ORIGINAL

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Title: BRIEFING BY DOE ON INTERNATIONAL NUCLEAR SAFETY PROGRAM - PUBLIC MEETING

Location: Rockville, Maryland

Date: Thursday, November 21, 1996

Pages: 1 - 82

ANN RILEY & ASSOCIATES, LTD.
1250 I St., N.W., Suite 300
Washington, D.C. 20005
(202) 842-0034

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING BY DOE ON INTERNATIONAL

NUCLEAR SAFETY PROGRAM

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PUBLIC MEETING

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Nuclear Regulatory Commission
Commission Hearing Room
11555 Rockville Pike
Rockville, Maryland

Thursday, November 21, 1996

The Commission met in open session, pursuant to notice, at 1:35 p.m., the Honorable SHIRLEY A. JACKSON, Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission
KENNETH C. ROGERS, Member of the Commission
GRETA J. DICUS, Member of the Commission
NILS J. DIAZ, Member of the Commission
EDWARD McGAFFIGAN, JR., Member of the Commission

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

KAREN D. CYR, General Counsel

ANDREW BATES, Acting Secretary

KRISTEN SUOKKO, Office of Nuclear Energy, Science and Technology

DAN GIESSING, Office of Nuclear Energy, Science and Technology

RICH REISTER, Office of Nuclear Energy, Science and Technology

LAURIN DODD, Pacific Northwest National Laboratory

P R O C E E D I N G S

[1:35 p.m.]

CHAIRMAN JACKSON: Good afternoon, ladies and gentlemen.

On behalf of the Nuclear Regulatory Commission, I am pleased to welcome representatives from the Department of Energy to the NRC.

The purpose of this briefing is to discuss the Department of Energy's international nuclear safety program and, in particular, its associated international nuclear safety centers.

As you know, our agencies share many common interests, both domestically and internationally. Under the Lisbon Initiative, several federal agencies share responsibility for the U.S. Nuclear Safety Assistance Program.

While the Department of State provides overall policy guidance, DOE is responsible for implementing projects involving training, operational safety and safety-related equipment. The NRC is responsible for assisting the recipient countries' nuclear regulatory organizations.

Through the Gore/Chernomyrdin Commission process, both DOE and NRC have worked together to enhance nuclear safety and security issues in Russia. Today, the Commission would like to earn in more detail about the DOE

International Nuclear Safety Program, particularly in regard to the operational safety and near-term risk reduction efforts. In addition, we are interested in learning more about the funding of the program, attempts at integrating regulatory strengthening, status of projects and projected scope of future activities.

While we are disappointed that Mr. Lash, the Director of the Office of Nuclear Energy, Science and Technology who has overall responsibility for administering this program is not present, we warmly welcome Ms. Kristen Suokko and her colleagues from the Department who are here.

So, Ms. Suokko, would you begin?

MS. SUOKKO: Thank you very much, Chairman Jackson and thank you very much to the Commission for inviting us here today to talk a little bit about the Department of Energy's role in the U.S. government effort to -- and the international effort -- to improve nuclear safety on the international scene.

Let me begin by introducing our team. My name is Kristin Suokko and I am the Associate Director for International Nuclear Safety at the Department of Energy. For the last eight months, I have also served as Secretary of Energy O'Leary's special advisor on countries of the former Soviet Union which has taken me into matters a little bit beyond just the international nuclear safety program.

The team that we have brought with us today, I would say, is really the backbone of the DOE efforts in the international nuclear safety area. To my right is Mr. Dan Giessing, who is the Deputy Associate Director for International Nuclear Safety; Rich Reister who is one of our key program managers and technical experts on the international program; and, Laurin Dodd, who is with the Pacific Northwest National Laboratory, which is our key technical and administrative support organization for the program.

Let me begin by talking about, in very general terms, the three key areas that our program is involved in, in international nuclear safety. I would also like to, at the same time, describe to you what the basis in policy, in U.S. government policy is for each of these activities.

The first area, as we have mentioned, is the effort to improve the safety of Soviet-designed reactors in the countries of the former Soviet Union. Following the Chornobyl accident in Ukraine in 1986, the international community began devoting resources and expertise to the effort to try to prevent such another disaster.

The first -- the first real commitment of funds, major commitments of funds and major international commitment was made in 1992, in part under the leadership of the United States that made a major commitment at Lisbon in the early part of 1992, which gave the early program its original name which is the Lisbon Initiative.

That gave rise to an agreement at the G7 Munich summit that same year to embark on a major international G7 effort to help these countries improve their safety.

In the nuclear security area, the Department and our office in particular is involved in assisting Russia to fulfill the terms of the 1994 agreement signed by the vice president and the prime minister of Russia to cease the production of weapons-grade plutonium, shut down their three remaining operating plutonium production reactors and cease the use of newly produced plutonium in weapons.

That effort has evolved and the approach that has been adopted by the U.S. government is to work with Russia to convert the cores or the fuel in these reactors such that they no longer produce weapons-grade plutonium but can continue to provide heat and electricity.

The third major area that we are involved in is the efforts related to the Chornobyl nuclear power plant and the unsafe sarcophagus over the damaged Unit 4. And those efforts are in support of and consistent with the December 1995 agreement between the G7 and the government of Ukraine to shut the Chornobyl nuclear power plant by the year 2000 and I will get into a little bit more detail on that later in the presentation.

Let me talk in a little bit more detail about what the policies are that really govern the efforts that we have underway. I should begin by noting that the U.S. government has really taken a comprehensive approach to the problem of nuclear safety in the former Soviet Union. What I mean by that is the U.S. government has efforts underway to address the overall economic situation in these countries which, ultimately, I think we would all agree, is going to be key to addressing the safety problems, the need to have macroeconomic reforms, stabilization, sufficient revenues to invest in safety and make decisions about how the energy sector is constructed.

Secondly, the U.S. government has placed, as you know, a major emphasis on the need for strong, independent regulatory bodies in these countries and the supporting laws and legislation to give them the power that they need. That is, of course, the effort that the Nuclear Regulatory Commission has so successfully been involved in. And then, thirdly, there is the effort to reduce the risks at the actual operating plants and that is the role that the Department of Energy has primarily fulfilled.

Now, the U.S. policy has been and remains to see the shutdown of the riskiest plants and to undertake short-term measures that do not extend the life of these reactors. What has changed is our understanding of how long that is actually going to take and let me -- let me try to explain a little bit.

I think that one of the things that we have learned in the conduct of this program since really the late '80s and particularly since 1992 has been that ultimately strong indigenous safety culture in the countries operating these reactors is going to be what ultimately leads to permanent changes in nuclear safety, the safe operation of these plants. There is simply not enough money existing in the West to either solve all the safety problems or to replace all of the reactors and, ultimately, it is going to be the host countries' themselves that are going to have to make those decisions.

We also, another tenet really of the way we conduct this program, is that much of the responsibility for safety lies with the operator of these power plants.

Based on those understandings and the understanding we have gained since conducting this program, we have built a program that really addresses two of the major areas of safety that you need to address. First of all, the safety-related hardware and systems and that involves the provision both of equipment and of technology where it is appropriate to allow the countries to, over the long term, sustain their ability to improve safety and safety systems. Secondly is the operational or the human performance component of safety.

Now, let me go into a little bit of how the program is actually structured.

