ATOMS FOR PEACE + 50
Nuclear Energy & Science for the 21st Century

October 22, 2003
The Watergate Hotel
Washington, DC

Admiral F.L. "Skip" Bowman, USN, Director, Naval Nuclear Propulsion, Naval Sea Systems Command

Harnessing Nuclear Technology for the Prosperity and Security of Our Nation

Panel Chairman:
Robert G. Card, Under Secretary for Energy, Science and Environment

CARD: Many of you may not be fully aware that there's two fleets of 100 nuclear power plants in the United States and you've heard about the civilian electricity half of them. The other half of them is owned by the U.S. Navy and the steward of that half is Admiral Skip Bowman, the Director of Naval Reactors. I want to say that Skip has done just an outstanding job. He's our star guest speaker at our annual safety summit that we have for all of the leaders and the contractors in the Department of Energy. And I think everybody here knows about Naval Reactors, they've built an envious record of outstanding technology combined with really world-class safety. So I'm sure Skip is going to share a few things about that. Skip, thank you.

BOWMAN: Well, with no microphone and no slides, I'd like to petition for two minutes more before you give me the hook [laughter]. And finally I would like to thank everyone who hasn't already been thanked here today [laughter]. I'm very happy, though, to participate in this conference because I truly believe that the past, the present and, indeed, the future of President Eisenhower's vision are closely tied to the story of Admiral Hyman Rickover and Naval reactors.

To give you my bottom line propositions. First, the Rickover story is living proof that a technically based organization with unchanging core values can harness this unforgiving technology for the prosperity and security of the nation. Second, that there is today a national security mandate for commercial nuclear power to greatly increase its role in meeting America's energy needs.

Let me piggyback just a little bit on Don Hintz' presentation. In 1946 Admiral Rickover, then Captain Rickover, set himself up at Oak Ridge National Laboratory under the slimmest of authorizations, some would say none, and with an even slimmer staff of one to study the fledging nuclear technology. By August 1948, Admiral Rickover had earned the support of key national

leaders in and out of the Navy, mostly out of the Navy, and they gave him a formal mandate to deliver a true submarine that could travel at high speeds, continuously submerged, without having to recharge batteries.

Well, Rickover attacked this challenge (as he did everything else), at full tilt ? developing the technologies, the materials, the standards, and, most importantly, the people. In March, 1953, just five years from receiving this mandate, and just 15 months after Argon Laboratory's experimental reactor illuminated that string of light bulbs, the prototype reactor plant for the submarine Nautilus began operation in the Idaho dessert, nuclear-powered operation, the first harnessing of nuclear power to do real work on a large and practical scale.

Everyone following the nuclear developments of the day recognized that if nuclear power could be used to propel a submarine, it surely could be used to generate electricity for homes and industry. So in the summer of 1953, Admiral Rickover received yet another national mandate: to build and operate a commercial reactor, thereby beginning this country's civil nuclear power industry. Several months later, and undoubtedly acknowledging the work of Admiral Rickover and the success of that experimental reactor outside of Arco, Idaho, President Eisenhower made the famous proclamation in his speech.

"The United States knows that peaceful power from atomic energy is no dream
of the future. The capability, already proved, is here today."

On December 23, 1957, again, fewer than five years after Admiral Rickover accepted that second challenge, our country's first commercial reactor, the Shipping Port Atomic Power Plant began providing electricity to the people of Pittsburgh, taking a giant step forward to fulfilling what President Eisenhower called a "special purpose... to provide abundant electrical energy."

When Admiral Rickover began the Naval Reactors program, he also began embedding into it these core values that endure today. First, technical excellence and technical competence are absolutely required in our work because things do happen and especially at sea: we rely on a multi-layer defense against off-normal events. Our reactor designs and operating procedures are uncomplicated and conservative and we build in redundancy. Next, we always will select the best people that we can find, with the highest integrity and professional competence, and the willingness to accept complete responsibility over ever aspect of nuclear power operations. And then we rigorously train them and continuously challenge them.

Third, we require formality and discipline and we insist on forceful back-up from the youngest sailor on board all the way to the commanding officer. And fourth, we insist that the only way to operate our nuclear power plants ? the only way to insure safe operations generation after generation ? is to embrace a system that mainstreams in each operator a total commitment to safety: a pervasive, enduring devotion to a culture of safety and environmental stewardship.

