according to criteria established by the AEC. In addition, as a teacher I tend to keep informed. Based upon my knowledge of radiological hazards, I support the most rapid development of nuclear power for the San Antonio area consistant with the safeguards required by the Atomic Energy Commission. The rhetoric of the two sides of experts heard this morning is informative. The proponents spoke factually of real safety considerations and the comparative values of need and safety. On the other hand the opponents have come with an organized cheering section and made irrelevant emotional appeals to attempt to scare you away from this important decision.

In the context of our current and future energy shortage, the City Public Service Board is to be commended for leading San Antonio into the Nuclear Age. In my experience and estimation, geothermal and solar energy as well as garbage energy are pie in the sky hopes. You have been hearing about them and their easy availability and economy and usefulness for some twenty years that I personally can recall. Their practical application is not significantly greater today than twenty years ago. Nuclear Energy is practical and practical use and we certainly need it. At least to tied us over until this pie in the sky becomes a reality. As I mentioned, my brother is educated in his field, knowledgeable and proficient. I trust his judgement, also based upon my judgement as a nuclear officer.

MAYOR BECKER: Thank you Mr. Hendrix, I am afraid that is all the time. Estella Hamilton? George Russell? John Gofman, Ernest Sternglass? Gavin Gilmore? Tony Wagner? Michael Masser? Lanny Sinkin? Allright. Andrew Longaker? D. L. Strauss?

MR. D. L. STRAUSS: Mr. Mayor, City Council, ladies and gentlemen. Let me assume you, singular, have a serious health problem. You consult an imminent physician and after examination and diagnosis, he prescribes a powerful, expensive, and controversial drug. To make sure you consult and equally prestigious physician, who warns you not to use this drug as it can produce drastic side effects and cause permanent injury should you take the medication. My analogy, we have a serious energy problem. Prominent experts and scientists advocate nuclear power plants as the solution and minimize their potential danger. Equally competent experts and scientists oppose nuclear power plants. These scientists direct our attention to their great financial cost and the limited reserves of their fuel, uranium. They strenuously contend that the existing controls, safety contrivences and techniques are inadequate to prevent major accidents in the operation of a nuclear power plant or in the removal and disposition of its spent radioactive fuel. And that such a major accident could result in catastrophic destruction of life and limbs and property over wide areas. In the consideration of these conflicting views, the opinions of those in favor of nuclear power plants must be weighed in the light of their employment by or retainers from the promoters of Nuclear Power Plants, the Atomic Energy Commission, the Electric Power Utilities, including the City Public Service Board, and the manufacturers of nuclear reactors, General Electric, Westinghouse, and others. Shall we accept the dangerous, expensive, and controversial nuclear remedy? Thank you.

MAYOR BECKER: Thank you, Mr. Strauss. Larry Van Horn? Dr. Carl F. Raba, Jr.?

DR. CARL F. RABA, JR.: Mr. Mayor, members of the Council. I am here representing the Bexar Chapter of the Texas Society of Professional Engineers as its immediate past president and the Builders' Exchange of Texas as a former Director on the Executive Committee. San Antonio's engineering profession and construction community is gravely concerned that our city have a safe, reliable method of generating energy in the future. Because of this deep feeling and after thorough analysis of the alternatives that are available, we have prepared and unanimously passed the resolution that I will now present: Whereas, the Bexar Chapter of the Texas Society of Professional Engineers in an organization of approximately 450 engineers; and Whereas, every day the lives, safety, health and welfare of millions of Texas citizens are dependent upon engineering judgments, decisions and practices incorporated into structures, machines, products and processes which are necessary to a rapidly expanding economy; and Whereas, the Professional engineer makes the public health, safety and welfare the basic tenet of his engineering practice; and Whereas, nuclear power plants are a proven method of safely producing power in a reliable manner; and Whereas, we are also interested Citizens of the San Antonio area and are deeply concerned about the future growth of Greater San Antonio and its future energy sources.. Now, therefore, be it resolved: that We, the Bexar Chapter of Texas Society of Professional Engineers, herby commend the City Public Service Board, its management and engineering staff for their progressive plans to associate in a joint venture of Nuclear Power Generation with Houston Lighting and Power, and Central Power and Light, and we further urge all other local governmental agencies to give their support to insure the continued growth of San Antonio. Thank you.