Beginning across the top line, the program is conducted in close cooperation and coordination and guidance from the Department of State and the Agency for International Development. There is also a great deal of cooperation with the Nuclear Regulatory Commission. Some examples of that cooperation include joint workshops jointly conducted by the two agencies, reciprocal visits by program participants to facilities, either belonging to the NRC or to DOE, and technical support where appropriate by the department, for example in augmenting the efforts of the NRC to transfer codes, for example, to these countries.

Moving to the next line, you will see the list of countries that are involved in the program. I would note here that all of the projects and all of the program elements are jointly developed with their counterparts in the host countries and we conduct joint reviews, we provide them with translations of much of the material that we produce, tracking the progress of the program and so on, so all of that is done jointly.

We also coordinate closely with the international financial institutions and the other G7 countries, particularly in an effort to not duplicate, of course, but also to leverage resources and leverage programs and there are several good examples of how we have been able to do that that my colleagues will talk about.

Now, the mission of this program is really accomplished largely through a pilot plant approach where a pilot plant or plants are chosen to receive the training or the technology transfer or the equipment and we try to develop models that then can then be used by the countries to address similar problems at their other facilities.

Our national laboratories, as I mentioned, Pacific Northwest National Laboratory, is our lead technical and administrative laboratory. Other national laboratories are also involved in the program including the Argonne National Laboratory, Brookhaven National Laboratory and others.

More than 75 percent of the resources in the program actually go to either the host country or to the U.S. private sector. We try, as much as possible, to have work done in the host countries. But where that is not possible, where U.S. expertise, U.S. equipment is required, we go to the U.S. private sector and, for the most part, bid competitively for the services or the equipment. There are a couple of exceptions to that but, for the most part, it is through a competitive bidding process. We do work with the regulatory bodies in the host countries in two major ways, I would say. The first major way is in trying to get --

trying to ensure that the regulator is on board and aware of the program activities as early as possible.

We try to ensure as well that they have the capability that the regulator has the ability to evaluate the programs and the safety improvements to the best extent possible and we do that through cooperation with the Nuclear Regulatory Commission primarily and, in some cases, by providing resources through the program.

We also have with the Russian regulator and proposed with the Ukrainian regulator cooperation to deal with facilities that are traditionally in the DOE purview, self-regulated by the Department of Energy not by the Nuclear Regulatory Commission, such as research reactors and some of the fuel cycle facilities. But the agreement is strictly limited to cooperation in those areas.

Moving on to the next slide, let me talk a little bit about how we select the projects that we undertake in the program. First of all, I might note that we have well over 100 projects, individual projects underway in this program. Most if not all of those projects address safety problems that are either highest or next to highest on the IAEA's list of problems with Soviet-designed reactors.

We become aware of potential projects through a variety of ways, either through our counterparts in the host countries, through experts, expert groups, you know, a variety of different ways. The projects first go through a screening process to look at three particular aspects.

First of all, the extent to which they actually improve nuclear safety at the plants. And here I need to note that this also includes, this first criteria includes an effort to figure out if they will or will not extend the life of the plant and if we find that there is a life extension aspect to the project, it does not become part of our program.

Secondly, we --

CHAIRMAN JACKSON: Does that then imply that you don't do any physical or material condition upgrades at these facilities?

MS. SUOKKO: No, it does not imply that. But what we don't -- what we particularly do not address -- we particularly make sure that we address safety systems and not aspects of the nuclear power plant that are outside of the safety systems or are life limiting components of the nuclear power plant. So we do do physical upgrades but they are only related to safety systems.

In the second criteria, we look at the extent to which a project will prevent or contain damage and what that means is preventing an accident at a nuclear power plant or containing the damage within the power plant. In other words, we do not look at projects that involve mitigation, evacuation plans, cleanup and so on. We focus on preventing the damage before it starts.

Then, finally, applying established technology. What that means is we do not look at projects that are exclusively research and development. The projects have to have real time, you know, on-the-ground applications.

CHAIRMAN JACKSON: Let me ask you this question: Do you have in place mechanisms or metrics to really gauge the overall effect in terms of reduction of risk that has been realized through the improvements or the upgrades?

MS. SUOKKO: We have some. We are working on more and I will actually get to that in just a moment and perhaps we could get into it -- Dan, maybe you could get into it a little bit more during your time.

If that's okay?

CHAIRMAN JACKSON: That's fine.

MS. SUOKKO: Now, the projects that sort of pass the first test are then evaluated according to their actual impact on safety and they are evaluated against, to the extent possible, existing safety reviews, expert opinions and so on.

Secondly, they are evaluated for their comparative value. The comparative value of the investment compared to other things that might be done and, particularly, the extent to which we can leverage resources with programs that other countries have underway, other agencies have underway, joint ventures, those types of things.

The last two elements here, sustainability and host country commitment, really go hand in hand because it is really ultimately the commitment of the host country to undertake these efforts and continue them when we are gone that is ultimately going to ensure the safety value. So we look at the host country commitment, we also look at the existing indigenous capabilities and when they are lacking, we look at the possibility of technology transfer to improve those capabilities.

You asked about the funding structure and I will address that briefly here.

Through FY '96, $195.5 million has been allocated for the program. Now, the funding structure is somewhat complex.

Up until FY '96, the money came through the Agency for International Development to the Department of Energy. In FY '96, the Department of Energy got its first direct appropriation through the Energy and Water Development Appropriations Bill for the effort to improve safety of Soviet-designed reactors. The Department of Energy still receives some funds from the Agency for International Development, primarily for the efforts in Ukraine as well as Armenia.

The Cooperative Threat Reduction, or Nunn/Lugar program, which is a Department of Defense program, also provides funds for the core conversion effort, the effort to convert the plutonium production reactors, so there are really three elements to the funding situation.

CHAIRMAN JACKSON: So of the $195.5 million, how does it break down among these three funding sources that you talk about?

MR. GIESSING: The 195 is for the Soviet-designed reactor safety activity itself. This does not include the funding for the core conversion or for the sarcophagus work which is funding which we are just now receiving.

CHAIRMAN JACKSON: No, no, no, I am talking about of the amount that you said has been allocated, how does it break down among the three funding sources?

MR. DODD: 30 million in fiscal year '96 for Department of Energy. The rest of it has been U.S. AID.

MS. SUOKKO: In fiscal year '96, the Department of Energy was appropriated $30 million.

Does that answer your question?

COMMISSIONER McGAFFIGAN: You said the money has been allocated. How much has been specifically obligated for specific projects and how much is carryover that is sort of lying around?

MS. SUOKKO: None of it is lying around.

MR. GIESSING: We have obligated 185 million of that and there would be basically 10 million, and of that 15.4 was just received late in the year so there hasn't been much time on that.

So we had, earlier in the year, a larger delta between nonobligated funds and now. But, during this year, we have basically been able to put contracts in place for all the money that we have received.

CHAIRMAN JACKSON: Actually, there is a follow-on question, though, which is how much of it has actually been spent, because obligated funds depends on --

MR. GIESSING: Right, there has been -- I think 115 million has been spent from this and the difference between spent and obligated is basically the time that it takes to do a project.

MS. SUOKKO: In some cases, that's a fairly protracted amount of time.

Does that answer your question?

CHAIRMAN JACKSON: Thank you.

MS. SUOKKO: Let me talk just a little bit about both our evaluation process and particularly our exit strategy.

COMMISSIONER McGAFFIGAN: Could I ask one question?

MS. SUOKKO: Sure.