Well, these core values, among a few others, are the foundation that have allowed our Navy nuclear-powered warships to safely steam more than 128 million miles, equivalent to over five thousand times around the earth, without a reactor accident, indeed, with no measurable negative impact on the environment or human health. As Admiral Rickover's successor, the fourth

Director of Naval Reactors, I do oversee the operation of 103 reactors, equaling the number of commercial reactors in this country. These reactors, powering United States Navy ships, are welcomed in more than 150 ports, in over 50 countries around the world.

I offer this thumbnail sketch of the past and the present as objective proof to the naysayers that it really can be done. Reliable and robust nuclear reactors can be operated on very large scale with the trust and confidence of the operators and the population that live and work nearby. And what nuclear power provides a warship ? a combination of speed, endurance, flexibility and reliability ? is counted on now more than ever to defend our Nation and further our national interests.

Immediately following the terrorist attacks on 9/11, nuclear-powered warships responded decisively and have contributed and continued to lead the way at sea in operations Enduring Freedom and Iraqi Freedom. Especially today, as we evolve to a more responsive Navy to fight the Global War on Terrorism, our nuclear- powered warships are needed to provide sustainable, reliable and independent operations to answer the call for prompt, overwhelming action.

But proud as I am of what our Department of Energy and Navy have done and their success at developing and safely using nuclear energy, I must say that as a Nation we must, can and should do more to accomplish President Eisenhower's "special purpose" vision.

And this brings me, of course, to the second point. I'm absolutely convinced that this country must take immediate steps to significantly increase our energy production from nuclear power. And I believe that we should feel the same national mandate to act that Admiral Rickover felt back in 1953 at the beginning of the Atoms for Peace era.

The late Edward Teller gave a sense of urgency to this suggested contemporary mandate years ago when he observed, "If we want safe and clean energy, we should accept fission reactors. Unfortunately the fear of that technology is widespread and it will be hard to eradicate. Therefore reactors must not only be safe; we must make them obviously safe. And if we don't find ways to make the obvious clear to people, to persuade them to accept the best technologies then," listen to this, "I believe America will turn itself into an underdeveloped country."

Pretty dire warning, but I believe it's corroborated by two synergistic facts of life.
First, there is a credible expectation the U.S. energy demand will increase significantly ? far beyond our current domestic supply ? over the next two decades. And, second, unless we do something about it foreign countries that aren't necessarily friendly and, perhaps, are even hostile to U.S. interests, will provide at their price ? or withhold at their whim ? the oil that could satisfy much of this expanding need.

As widely reported, OPEC will exercise its arbitrary authority at the end of this month to cut the supply of oil by over 900 thousand barrels a day. This action will show us again that our dependence on foreign oil puts us at the mercy of foreign entities such as OPEC. As they vary production quotas and price for a third of the world's oil supplies, we feel that economic impact, and they demonstrate the significant power they have over our economy.

Well, will America continue to grow and prosper or will we tumble rapidly and chaotically into Dr. Teller's "underdeveloped" status? Unless we control our own energy supplies, the choice may not be ours to make. Given that nuclear power is a necessary part of the answer to our growing energy needs, what must we do? Advancements in science and technology as Bill Magwood discussed, like Generation Four are very important for the future. But what we urgently need today is an earnest, robust, and large-scale program of media and public education.

It's encouraging to see that recent NEI survey on public attitudes towards nuclear power, especially the bottom line that 64% favor nuclear power. But I note that while that is a positive sign, that same survey indicates that the public is split down the middle on the need to build new nuclear plants. And that recent MIT study, "The Future of Nuclear Power," also indicates that more needs to be done. The study's summary concludes that, "the public does not yet see nuclear power as a way to address global warming, suggesting that further public education may be necessary."

Therefore the fact that we must deal with is that American people have been led and conditioned to mistrust anything nuclear. For far too long we have allowed this feeling to simmer, despite the consequences. In addition to our nuclear Navy's 50-year success, the commercial nuclear industry has a very powerful case to make and we've heard some of this case today from my fellow panelists.