MAYOR BECKER: Louis Pufillo? You didn't think you were going to get a chance to speak, did you?

MR. LOUIS PUFILLO: Mr. Mayor, members of the City Council, ladies and gentlmen. I am a private citizen. I am not a scientist. I am here on my own time, nobody paid me. I have been here all day. In fact, I am a music teacher, a violinist and as Mayor Becker well knows, in fact, I have serenaded the Mayor on several occassions. Now, getting down to nuclear power which I don't know much about, but I am going to quote people who do know something about it. According to Senator Mike Gravel of Alaska who states as follows: "Senator Mike Gravel has plans to introduce legislation which will remove preferential treatment for nuclear power plants and give new attention to safer ways of making electricity." Now the question is this. If the Price Anderson Act is repealed, would the Electrical Utility Industry be willing to go ahead with nuclear electricity generation? And the answer is....There have already been a number of statements by utility officials that they would not go ahead with nuclear power plants, if they had to bear the financial liability for the consequences of major accidents and we also know that the private insurance industry refuses to insure the full liability for major accidents. Thus, I'll consider nuclear electricity industry will undoubtedly come to a standstill if it has to be financially responsible as all other industries must be. Every industry should stand on its own legs, you know. Why should the United States Government or the City of San Antonio be responsible to the citizens for a nuclear accident and they have to pay off. The insurance companies will not insure anybody, as Dr. Gofman pointed out and as Dr. Sternglass pointed out.

So, therefore, we have two experts there who tell us that nuclear energy is very dangerous to the community and we are not insured against accidents and they could happen. Now, San Antonio, I wish to point out, is a tourist city. In fact, a good portion of our growth comes from conventions who come here and new people who come here every year. The tourist attraction, and I wish to say that the growth of San Antonio, would decline easily thirty to forty percent if they know that in ten years from now that there are going to be nuclear reactors here that will pollute the air and cause the people to get sick.

MAYOR BECKER: Thank you sir, your time is up.

MR. PUFILLO: I just wanted to point that out.

MAYOR BECKER: Yes sir, we appreciate it. Mr. W. A. Simmons? Jose Barrios? We have one more person to be heard and that is Mrs. Louise Harvesty, and that will bring us right close to 6:00 deadline.

MRS. LOUISE HARVESTY: There are just a couple of things I want to point out, Mr. Mayor, because most of work has been covered, I did take a post graduate course in radiation safety, it was a short course but one of the things that they pointed out was that the soft rays were the most dangerous. In other words, if you are running an Xray, you are putting in more killovolts so it goes through the body and these soft wandering rays around the office or in your atmosphere are the ones that get inside you and travel around and work for twenty years or more to cause trouble. Now, all of you have had difficulties with computers. I hate them and I think a lot of times, when we have to depend completely upon science and not on human good sense that we run into trouble that we cannot correct with good human sense. We took a trip to the dump, Sunday, just to make sure that we were on solid ground and we found that we are now burning trash and I see no reason for burning trash out in the open and running a nuclear reactor over here and adding any small amount of radiation when I am putting smoke in the air only to get rid of trash. Let's use it. There was one other point and that was that in my office if I hire somebody under eighteen, I may not expose that person to one ram per year. I can only expose him to about 5 rams after the age of eighteen. This is in their work. Now, naturally a doctor taking an Xray could expose them if there was a reason for taking the Xray. But up until eighteen, back ground radiation is mill. I have no authority to add any of that to anyone and I don't see how you do. I can't even get rid of my old Xray machine because it was outlawed by a change in radiation. Thank you.

MAYOR BECKER: Thank you Mrs. Harvesty. Ladies and gentlemen, members of the audience, the press, City Public Service Board, honored guests and dignitaries that spoke, thank you very much for spending your day with us today. We appreciate it more than you know. I think it was a good exchange and it certainly was informative I believe to all parties involved. I believe the public will benefit considerably from having this type of hearing. Also, I would like to thank the City staff, the members of the Theater of the Performing Arts here who provided the lighting and the audio and all the rest of the comforts that we have enjoyed today and we appreciate their indulgence also. It is rather late today, it is about three minutes after six and if there isn't any objection from anyone, we will adjourn this hearing today. Thank you very much.

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The hearing was adjourned at 6:00 P. M.

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