COMMISSIONER McGAFFIGAN: Before we get off this, the GAO says you have plans for $500 million 10-year further expenditures. Is that on the mark? Is that what you envision your program being, a decade-long, $50 million a year program, as you look to the out years?

MS. SUOKKO: I think we are looking at the early part, definitely the early part of the next century for the end point of the program. Whether it is exactly 10 years may be a little difficult to say but that actually brings me to the next discussion which is that we have recognized in the course of this program the dire need for an evaluation process, a structured evaluation process, and we are well on the way to having that in place.

We have many criteria which we evaluate the program by already but we are putting that into a structure that we can -- you know, that we can use consistently. One of the key elements of developing such a structured process is identifying the end points of each of the activities that you are involved in and that is something that we are considering very carefully right now, what those end points are.

And I think to go back to your question, Commissioner, the -- I think the process of evaluating that will determine, you know, determining those end points will determine where we will be when in terms of phasing out of this program.

Let me just give you a couple of examples of the kind of end points we are considering and, as I say, this is in process and it is going to, you know, require a lot of discussion. But some of the types of end points we are considering are, for example, that training criteria are developed in all host countries, evaluated, endorsed by the regulator and that all of the operators of nuclear power plants in a host country have at least been introduced to the concept of systematic approach to training. That would be an example of the type of criteria that you could use to say that you've done what you can and it's now up to the host country.

Another example might be that safety analyses that are currently under way at a couple of pilot plants would be completed according to international norms, would be accepted by the regulator and would be incorporated into the licensing process. That would be another sort of example of an end point.

Of course, on the plutonium production reactor effort, obviously actual conversion of the cores according to safety norms is an obvious sort of end point and, likewise, Chornobyl, the shutdown of the two remaining operating reactors and putting the sarcophagus in a safe condition would be an example of an end point.

So, as I say, we are working very hard ensuring that we have a structured and transparent evaluation process and we have clear end points for the program.

COMMISSIONER McGAFFIGAN: Could I ask a question? I'm new to this.

Why the focus -- I understand the focus on Chornobyl is a political matter, the two graphite reactors that are there, but there are lots of other reactors of the RBMK type and the VVER-230 type all over the former Soviet Union, Eastern Europe. Why the focus on getting those two closed and not the others?

MS. SUOKKO: Well, they are the oldest, first of all, they are the oldest two reactors of that type. So that is one of the reasons. And, you know, I think the other reason is, you know, we have specific concerns about that particular site obviously and the -- you know, the overall effort involves, you know, more than just those two reactors, it also involves the effort to improve conditions at the sarcophagus and so on.

But I think the symbolic nature of this is quite significant, seeing the oldest of the type of the reactor that we have looked at actually shut down.

MR. GIESSING: I think it would indicate, too, that there is a recognition that there is going -- that these plants are going to operate for a while and so, in that time period, we are doing things to help improve their operation during their remaining lifetime. But the policy still is to move the RBMKs and the 230s to shut them down and we do have numbers of programs with each of those that are ongoing.

COMMISSIONER McGAFFIGAN: But aside from the age issue, there is no rational -- we haven't gone in, the Western community hasn't gone in and looked at the set of, what is it, 60-odd reactors and said, these are the two most dangerous and therefore -- or have we? Has the IAEA done that or someone done rational analysis of which are the most dangerous?

MR. REISTER: No, there has been no formal assessment like that to evaluate each reactor and rank them according to their level of safety but the first operating unit number one that is still operating is certainly one of the oldest and has some of the most significant safety deficiencies, even among the RBMK reactors. The other operating unit, unit three, is right next to unit four and there is a lot of concern about a problem like a collapse in the sarcophagus could then affect unit three so I think those are two, I think, compelling reasons to shut down the operating reactors at Chornobyl above the other RBMK reactors.

MS. SUOKKO: Good point.

MR. DODD: Well, I would add to that Chornobyl is a unique reactor plant in Ukraine, it is the only RBMK plant in Ukraine. So they have less infrastructure to support the operation of the plant and until a year ago there was no international assistance to improve the safety of those operating reactors, unlike I think every other plant in the former Soviet Union. And I think that it's a subjective decision that could be made that in fact that risks at that plant are higher than probably any other operating plant.

CHAIRMAN JACKSON: Why don't you go on.

COMMISSIONER ROGERS: If I could just ask one question?

MS. SUOKKO: Sure.

COMMISSIONER ROGERS: I am a little puzzled about the lack of any international participation in, at least as you have described the program so far, with respect to the screening criteria and with respect to the end point criteria because it seems to me they are related to each other and everybody doesn't quite agree on, you know, what is the most important and worst aspect of each of these plants. There is some disagreement.

It sounds to me as if we are, you know, trying to do this all on our own and both with respect to screening and determination of the end point and while it's clear that we have to demonstrate that we are watching very carefully how that money is spent, from an accountability-to-Congress point of view, I wonder if we -- and maybe there is more international participation in this than I have heard.

But if, in some way, it really is a tremendous burden on our resources to try to bring these programs to some kind of closure and we really do seek the participation of -- financial participation as well as technical participation of other countries' expertise, I wonder what role we are giving them to play in this so that they are willing to come up with resources to help close out these programs?

MR. GIESSING: There are a number of donor countries very active, involved in this overall activity. In fact, the U.S. effort probably amounts to about 15 percent, maybe 20 but I'd say about 15 percent of the overall assistance effort that is being provided. The European Union through the TACIS program is providing a significant amount of funds. The European Bank Reconstruction Develop is, there are a number of bilateral programs that are underway. And so there are a number of mechanisms for coordination with these countries, both formal and probably more effectively through an informal means to make sure that where we have strengths, that's where we're trying to apply more of the effort and where there is overlaps we talk about it.

One of the examples I will give, we jointly conduct projects so, as I say, we are a player, a significant player, but there are a tremendous amount of other people involved in this.

MS. SUOKKO: Yes, I don't know if that directly answered --

COMMISSIONER ROGERS: I was getting at how it really works, you know. But go ahead. I don't want to belabor it. I think if we set up the screening criteria for what we are going to do and the end point criteria for when we are going to get out, how does that relate to any other participation of other countries in those same projects? How do they tie together. I am just curious as to how that works but I don't want to delay your whole presentation.

MS. SUOKKO: Well, I think your point is a very good --

COMMISSIONER ROGERS: If somewhere along the way, before we part, you could say something to that, I would like to hear more about it.

MS. SUOKKO: Right. I think your point is a very good one and, certainly, in developing the programs and the program criteria, that is certainly a product of our collaboration with our international colleagues through all of the mechanisms that Dan described and I think, likewise, the effort to see these programs to their logical conclusion should also be equally collaborative. So I think your point is a very good one and we can either address that later here or separately.

What we thought we would do is move to some of the specific project elements and some of the specific things we are doing in each of the areas. So each of our team members will address the areas that they are responsible for.

MR. GIESSING: Let me cover areas of training, simulators and emergency procedures and safety analysis areas.

In the area of training, we are basically transferring technology to the host countries based on the systematic approach to training that is used in the United States. These are based on the INPO documents that have been developed since Three Mile Island. We use a pilot plant approach in this case where we don't do the work, we show them how to do these programs and how to develop the training for the various 12.