As we do what Teller suggested ? make the obvious clear to people ? let's talk to the American people about comparative risk. David Ropeik of the Harvard Center for Risk Analysis makes some interesting points: 7,800 deaths attributed to sun a year from melanoma; medical mistakes kill as many as 98,000 Americans a year; food poisoning kills 5,000 Americans a year; air pollution kills over 60,000 Americans a year. Mr. Ropeik recently compiled a list of "risks that aren't really risky." Do you know what was number one on his list? Radiation from a nuclear reactor.

Let me reinforce his points with a few of my own.

Three Mile Island was, obviously, this country's worst nuclear accident, yet few people realize that even though 90% of the fuel rods ruptured, TMI was an absolutely non-event from a radiation and health hazard standpoint.

My submarine sailors, who live and work within yards of operating reactors, receive less whole body radiation while underway than they do while at home exposed to natural background radiation. So if you really want to minimize your exposure to radiation, go to sea on a submarine. [laughter]

We need to tell this story. We need to educate our fellow citizens. For sure, this is an unforgiving technology and we can't forget that. It demands our keenest attention to keep it safe, but it can be safe. Our country... today operating 206 reactors... with the world's largest operating nuclear Navy... the world's largest output of nuclear-generated commercial electricity... the Atoms for Peace country... must continue to apply today's stringent requirements and defense in depth to

this technology to ensure the nuclear power meets President Eisenhower's mandate, his "special purpose," to provide abundant nuclear energy. Thank you.

[applause]

Questions and Answers:
CARD: Thank you. Unless my watch is horribly off, we have a generous amount of time for questions, challenges, comments, whatever from the audience.

COZARELLI(?): I'm Nick Cozarelli from UC Berkeley and my question is that we've heard several people talk about the hydrogen fuel cell but, obviously, the amount of energy you are going to get out of the hydrogen fuel cell is going to be less than the amount of energy you put in to making that hydrogen and, given the fact of what we've been hearing about this morning, about how far off any kind of really substantial nuclear power is, the hydrogen fuel cell is more polluting than any other form, than just gasoline for running a car.

So I was wondering if anyone would like to respond to this negative aspect of the hydrogen fuel cell idea.

CARD: Does anyone on the panel want to take a shot at that?

MAGWOOD: Sure, I'll-- I think first I'll say that I don't entirely agree with your postulate. First, I think that hydrogen fuel cells, especially the advanced fuel cells that DOE is doing research on now, has a great potential for very high efficiencies and I think that if we're successful in having very efficient means of producing hydrogen, that the overall efficiency will be very good. I think we will be very competitive. What we're trying to accomplish is not necessarily to achieve an alternative to petroleum that is going to be cheaper than petroleum.

I mean the reason that we use petroleum is because is cheap. What we like to do is have a viable alternative to petroleum that is not vastly more expensive but yet has huge environmental and economic security benefits for the country. And discussing this in the context of a lot of the overseas meetings, I've been to; there are many countries that agree with that point of view. So I actually am an optimist on both the fuel cell development and also and possibly for having nuclear technology appear in the foreseeable future, in the next decade or two that will fuel those fuel cells especially.

CARD: Thank you Bill. I just might attempt to weigh in just a bit on that. Right now, today I think well-to-wheels efficiency probably would favor a diesel or a diesel hybrid. But we really see an addition to the strategic diversity issues that Bill mentioned, which are vitally important, we're really shooting for breakthrough technologies and when you couple that with the possibility of fuel price increases and other inputs, we think the hydrogen system is an extremely important alternative.

Okay. I just wanted to make sure I had the right person.

NEFF: I don't know if I'm the right person. I think I am. I'm Tom Neff from MIT. I just had a question and a comment about renewables. Everybody there on the panel I think said something very kind about renewable resources and energy and nuclear but there is a link and not much has made of it. It is actually an old point. I wrote a book about it about 25 years ago. Most new energy technologies have payback times. They take two, three, five years even to generate as much energy as it took to make them.

So if you and to get from a low installed base for renewables to a large installed base, you need to expand a lot of traditional forms of energy in order to get that base installed. It takes aluminum. It takes-- Whether it's wind, wave, solar panels or whatever or hydrogen fuel cells. For example, if you want a gigawatt of solar next year, you've got to use about three gigawatts this year. I'm not sure why the point has not been made that, in order to have, say, expansion of renewable resources over the next 50 years or 100 years, we actually need to build a lot more conventional capacity.

We have two choices, basically. Gas is saturated. We have nuclear and we have coal. And I think it's a great argument for nuclear. Nuclear power plants can generate the electricity that is largely used to make the facilities necessary for renewable for energy generation. And I think that might help disarm a certain amount. There is a certain dichotomy here between those who sort of favor the soft energy path, the renewable resource path as a simple, totally separate kind of path to go forward. But there is no such simple, separate path. They are linked.

CARD: Thank you Tom. Does anybody want to expand on that before we go on to the next question? [pause] Let's look over here. Burt, I think I saw your hand up and then we'll go there and over here and back.

RICHTER: I think all the technical people certainly agree that nuclear power is the way to go.

CARD: Burt, you want to tell us who you are?

RICHTER: I'm Burt Richter, physicist, Stanford. All the techies agree, nuclear power is wonderful and we should go that way. I have a question I want to direct toward Mr. Hintz and I want to start with three comments, first. The present nuclear power plants are gold mines because of the life extension programs, their capital costs are paid off and the utilities that own them are making a fortune. That's wonderful. (Laughter)

Second, fossil fuels get a huge subsidy in our system because they're not required to pay for the disposal of waste product, carbon dioxide. Because of that subsidy, fossil fuels and new power plants in fossil fuels are cheaper; generate cheaper electricity than nuclear, at least according to all the studies I've seen. Now, Mr. Hintz talked about building new nukes in the United States. The question is, is industry really going to do that without some incentives? What does the government have to do to strike the appropriate economic balance to make up for the subsidy that fossil fuel is getting?

HINTZ: Well, I don't know if I agree with you that we're making tons of money on the existing plants (laughter) but they are very profitable and that's primarily because the production cost is

very low compared to other ways of generating power. But getting back to what it would take for say, Entergy to build a new nuclear plant, I guess it's been about two years ago, I made a presentation. And the title of the presentation was, "The Stars are Aligning" and the theme was that it does seem like everything is starting to come together that would allow us to go ahead and build new nuclear plants.

And the star I was talking about was, I think the public opinion is continuing to get better. We're seeing plant operational performance not only being better but I think we have a lot of confidence that we can operate them consistently at high performance levels. And I'd say ten years ago we weren't sure of that because it always seemed like you could operate them well but then you would end up with a long-term shut down for some reason or another. The safety record has been extremely good.

We still see that operating costs are decreasing or at least stable and we're seeing most other fuels, the fuel costs are continuing to escalate. And so I mean it looks like everything is coming together that, why aren't utilities jumping at the chance to build a new nuclear plant? Probably the biggest reason I think is that the capital costs are still quite high. And I know the vendors have done a lot of work in trying to reduce the costs and trying to make the plants a little simpler and having more passive systems and things like that.

But the issue is, with the special things associated with nuclear, a lot of capital dollars, it takes a long time to build them and things like that, that the capital costs are still such that the other forms of generating electricity are more attractive. But it is getting close and I get a lot of questions now, when people see what happens to the price of gas. Well, surely, now, that's going to be the final thing that's going to tip it. And I think everybody's got a different view on natural gas and I'll give you Entergy's, which I'm sure is wrong. We've never been right on it in the past, but (laughter) we see natural gas is going to be very volatile. I mean you are going to see $10 dollar gas and, we used to say, $2 dollar gas. I don't think you are going to see that again, probably.

But you are going to see, we believe, fairly low-priced gas. You're going to have the volatility. So, when you are building a plant, like a nuclear plant, you've got to figure out, on average, what's the price of natural gas going to be? And we're not convinced on the average that it's going to be greater then $5 dollars. And if you're somewhere between $4 and $5 dollars, these capital costs are still too much. But I think if we got any credit or much credit for the environmental advantages of nuclear, I think that would be enough to tip the table and I'd be surprised if you wouldn't see someone going ahead it.