If you break down the operations at a plant in maintenance, turbine operators, reactor operators, refueling operators, what we do in each of those cases is develop a duty for each one of those, show them how to do it with one of our contractors and then turn over to them the development of the training programs for each of the rest of those projects. We hold their hand, if you will, as the rest of the training program is being developed.

CHAIRMAN JACKSON: Is there specific coordination, since you are using INPO documents, do you coordinate these activities with or through INPO or WANO, which is the World Association of Nuclear Operators? Do you have a specific program with them?

MR. GIESSING: Not in the training area; we do in the emergency operating procedures that I am coming to. But this one, there are contractors who are very skilled in doing this and so we have used those contractors to assist us in this effort and that is the way this one has been done.

CHAIRMAN JACKSON: So you have not made any specific approach to INPO or INPO making any specific approach to you in that area?

MR. GIESSING: Not in this area, not in training.

Actually, when we did the earlier project on emergency operating procedures in Novovoronezh, where we were developing the emergency operating procedures, developing the training program with it, that was done with INPO and we used the same approach where INPO and U.S. Utilities were involved in the project.

When it came to expanding this to all of the other reactor types, we just went ahead and used that model to continue this project. They are very aware of what we are doing. We meet with them often, dealing with the emergency operating procedures area, so we talk about it. But we have not specifically involved INPO in this.

CHAIRMAN JACKSON: I just want to perhaps leave that with you as a suggestion because INPO's strength, in fact, is in the training area and it strikes me that since WANO exists and it has a Moscow center, that provides some opportunity for you to leverage your resources as well as, de facto, having a structure in place that can allow for follow-on efforts since, from the point of view of having an exit strategy, that this is an ongoing organization and it is going to be there.

MR. GIESSING: Correct. In fact, with emergency operating procedure that I am going to come to in a minute, we are already in the process of transferring that over to WANO and Moscow center with help from the Atlanta center and one of the duties besides following up for the EOIs will also be in all the other areas.

The training program actually is coming near to a close. We have completed eight of these 12 courses in Russia. The other four are going to be complete within the next several months. We have worked with two particular training centers in Russia and Ukraine, one at Balakovo and one in Khmelnytskyy in Ukraine and provided equipment along with the material that we have -- along with the development of the training courses.

Balakovo represents, I think, a good example of where they have understood the benefit of what they have been receiving. Their training department had like 10 people in it when we started and now there's over 60 people in the training department which is coming close to what you would see in the U.S. Their salaries were only half of what the operators were and, of course, you want some of your best people as the trainers but they weren't getting that. So those are, I think, the best of the programs right now that are nearing completion.

The other aspect of that is the government organizations within Russia and Ukraine are now taking an active role in transferring this work to the other sites. We developed all the -- basically all the INPO documentation has been converted to the Russian system and the Balakovo people are knowledgeable now are helping transfer this technology to the other sites and we are continuing to assist in order that we can make sure that it gets transferred in the proper manner.

In the area of simulators, we believe this is an important training tool obviously and are working with full scope simulators that are listed here, Kola and Kalinin in Russia, South Ukraine Units 1 and 3 and Khmelnytskyy and Rivne and Zaporizhzhya in Ukraine.

COMMISSIONER ROGERS: What is your view on RBMK simulators?

MR. GIESSING: We have not done any work on RBMK simulators, among other reasons because of the intent to close these reactors down in as near as possible terms and so the investment for those has not been judged as a --

MR. DODD: So what we are doing is an analytical simulator for Chornobyl.

MS. SUOKKO: Right.

MR. GIESSING: Except for Chornobyl, right. We are providing an analytical simulator for Chornobyl to help there, but there also is a Chornobyl center that we are trying to start there and so once that is -- the Chornobyl units are shut down that can then be transferred over to the center for infrastructure building there.

COMMISSIONER McGAFFIGAN: You have done work, though, for the simulators for the VVER-440/230s. Why did you make a different judgment, even though there you also want to see those closed down?

MR. GIESSING: Actually, these are for the 1,000s.

COMMISSIONER McGAFFIGAN: But in Slovakia, don't you have simulator work on the 230s?

MR. GIESSING: There has been some upgrade work there but not to the extent that we are doing simulator work in Russia and Ukraine. This has been to help them upgrade their simulators and also help them to develop training programs in those simulators.

COMMISSIONER ROGERS: Do you think that policy really is one that makes a lot of sense everywhere; for instance in Lithuania, where almost all their power comes from those big RBMKs? They're going to run them for some time.

MR. GIESSING: The other factor that, frankly, has been involved besides that is that the funding that we had received through the time that Kristen has mentioned has been country-specific. So that the funding that has been received for the Eastern European countries has been at a level of only like $2 million a year and that's been divided amongst the five countries. So the Western European countries have been more active, also, in those countries than we have and we have put much more of our effort on Russia and Ukraine.

MR. DODD: Let me add, there is -- it may be somewhat antiquated but there is a simulator at the Smoltez plant and historically people from other RBMKs have gone there for training. And Leningrad is just starting the operation of their modern, full-scope simulator which they procured on their own.

COMMISSIONER ROGERS: But my understanding is that the RBMKs differ quite a bit from each other. You know, a generic simulator is quite a bit away from a site-specific --

MR. DODD: There are three generations of RBMKs operating, right.

MR. GIESSING: To go to the next one, development of emergency operating instructions, these are instructions, symptom-based instructions that were developed in the United States and, in this case, we are using INPO to conduct these projects. Also, there are nine U.S. utilities that are involved.

Again, we show them how it is done in the United States. We do not write the procedures for them. Through meetings and workshops and other ways, this is done.

Again, we are using a pilot plant concept so that we can do it at each of the reactor design types and subsequently, once all the base documentation is generated, this then can be transferred to other sites.

There has been one set implemented at Novovoronezh and that is the one that has been worked on for the longest and the technology transfer is largely complete in a sense of the host countries learning how to develop such procedures and we are basically in the process of turning these projects at these sites over to WANO, Moscow center, with help from the center in Atlanta.

We are doing it for the 230s, the 213s, the 1,000s and the RBMKs. I think a pilot of each and then transferring the technology to other sites.

COMMISSIONER ROGERS: What is the coordination between the implementation of emergency operating procedures at any site and the training centers? How are they tied together? Are these going along sort of separately or are they well-coordinated together, which they should be?

MR. GIESSING: They should be and, where they are being done at the same sites, you know, there is a better opportunity for that than others.

We are finding that much of the coordination that we have to do because of their structured way of doing business --

COMMISSIONER ROGERS: This all comes to what really constitutes a safety culture and when they are thinking in this compartmentalized way, that's when they get into trouble. We all do. And I would hope that we would treat the coordination of activities as a part of the development of the safety culture because it is really fundamental to it.

MS. SUOKKO: Yes and, frankly, I think that that is one of the key benefits of any advanced nuclear safety culture or country being involved in these kinds of activities is the ability both to change the way that thinking is done but also to do, as Dan says, a lot of the coordination that they might not otherwise do themselves. You know, I can't tell you the number of times that we have held sessions where people have been brought into the room together that literally have never sat down in the same room and, you know, if we do nothing else, that I think is extremely important.

MR. GIESSING: One of the questions you had asked earlier also dealt with when are we finished. Like in Russia, we are the main country that is providing training support, same in Ukraine with a couple of exceptions. And with the agreement on the host country to transfer this approach to the other sites, when this is done, then we could consider this piece of the program complete and it is something that is not being done by another country.