Let me just say. I know I am taking much too much time. But let me just say one of the problems that you have with building a nuclear plant, besides large capital costs, we can't get debt on them. And maybe we can't today, but we built a gas-fired plant with 90% debt and we're building this nuclear plant with 100% equity. And it could be the greatest technology in the world and vendors can do a great job of getting costs down, but when you're building something with 100% equity, that does change the financial situation of that plant. I think we're close but we're not quite there yet.

CARD: Thank you Don. I think it was important to have that dialogue so that the audience understood that it is not a national policy issue is why we are not seeing more nuclear plants. It's the financial structure and the thing the Don didn't delve into but I think is a big deal is that since we have liberalized the market and we're in favor of that and Europe is doing the same thing, when you apply corporate rate of return to that capital, it makes it very hard to recognize the long-term investment potential of a nuclear power plant.

Finland, TVO, the buyer of the Fin Five plant was using a 5% rate of return in their calculation, which is a third to a fifth of what Don would have to use for his company.

We have a question down here and then I'll take the next one from over here.

WAGNER: Henry Wagner, Johns Hopkins. I would like to ask the panel what role nuclear energy has in desalination. Fresh water availability is a major, major problem for the future. And sometimes I dream of seeing a nuclear submarine temporarily parked outside the island of Kauai(?) in Hawaii, making enough fresh water for next year and then moving on to another place and producing more fresh water. Could somebody comment on the role of nuclear energy in desalination?

CARD: Since you mentioned submarines, Alain or Skip, do you want to comment on that?

BOWMAN: I see a golden opportunity to use nuclear power in desalinization. I see less opportunity for using a nuclear submarine to do that. First of all, just very quickly, we need all the nuclear submarines that we can get and then some to do the Nation's business with what's going on in the world today. It's not that outlandish a proposition, by the way. I've been approached several times in the seven years I've been in this job to back a submarine into the piers in New Hampshire and perhaps feed the energy grid there.

The truth of the matter is, if you look at the size of our reactors and you look at the devotion of the majority of that energy to propulsion power and not to electrical generating power, you will see that it is a non-starter from the standpoint of contributing measurably to any of our deficits. But nuclear energy as a means of desalinization, you're right, we do that onboard our nuclear-powered aircraft carriers and submarines today and it certainly, with the advent of new systems, such as reverse osmosis systems for desalinization, I think it is another thing we should be thinking about.

We talk mostly about cracking water for hydrogen today as out-of-the-box ways to use nuclear power. But I think desalinization is certainly another one.

CARD: Alain.

BUGAT: Yes, I can add some more on the subject. We are studying 300- megawatt electric co-generation nuclear plant for electricity and desalination and it works. The Indian people are studying too. But roughly speaking, with the 300- megawatts you can use 250 for electricity and use 50 megawatts for desalination and with that 50 megawatts you can produce 200 thousand

cubic meters by day. So that means that that kind of is able to furnish electricity and water for one million people, an area of one million people.

So it cannot be-- We are not plenty of that kind of population who need the water. That is tropical countries with networks and are able to transfer the electricity. And more of that, what is important, the cost of the kilowatt that is produced is two times the cost of one thousand megawatt plant, which means, how do you build the investment? How do you build the capital for the investment? It was a question on which every company is locked(?) now.

CARD: There is another example that comes to mind that is being mused about. I don't know if anything will happen, but Canada, and its oil sands in Alberta is looking to consume two billion cubic feet a day of natural gas to turn oil sands into oil and produce one to 200 million metric tons a year of CO2. So people wonder, would that be a good application. We will see what happens there. Is there a question? Yes.

DOWNEY: Good morning. Lieutenant Colonel Jim Downey. I'm currently a fellow at Harvard University. And I want to ask just a little off question. We've spoken about nuclear power and land and also the sea. I'm interested in the medium of space. NASA has a new program to develop a nuclear reactor based propulsion system for deep space. And what surprises me is so far, it has not received a lot of attention in perhaps the environmental concern arena, although it may in a couple of years.

But I wonder is how any of you might feel about that program and does it inform, help or hinder development of nuclear energy in general.

CARD: Well, Naval Reactors has actually been assigned that mission. So, Skip, do you want to take a first shot at it?

BOWMAN: Yes, Secretary Carter, the truth is we haven't been officially assigned it, but we anticipate that to happen.

CARD: So, no breaking news.

BOWMAN: No breaking news. I'm still developing some understandings.

I believe space nuclear propulsion will forward the cause of nuclear energy. I suggest that your opening salvo may come true sooner than we want, that the environmentalists will notice and we will begin having to answer some questions about it. The first idea that NASA is working on is an unmanned orbiter for the icy moons of Jupiter and the JIMO project. It's funded. It has received funding for the past two years in NASA and, indeed, the possibility that Naval Reactors will be delivered another national mandate similar to the two that I discussed earlier, that Admiral Rickover received is very real and we're looking at that even as we speak.

But I think it would be a positive advancement if, obviously, the kinds of reactors that you know we use on our aircraft carriers and submarines are not exactly amenable to space travel, so we would have to branch out and think about other ways to do that and that would involve

organizations across the country that have been working in other types of technologies over these years.

CARD: --Space nuclear. Bill, did you want to add anything to that?

MAGWOOD: Sure, I'll just add that I think that whenever you are able to use nuclear technology to take on an activity such as exploring space that the public gets excited about, I think it's something that has potential benefit all over for nuclear power. I often, in talking to school children about nuclear technology, point out the wonderful pictures we've gotten from the planets, from Jupiter, from Uranus and others-- And to be able to point to that and say, "We wouldn't be able to do that without nuclear technology," I think is a real advantage.

And the fact is that as we've worked with NASA over the years about what their future visions are for space exploration, it became extremely clear to them-- We had to sort of drag them into it but it became very clear to them that they couldn't accomplish their mission without nuclear technology. And someone mentioned earlier there needs to be an education process and that is part of the education process because there are things you can do with nuclear you can't do with other things, not just in space exploration power but also in medical treatment and other things and I getting that story out has to be very important.

CARD: We'll begin drifting back this way. Anything else from here? Yes, sir,

BRODSKY: Alan Brodsky again, ...(inaudible)RC and Georgetown University. But I'm speaking for myself. Not even my wife approves very much of what I say. (Laughter) I congratulate the nuclear energy industry and the great safety record and I wonder why they don't-- My question is, why don't they spend more advertising funds to educate the public properly. I've made my own miniscule efforts through professional society and have had very little success.

The President, as opposed to the conditions under which President Eisenhower was able to promote nuclear energy, has to face the possibility that he won't be re-elected because so much of the misinformation that some of the people I know have spread through the media to the public. I have some ideas about the proper kinds of information to be given by the public but have not been able to reach anybody in a leadership position who can present this information.

My question is to Mr. Hintz, why doesn't your Entergy spend more money on advertising the things that have been presented at this meeting?

CARD(?): Yeah, all that money you're making. (Laughter)

HINTZ: Angie(?) Howard is here from NEI and she continually begs for more money to do more advertising. I can't agree with you more that we have a tremendous education undertaking ahead of us and at times we have the discussion whether or not advertising is the best way to do it. It's very expensive but maybe we should do more of it and maybe it is an effective way to get out story out.

You know, I personally think at times we spend too much time educating the people that believe in our product and we're speaking to the choir. So I think we have to look at that more, other ways to educate the public including using more advertising. But, it is costly and when it's been recommended by NEI that the industry spend more money on it, we got sort of mixed support on how much we want to spend on the advertising.

CARD: Okay. I have one back here and then you and-- (simultaneous conversations) Let's take this question and we will come back--

__: Great. So, I'm a physics professor at Michigan and like Bart Richter, I work at high energy accelerators. We're not producers of electricity; we're customers. But I'm going to talk about nuclear engineering. President Eisenhower's 1953 "Atoms for Peace" speech, certainly helped to make nuclear engineering a very exciting field. Therefore it attracted some of the best and brightest young students. As I say, I sure am not a nuclear engineer but for a complex reason, I came to know and admire some of the ex-students about 20 years later in 1973, when there was some problem.

Some of them were ex-nuclear Navy guys, some of the really good ones. However, most of these guys are no longer bright young guys. If some new international crisis comes up, we may have a real shortage of capable people to build all the nuclear reactors that are going to be rapidly needed. And my general feeling was that the guys from the nuclear Navy were the very best.