So in both of those cases, the U.S. approach has been adopted or is being adopted and so we can have a better clue as to when we are done as opposed to if each person is doing it at the site or each person doing something a little bit different.

COMMISSIONER McGAFFIGAN: Could I ask, it looks like in choosing pilots for these different areas, you spread the wealth around. Was there any thought given at the outset of the program to having one area where you would pilot everything so that the integration that Commissioner Rogers just talked about would happen because Novovoronezh shows up in two. There is probably no site where you are trying to do all four of these things and you are sort of piloting it here and another thing there and another thing there and then it is their responsibility to spread it around.

Was any thought given to an integrated approach or was there politics involved in everybody has to get a little piece of the action, I guess I'm asking.

MR. GIESSING: To a large degree, no, this was discussed and they had a very significant say, if you will, in which plants were to be involved as pilots and so we had -- we pushed some of these projects in a more concentrated way but only to a degree. The safety upgrade projects, which Rich is going to mention in a minute, we tried to do all at Novovoronezh but they wanted some of them done at Kola and some of them done at Novovoronezh, partly based on where they felt they were to receive such equipment or assistance as well.

MR. DODD: And I think it is worth mentioning that in two of the four areas that, in fact, all of the plants are involved. In development of the emergency operating instructions and development of the management and operational control procedures that, in fact, representatives from all of the plants are involved, even though they are actually being implemented first at the pilot plants.

CHAIRMAN JACKSON: I think we need to move on.

MS. SUOKKO: Yes.

MR. GIESSING: Let me cover briefly the plant safety evaluation area. There is a code transfer and training that is underway. NRC has actually transferred many codes over to these countries and in a few places where this has not been done or training is needed, DOE has augmented that effort.

This is especially important in building infrastructure in these countries but the focus ultimately is for the preparation of in-depth safety analysis reports. As you probably know, right now, they just require an annual approval to continue to operate and one of the focuses has been to get them to do in-depth, Western style, type safety analyses.

We are participating with Leningrad, Kola, Novovoronezh and Kursk as listed here in a cooperative way. We --

MS. SUOKKO: Could I just interrupt for one moment?

Kursk, largely as a result of the efforts of yours and Secretary O'Leary's I've heard at the last Gore/Chernomyrdin.

CHAIRMAN JACKSON: Yes?

MR. GIESSING: Leningrad is an example, also, where some cooperation is being done. We found the Swedes were involved in probabilistic risk assessment. We wanted to do some deterministic analysis and so we have joined forces there and with the U.K. The Fins are involved in work at Kola and Switzerland involved in work at Novovoronezh, so we have cooperative efforts in these areas.

One of the other aspects that we have included, starting with the Kola project but we are going to extend it elsewhere is to have the Academy of Sciences, the Institute of Nuclear Safety, Bolshov's Institute, to do independent analysis and check calculations, if you will, of the work. And he and Mr. Gutsolov have arrangements as to how that will be a resource for the regulatory body when they move toward having to review these safety --

CHAIRMAN JACKSON: Do they actually have an MOU to cover that?

MR. GIESSING: I have not seen the MOU but we have talked to Mr. Gutsolov in this regard to confirm that the work that is going on by Professor Bolshov is of interest and he has supported it. So I don't know about a formal MOU, though.

Because of the time, I really maybe will just skip this next one other than to say that we are drawing to a close on this dry cask storage project at Zaporizhzhya.

They basically are running out of pool space, they have already waived the full core offload for two of the units there and need this dry cask storage in order to continue to operate these plants.

And Kristin basically covered this regulatory support area earlier. We are focusing on two main efforts. One deals with supporting of our projects that are ultimately going to be reviewed by the regulator. One example is the dry cask storage project where we brought over -- where the Ukrainian regulator asked for some additional training in codes that they were going to use to analyze the safety analysis that was going to be provided by Zaporizhzhya and PNL provided training over about a two-month period in those codes.

CHAIRMAN JACKSON: Do any of these agreements that you are talking about, are they in any way tangential to or conflict with NRC programs?

MR. GIESSING: We don't have special agreements in these -- in this first area. The second area, dealing with research reactors and fuel cycle facilities, it is my understanding that they do not.

CHAIRMAN JACKSON: What about in the first area?

MR. GIESSING: Well, those are basically elements of each of our projects where we indicate that if there is -- first that you need to bring the regulator in early in the project and then if the regulator requests or needs special assistance in some of these projects, and talk to us about it, then we try and provide --

MS. SUOKKO: And we certainly, if the Nuclear Regulatory Commission already has efforts under way that will fulfill this function or has the possibility of doing that, that's certainly what we do and what we prefer.

So, no, I mean, our greatest interest is in fact in not creating overlap or duplication but rather in reinforcing what each of our agencies is doing.

CHAIRMAN JACKSON: As a matter of course, is there a systematic process when you get into these regulatory areas where you actually sit down and contact the NRC just to talk about what the scope of the deeds may be and how they can best be addressed on an interagency basis?

MR. GIESSING: Well, we have done some coordination and we talked with members of the staff here. The safety analysis area, I know there has been quite a bit of dialogue. It is probably not systematic to the degree you are referring to, though.

Again, we have --

CHAIRMAN JACKSON: Do we need an MOU in this area?

MR. GIESSING: I don't -- I don't think so. If we need to coordinate on a more systematic basis, you know, I think we should just do it.

We can have an MOU --

MS. SUOKKO: Yes, an MOU is not a bad idea.

CHAIRMAN JACKSON: Well, I think I will come back to that.

MR. GIESSING: Maybe we should move on to the other areas.

MR. REISTER: I am going to cover the safety system upgrades which is sometimes referred to as risk reduction projects.

One of the largest areas is in fire safety and it has been recognized that this is a deficient area at these plants highlighted probably by the fire at Chornobyl Unit 2.

What we have done is provide basic fire safety upgrades. These are just basic tools to fight fires and examples of that is fire fighting equipment like communications equipment and fire suits for the fire fighters so they can do their job.

Detection and suppression systems for fires and improving fire barriers at the plants. We do this at pilot plants listed here and we also intend, if the program continues to ensure that either we or some other international group or other bilateral country on a bilateral basis provides these -- or the countries themselves provide these basic upgrades to fire safety because they are so important we feel.

Another effort we are doing is developing some guidelines so that the plants can do a fire hazards analysis or a safe shutdown analysis evaluation to ensure that if they had a fire they could shut the plant down and keep it cool, the reactor cool.

We started out really thinking that we could do this on a simplified or limited approach, recognizing that these plants have significant problems already. But it turned out that that was hard to do because we had to make judgments as to what to cut out and we didn't feel that was appropriate.

So we basically developed some guidelines which we have just completed which really kind of describe the U.S. approach to doing a safe shutdown analysis. Although it provides avenues -- tries to describe avenues where you can take some, if you don't have the information, like if you don't know where your cables run and it is too difficult to trace all your cables, there might be ways to get around that problem by making certain assumptions.

But it is left to the host country to actually decide how they want to approach that. We didn't feel that we could make those judgments for them up front. This document has been developed in cooperation with the Nuclear Regulatory Commission.

Early next year, we are going to provide training on what is in the guidelines and we also hope to sponsor at least a couple pilot plants in actually performing the analysis. It is also interesting to note that both Russia and Ukraine have indicated a strong desire to use these guidelines to form a standard in their own country in order to implement it on a permanent basis.