Is there any plan for DOE or the nuclear power industry to start rapidly providing some scholarships in nuclear engineering for freshman engineers, some fellowships for graduate students in nuclear engineering and some post-doctoral fellowships to keep these young guys occupied so that you can start attracting people? I started talking to some of the kids in my physics class into going into nuclear engineering and I work at it and I got a few. But it's hard when there is not clearly any jobs downstream.

CARD: Burt, is your Nobel Prize inheritable?

BURT: Do you want to borrow it?

CARD: If we could pass that down, Bill, go ahead.

MAGWOOD: We're currently funding about 150 scholarships and fellowships for nuclear engineering students every year. That's not enough. I mean I would like to do twice as many but it's a start and it's a basis to build on. The point you make is absolutely correct. There is a real threat in the United States particularly, that the infrastructure that was built after Atoms for Peace-- It is not just the people. It is the research reactors. It's the program. They're all aging to the point where many schools are abandoning their programs.

We're making a bigger investment. When I first took over the Office of Nuclear Energy, we were spending about $3 million dollars a year on nuclear engineering. We're now spending about $20. So we've increased it. I would like to do more. I will do more. But the fact of the matter is there is a limit to how much the government can do unless Don here gets his industry,

galvanizes it to build more plants because when we talk to students about the future prospects for nuclear, it's very clear that the people we're seeing are the people really excited by the science and technology.

But when they're thinking about their future careers, they like to know that there really are going to be new nuclear power plants being built in the United States. So I think there is always going to be a limit to what will be successful in accomplishing until there is really a revival of nuclear power in the United States.

CARD: And a follow-up question up here. Can we get the mic up here? I notice in Nobel land we have Mr. Letterman(?) here today also.

IRVINE: I'm Reed Irvine the founder of Accuracy in the Media and I want to say that like Alan Brodsky, I was rather amazed to come and have a panel like this where it has indicated that economic reasons were the reasons that we have not built nuclear plants in this country. And, of course, the ...(inaudible) experience, shows that it is fear that has stopped the building of nuclear plants, the misapprehensions that the public has.

And I give you an illustration of ...(inaudible) well they could advertise. But it isn't necessarily a matter of advertising. It's a matter of getting you message out and there are many ways that that can be done. I'll give you an illustration. A couple of years ago The New York Times ran an article in which they said that thousands of people had died as a result of the Chernobyl accident. How many of people here, I wonder believe that thousands of people died at Chernobyl?

__: Not at Chernobyl but as a result.

IRVINE: As a result? Well, so it happened that ten years after the accident, there was a conference in Vienna where all the people that had studied the impact of Chernobyl on health met and it may surprise you to know that they agreed at that conference in Vienna that the number of people who died as a result of that accident was less than 50. You may find that incredible but I invite you to go look at the record, the report of that conference, which you can find on the Internet.

__: ...(inaudible)

IRVINE: Yes, except they pointed out that there were a lot of lives lost as a result of the abortions because the mothers feared that the babies would be malformed or something like that. So, what you should do, Mr. Blitz is when you see something like that in The New York Times, you might have done what Accuracy in Media did and that is write them a letter and tell them they were wrong and lean on them to persuade them that they are on the wrong track in terrifying people. I'm sure that the people who were resisting putting that $7 billion dollar plant at Shoreham(?) into operation, were not concerned about economics. They were not even concerned about their taxes or electrical bills. They were concerned about the danger that they perceived even though the industry has an outstanding record for safety.

CARD: We're just fortunate we don't have anything like Chernobyl here. So, rather than get into that issue, I want to go all the way over and then we will come back and sweep around this way. All the way in the back over there--

CONNOR: Hi, my name if Mike Connor and I'm the President of Nuclear Resources International. But along with Don Hintz, I think I'm one of the few utility people that's here at the conference. I manage the nuclear fuel for the Robert Emmett Gina power plant outside Rochester, New York. And I just thought after listening to these papers that you might enjoy a small success story. Ginna is 500-megawatt Westinghouse PWR.

It started up in 1969. So we just voted region 33. We did it in 33 days and replaced the reactor head. The plant runs on an 18-month cycle and in the 12 months when it is running continuously, it has 101% capacity factor. So it is possible, even with old plants, small plants, goodies to keep your heads up high in the nuclear industry and to look forward to more days.

I wanted to call your attention on page four of the program, the first bullet says, Three Mile Island and Chernobyl cast a very dark cloud over the nuclear industry. Now that we have greater historical perspective, how should we view these incidents? What have we learned from these events? It was just published two days ago that the other Three Mile Island Plant just hit a record of 680 days continuous operation before it shut down for its refueling outage. So, that's some perspective on Three Mile Island.

CARD: Any panelist want to comment on any of that? Skip?

BOWMAN: One other-- In the same vein as to the Accuracy in the Media report that we heard. Three Mile Island, of course, I said in my discussion, was a non-event from a radiation standpoint and I truly believe that. The number of the public that received the most radiation from that event was back calculated to have received 37 millirem, which we, in this audience know is not very much, about a little over a tenth of what she would have received in her home anyway, for that year.

Thirty-seven millirem is a little over a third of the allowable non-occupational exposure. The Three Mile Island worker who received the most radiation exposure did not exceed the occupational limits. So I couldn't agree more with the perspective that more needs to be done in educating the public. I would suggest that along with advertising, we need to, as a group, go ahead and go for the throat and speak to the concerned scientists who are legitimately concerned, but need some information ? need some education about some of the things that we know that they don't know. Indeed we do preach too much to the choir.

We need to go, maybe to the concerned scientists and sit and walk through some of these facts and figures and we've been in operation long enough now that it might be time that we stop trying to prove the negative and put the onus of responsibility on the other side, bring forward the proof of the bad effects of this rather than challenging me to show that there is no bad effect, that we've been through two and a half generations of Navy nuclear power and there's nothing there; there are no bad effects to show.

So I think that there is a great deal that can be done in the way of public education outside of full page ads in The New York Times or things that would be, I think, hooted at by the people who hoot today. I think we should go to them and talk softly.

HINTZ: I think there is one other threat that we haven't mentioned, a threat to the commercial nuclear industry. We talk about threats on public opinion and maybe not having the public educated and we talk about the economics of the new nuclear plant. But I think there is another big threat that industry is dealing with as we speak and that is the consequences of 9/11 and the impact on security on these nuclear plants. I mean we were the most secure major infrastructure in the United States prior to 9/11.

But as a result of 9/11, we are an industry that has been put in the spotlight and we spent a lot of money on security already and it's not over yet. I mean we just have to keep dealing with the bigger bomb and we get that done and we start on something else. And, you know, the industry, we're advocating that at some point in time, we would like to get thrown in with all the other critical infrastructure in this country. And if we were and you compared the threat associated with a nuclear plant compared to chemical plants or any other critical infrastructure, we look, actually, pretty good.

And yet we're spending lots of money and it's not over yet. And, you know, I think we've got to start putting our nuclear plants and the threat from terrorism in perspective with all the other critical infrastructure in this country. And if we can't, we will see that we are going to start seeing some of the small nuclear plants get shut down because of the cost associated with it.

CARD: We're technically needing to go to lunch, but a sensed a real desire to respond to the Chernobyl comment so we're going to do that and they we're going to wrap it up.

GARWIN: I'm Dick Garwin again. In January of this year I published with George Charpak a book, Megawatts and Megatons: The Future of Nuclear Power and Nuclear Weapons and we did look at all of the accidents including the 1986 accident and the ten years afterward. And our judgment is that (a) a couple of people probably, unidentifiable, died from Three Mile Island. It's a very safe plant. We advocate the wide expansion of nuclear power.

But 24 thousand people, we anticipate, have died, will die from Chernobyl. It is just a tiny fraction of the population. It does not influence the positive views on the expansion of the nuclear industry but we provide the quotes from Abo(?) Gonzales, from the IAEA who never did the multiplication but says the 600 thousand seabirds, 60 million person rem, would correspond to that number of deaths and that's the cost of doing business. You kill many more people from air pollution from coal-fired plants.

But I agree with the Admiral that the way to go forward is to educate people not to propagandize and make the value judgment that with this technology, we can have great benefits for mankind. The key is, though, to get the capital cost down. We cannot build old plants and have them competitive. We need to bring in the new plants at those numbers.

CARD: Thank you. With regrets to the at least dozen people who are still waiting for a dialogue on this-- I'm thrilled with the interaction.

END OF SESSION 2