Other safety system upgrades we are performing are safety parameter display systems for both the RBMKs and VVER reactors. This is done in coordination with the emergency operating instruction development work and it is to provide the operators with their plant information and coordination with the symptom-based emergency operating instructions, better emergency procedures.

The first system like this is now being involved at Kursk Unit 2 by a Parsons and Westinghouse team and there is basically a rolling schedule to do that about every three months or three or four months a new system. So it should be done, completed in a couple, three years.

Another area is emergency DC power supplies. You can see on the screen, on the left, is the old wooden boxes with the laminant inside or sometimes they are glass cases. They are very, very poor batteries and this is susceptible to any kind of disruption to lose their emergency DC power so what we provide is on the right, which are safety-grade type of DC power supplies for emergencies.

COMMISSIONER ROGERS: These are the batteries you're talking about?

MR. REISTER: Yes, sir.

COMMISSIONER ROGERS: It's kind of odd, isn't it, that the batteries used in the nuclear power plants are so inferior when they have had apparently an extremely successful battery program for their submarines?

MR. REISTER: Right. Most of these batteries are actually manufactured by the plants themselves. A few plants that have upgraded these batteries on their own actually have purchased them from European companies.

Why they are unable to manufacture the batteries in country when they have battery technology is a problem.

We have what we call a battery technology transfer process under way and are trying to identify an in-country manufacturer for these batteries because we do not intend to provide batteries, Western batteries, for all these plants. They are fairly expensive. So we are trying to find an in-country way of solving this problem, like you described.

Another area is confinement leak tightness improvements. We only have one plant that we've done this at, at Kola, and the plant -- the project is basically complete. We have seen an order of magnitude improvement in their confinement leak tightness but it is still an extremely leaky confinement. The plant has the materials and technology to continue to plug the leaks but even if they do plug the leaks, to be honest with you, we feel there is only limited value to this and there is some concern that it might only be of value in a certain limited number of cases.

These are not containment systems; they are just simply confinement systems. So actually, we are essentially done in this area and we have demonstrated the technology you can make improvements but we don't intend to do any more work in this area.

And emergency water supplies, we are providing some mobile pumps. These provide some emergency feedwater to steam generators for long-term cooling. It addresses a concern of these plants for loss-of-power accidents where they have no way of cooling the plants. And these systems are also available to provide an emergency source of fire water, too, so there are actually multiple uses.

COMMISSIONER DIAZ: I gather the photograph was taken in the summer?

MR. REISTER: Yes, well, actually that was taken in the U.S.

COMMISSIONER DIAZ: Worse.

[Laughter.]

MR. REISTER: That system now is actually at the Kursk plant. That is actually an off-the-shelf system and what it was originally designed for was pumping out quarries and you can -- that system will actually pump golf ball size rocks through it and still keep on chugging, so it's a pretty good system.

Another area is electronic module replacement and here we are trying to address a general problem with unreliable I and C systems by providing them again a technology and process for fixing this problem themselves in country. So we are trying to develop -- we are not necessarily trying to fix their total INC problems; we are just trying to show them a path to upgrading their systems reasonably.

What they would like to do is do wholesale replacement of their I and C systems for many millions of dollars but we simply can't do that.

Last, I will talk about some ultrasonic test equipment. This was mostly for RBMKs to address some problems with the group distribution header, welds and pipe wall thinning issues that they had and they had no way of testing their pipes for these problems so now we are providing ultrasonic -- both manual and some automated ultrasonic test equipment.

COMMISSIONER ROGERS: What about other kinds of portable test equipment for looking at hot spots and things like this? Infrared detectors and so forth. Those have proven to be extremely valuable in finding out where it was taking place and hot spots in pumps and so on and so forth. I mean, very, very valuable.

Any use of those -- that type of equipment?

MR. REISTER: I don't recall infrared detectors in particular. We do have a larger maintenance program that is trying to address some of these maintenance-related safety issues, I mean safety, not operating maintenance but safety issues like pump alignment equipment to make sure you don't get unusual vibrations. I am trying to think of some of the other maintenance equipment that we have provided along those lines.

MR. GIESSING: But this is a project that is just beginning and these are some of the kind of things that are being discussed.

COMMISSIONER ROGERS: Yes.

MR. REISTER: We'll move on to core conversion activity which is another area I am program manager for.

We have completed a feasibility study on core conversion in December of '95. The Russians were fully cooperative in this because they also feel this is an important thing for them to do to maintain, as mentioned before, continue to provide heat and power at these sites.

One of the things the feasibility study did was try to address the safety issue and it had some criteria on how to do what was required for a core conversion and by -- we can move on to the graph -- core conversion is, what it actually is going to do is replace the fuel in the cores from aluminum low-enriched fuel which has a short lifetime in the core for producing plutonium to highly enriched uranium, zirc fuel, and -- well, 20 percent enriched is low enriched, I guess.

Some of the advantages to this process in terms of safety is it will eliminate the positive void coefficient of reactivity which is what these plants currently are operating with, which is similar to the problem that caused the Chornobyl accident, having the positive void coefficient of reactivity.

Another thing it will do is reduce the power at which these plants operate because now they won't be producing plutonium. I mean, their function will just be to produce the heat and electricity.

Also, the use of zirconium fuel and zirconium process tubes in these plants allow a lot more margin in terms of the heat-up of the fuel. In an accident condition, it can sustain a much greater heat-up as opposed to the aluminum.

Additionally, there are some safety upgrades which would be performed.

CHAIRMAN JACKSON: What is the status of the graphite block itself?

MR. REISTER: The Russians did an investigation of the graphite stacks, I mean they monitor the graphite stacks as part of their monitoring program at the plant and it was determined that there is enough life remaining in them to operate the plants until about the year 2005 to 2010, depending on how they --

CHAIRMAN JACKSON: Are they cracked?

MR. REISTER: There are some cracks, yes.

CHAIRMAN JACKSON: Does that affect safety margins?

MR. REISTER: Well, as more and more cracking occurs, the thermal conductivity of the graphite becomes less and less and that's the problem.

CHAIRMAN JACKSON: Has there been a specific safety analysis done of that and the effect in terms of the operability until 2005?

MR. REISTER: They have not done a safety analysis yet. In Phase II of the process, which we are just starting, is when the safety analysis will be performed.

As I just mentioned, we are -- well, let me go to the next slide.

This is driven in large part by the nonproliferation concerns and as this slide illustrates, simply, right now they are producing one-and-a-half tons of plutonium each year and what we hope to achieve is by burning highly enriched uranium or highly enriched uranium that has been blended down to 20 percent uranium for fuel, it will burn three tons of highly enriched uranium per year.

We are just beginning the Phase II work. This phase, as I mentioned, is where we do the safety analysis for the converted cores and evaluate the plant upgrades that will be performed. Additionally, tests of the fuel, the new fuel designs and the neutron absorbers that will be put in the core are performed. These are in-core reactor tests.

For example, some of the highly enriched uranium they already have, they already use in the cores now so they have some data on their performance but the 20 percent fuel they don't have data on so they would actually have to do in-core tests. I would also like to mention quickly all of this work is being done by the Russians.

We are paying for the Russians to do the work but the U.S. contractors, the U.S. is not doing the work. We monitor the work to some extent to make sure it is proceeding appropriately and that the information is being provided but it -- we aren't actually doing the work. So I think that's important.

COMMISSIONER ROGERS: What kind of checks do you have on the results, then? I mean, do you have some independent verification of the results that are coming out from that work?

MR. REISTER: We do have an evaluation of the information and the results of the work. It is not a thorough evaluation in the sense that we don't try to duplicate the work or make a judgment as to whether it's completely adequate or not because certainly if we find a problem then we will address the problem but it is incumbent on the Russians, both their operators and their regulator, to approve the core design of these plants and I think it would be inappropriate for us to provide a stamp of approval on the design because it --

COMMISSIONER ROGERS: Well, I wasn't saying that we would have to do that but, you know, there should be some cross-check by somebody, you know, that just didn't do the work that is looking critically at it. You know, a peer review type process.

CHAIRMAN JACKSON: As you know, at the sixth Gore/Chernomyrdin Commission meeting in January, the NRC committed to the vice president that it would assist, you know, in this project and I have to tell you that I note at various points along the way you talk about regulatory approval or GAN's approval and we do have a question about the capacity of GAN to do the necessary reviews because, of course, like you, we have the perspective that, you know, making the judgment on the relative safety of the existing plants and the converted core plants is a Russian decision.

So the question becomes, if there is a question about the capacity of GAN, what is being done to ensure that they have the capability to do the necessary safety reviews and I note there was a meeting held yesterday, I guess it was, between DOE and NRC staff to discuss these activities in more detail and if that means more coordination, we think it is a positive step and we want to fulfill what we said we would fulfill but it requires coordination and up front planning, hence the question about MOUs if necessary.

MR. REISTER: I'm sorry, was that a question to me? I agree with you.

CHAIRMAN JACKSON: The point is that we are very sensitive as regulators that our names are not used to put a stamp on something from a safety point of view or that GAN does not have the capacity it needs in terms of any pass it would give to the project.

So that is something, following along the line of Commissioner Rogers's question or comment about the need for an independent judgment, which we don't want to be the ones to give, then the only place it can come from is within the Russian Federation. If that's the case, then we are involved and our fingerprints are on it, then the capacity to do the reviews, to give that judgment, is very important.

So it is very important that in fact we carefully plan that out to ensure that that capacity is there and that we don't just rush along, particularly when there are fundamental questions. I mean, I raised the one about the condition of the graphite. And these are nontrivial in terms of what impact it can have on the core physics.

Commissioner Diaz can probably speak more directly even to some of this than I, but I just want to get that onto the table here and onto the record.

Commissioner Diaz, do you have any questions you wish to make?

COMMISSIONER DIAZ: No, I am waiting.

[Laughter.]

MR. REISTER: Yes, ma'am, I think we completely agree with your review --

CHAIRMAN JACKSON: Well, it is not a question of just agreeing.

MR. REISTER: Right. We look forward to --

CHAIRMAN JACKSON: It is a question of we move along in a certain direction.

MR. REISTER: Yes, ma'am. We look forward to working with you.

Let me briefly -- well, extremely briefly because we are running out of time --

MS. SUOKKO: Yes, we want to get to Chornobyl.

MR. REISTER: We have gotten through the -- we are doing the safety analysis and upgrades. Part of that is also determine the cost estimates for the upgrades and approval.

Phase III, it is pretty obvious what needs to be done in Phase III in terms of implementation and, of course, that does include GAN approval of the implementation of the core conversion and upgrades.

It is also important to note there are some compliance measures related to use of highly enriched uranium in Russia and that these compliance measures must be put in place before the U.S. would agree to convert the cores.

MS. SUOKKO: Yes, there are quite a few conditions that need to be met before a decision is made about Phase III. This just describes what would happen in Phase III.

MR. REISTER: That's all.

MS. SUOKKO: We really had two more components we wanted to talk about. One was the actual -- some of the things, lessons learned and things we have run into in implementing the program. We also wanted to talk a little bit about Chornobyl activities.

I am not sure we have time for both.

CHAIRMAN JACKSON: You have time. As long as you have time, we can extend the meeting.

MS. SUOKKO: Laurin, do you want to go ahead?

MR. DODD: Yes, I would like to just address some of the issues associated with implementation of the program.

In the United States, there are four-plus national laboratories involved, more than 30 commercial contractors. We are working in eight different countries representing some 20-some nuclear power plants with maybe 65 reactors.

The coordination is a challenge. Let me just say that we use widespread use of modern telecommunications means. We have weekly video conferences with the Department of Energy and some of the other U.S. participants. We put out weekly activity reports which are sent electronically to both Kiev and Moscow and are translated and sent to all of the people involved in the program which helps them in terms of coordination.

We hold semiannual meetings with our contractors here in Washington, D.C., to review progress and issues. We have established offices. We have one staff member along with two Russian support staff in the embassy in Moscow. One of our staff members is living in Slavotich, the company town for Chornobyl, and in February will be establishing a one-person office in Kiev to help us with our coordination of increased activities in Ukraine.

Contracting has been a major challenge. Much of our contract staff have found this to be much different than their run-of-the-mill contracting in the United States. We assumed responsibility for this in the program. We immediately started an activity to put basic working agreements in place with all of the nuclear power plants where we were doing work, as well as many of the design and safety institutes in Moscow and Kiev and elsewhere.

I don't know the number today but we have contracts basically in place with all of those organizations. These are all fixed price contracts. It helps us avoid some of the issues in terms of auditing and to some extent helps avoid issues like hourly charge-out rates and so on but let me say that labor rates in doing cost/price analyses of these contracts, you know, continues to be a challenge and the whole labor rate situation in the former Soviet Union is very complex.

So we started out in the program, we worked from a State Department guidance of $600 a man-month and things have changed considerably, at least in Moscow, in the last three or four years since that guidance came out and our folks have worked since then from salary surveys and other data that they are able to collect in order to try to do what is reasonable and fair with these people.

Having the contracts in place and the basic working agreements just gives us the ability to do work with the people. Then we put in specific tasks and that process usually goes pretty smoothly. Of course, when tasks are completed, then there is the issue of paying people and this is a real challenge many times.

Many of the organizations we are working with, though, are virtually bankrupt and we have cases today where they have completed work and they have asked us not to send them money because the money will disappear to the creditors as soon as it arrives and so we are continuing to struggle with some of those issues.

Intellectual property and sensitive data. Intellectual property, of course, is a contracting issue. It is also an economic issue for some of the institutes that we work with. Some of these people, in fact, see the data that they hold and the information that they have concerning the design of their reactors as information they have always held very closely. I think in the old days, for secrecy purposes, just the nature they worked. But today they realize this is value to them, this represents work for them in the future as long as they don't let this information out.

So it is a continued challenge to have these people work with our people and fulfill contracts and then say, well, we really don't want to give you the basic data that we used.

Sensitive data, the core conversion represented an interested opportunity for us because the Russians still consider these reactors to be secret reactors. They're still in closed cities and it was a real process to get around this process of how do we work together on something where there's secret data involved and, of course, from our perspective, the data is not secret. It is very common information that we have released in this country years ago and we addressed that basically through a nondisclosure agreement and confidentiality agreement between Pacific Northwest National Laboratory and the Kurchatov Institute, which is the designated lead for the Ministry of Atomic Energy and we have been continuing to work under that confidentiality agreement and it has worked very well.

Customs, shipping material to these countries, has been a continued challenge. In fact, more and more, we try to buy as much equipment and material and computers and so on in country. When we do have to ship, historically, there has been a lot of problems in getting things through customs. In early 1996, we had some $2 million of equipment held up.

Today, through cooperation and agreements and processes that we have worked out with Ukraine as well as some innovation that has been used in Russia, today there is nothing being held up in customs; everything is through.

Communications, it is very important in working with them to have redundancy and to have, in translations, just about everything, every letter that we send, memo that we send or contract that is drafted, we always send a version in the language of the host country as well as in English and we have redundancy in that we always send copies to our in-country representatives and have them call and say did you get this. And we learned this the hard way.

In the old days, it might take a week to get a fax through to some organization and then you thought you had it through and you discover several weeks later that they still didn't get it. But we've pretty much eliminated that now.

Travel, there's lots of travel in the program. There is a lot of travel involving people in the host countries, going to meeting in Moscow from Bulgaria, for example, and we have set up an office that handles this. We have arranged special arrangements for hotels and so on in the countries where the meetings are held. I might say the programs have established a practice of trying to have the U.S. travelers stay in fairly modest hotels and so on to try and be as unobtrusive as possible.

Issues in terms of meeting programmatic goals, I think one of the first things people learn in this program is you have to develop trust with the people you are working with and just a very quick story, that is when program representatives first went to the Chornobyl plant a year-and-a-half ago to establish agreements for moving forward, they were asked the first evening, why are you here after 9 years, why are you here?

Well, today, we have a program representative and his wife living in Slavotich, they have fit into the community. I think they are the first international representatives to live in this town and we have broken down those walls and that has been an important element in terms of the success of the program.

Demonstrating relevance, there are several activities that this program has thought are very important and has tried to move forward on. The host countries sort of say, gosh, we really don't want to do that, we don't think that's important.

One area was an overall area of doing safety evaluations. Eighteen months ago, two years ago, it was very difficult to talk to them about doing this. Today, Russia and Ukraine and other countries have signed the International Nuclear Safety Convention. They realize that at least for that reason they need to do safety evaluations and other areas they have realized that they want to do it for the right reasons.

Finally, you know, fulfilling commitments, moving forward, getting things accomplished is very important to the program in terms of maintaining credibility with the people and there has been a lot of emphasis in the last couple of years on this and I think that we are having an impact and I do believe the question was asked, you know, how can you measure the amount of risk reduction that has been completed and it is a very good question, it is a very difficult thing to give a definitive answer to, you know, but the results are there and there will be a definitive answer one of these days.

MS. SUOKKO: Thanks, Laurin. I should also note that Laurin has to catch a plane so he may disappear. The rest of us are here.

COMMISSIONER McGAFFIGAN: May I ask one question, because it pertains? How is the liability issue in this country solved? You are at a contractor laboratory and I know there was great concern at the outset of the program about, you know, us being responsible in some way if there ever were another accident.

MR. DODD: Well, several things have happened since that issue was raised. One is, there were bilateral agreements put in place between Russia and Ukraine. Vice President Gore later wrote a letter and informed the intention of the Administration to support those agreements.

The Pacific Northwest National Laboratory, as a national laboratory, has some protection as a result of their contract with the Department of Energy. And then, finally, we manage the risk. I mean, we manage the liability and we look at each project on a case-by-case basis and try to make sure that, in fact, we aren't taking responsibility for the ultimate decisions at the plant. The plant is responsible for specifying the design of the equipment, approving it, accepting the equipment and so on.

So we are managing it, it continues to be an issue. But to date, every project that we have agreed to go forward with with the host countries, we have been able to go forward with and the commercial contractors are supporting it.

MS. SUOKKO: And let me just add that we work with and support the efforts of our Department of State in coordination with the Nuclear Regulatory Commission to try and encourage these countries to pass domestic legislation, which ultimately is what is going to be required to fully solve the liability problem, to pass domestic liability legislation and, you know, sign up to the international conventions and so on.

There have been some workshops here in the states. We support all of our lawyers in working with them on draft legislation and so on.

I thought we would just touch quickly on the Chornobyl activities and then answer any further questions that you have and I have a couple of concluding remarks.

CHAIRMAN JACKSON: Thank you, Mr. Dodd.

MR. DODD: Thank you.

MS. SUOKKO: In December 1995, the G7 countries signed a memorandum of understanding with the government of Ukraine on the shutdown of Chornobyl by the year 2000. That memorandum of understanding is very broadly based, covers a lot of different efforts including reform of the electricity sector to a market-based and financially viable sector. The possible completion of two reactors, one at Khmelnytskyy Unit Number 2, and one at Rivne Unit Number 4, of course, presuming it meets all these cost and due diligence standards, thermal rehabilitation projects and efficiency projects.

There are also a number of grant based projects that are included in this memorandum of understanding including some short-term upgrades at Unit 3 of Chornobyl, some activities in decommissioning, preparing for decommissioning, looking at the social costs of the shutdown and putting the -- addressing the whole problem of the sarcophagus which, I might just add, is really the key, I would say, from the Ukrainians' perspective, in terms of their ability to shut this plant down.

Let me just briefly say what we have got going in terms of supporting those efforts. One that has been mentioned a couple of times is the establishment of what is a very long, complicated name, the International Chornobyl

Center for Nuclear Safety, Radioactive Waste and Radioecology. That is a product of protracted negotiations with the Ukrainian counterparts but the idea of the center is to provide a vehicle for international joint research and collaboration on a variety of problems related both to Chornobyl and to nuclear overall. In Ukraine it will be, when it's fully established, a Ukrainian owned and operated organization and hopefully ultimately we will be able to address some of the social issues with the workers who will be needing to find something else to do when Chornobyl shuts down.

Now, just quickly, the status of that is --

COMMISSIONER ROGERS: Excuse me, on that?

MS. SUOKKO: Yes.

COMMISSIONER ROGERS: I know there was a concern at one time, probably an ongoing concern, that when you mentioned, you know, finding something for the Chornobyl workers to do, that that International Nuclear Safety Center not be simply a parking place for those folks. That if they could, in fact, make significant contributions through special expertise that would be fine but that it wasn't, you know, a make-work place for them and that the tasks to be carried out would be important challenges that had to be tackled by the best experts they could put to work on it and not just somebody who happened to have been working at the plant and needed a job.

MS. SUOKKO: So the question is, how are we ensuring that that is the case?

COMMISSIONER ROGERS: Yes, how is that going?

MS. SUOKKO: Well, there is a complementary effort conducted by the U.S. in connection with the European Union to do an overall assessment and action plan on the social and economic problems associated with shutdown that will come up with proposals for, you know, alternative training, alternative industries, all of those kinds of things. So one hope is that those two complementary efforts will ensure that the people will find their appropriate place, whether it be at the center or in an alternative training program or alternative job.

Then, secondly, I think that there will be a sort of check-and-balance system on that in the sense that we anticipate that most of the projects will be done with international collaboration, whether on a bilateral or some other basis and, you know, I would expect that there would be certain criteria and expectations on the part of the international partner that they would not just be getting anybody but they would be getting the best expert. So, certainly, a consideration that we will keep at the top of our minds as we talk to these people.

CHAIRMAN JACKSON: Let me do a little bit of followup.

MS. SUOKKO: Yes.

CHAIRMAN JACKSON: You mentioned other countries. There have been other countries, I know, that have expressed an interest in participating in that center and they may have ideas for projects or research programs that are different than the ones that you have outlined.

How is that being handled? What is -- how is that being structured in terms of other participants coming in?

MS. SUOKKO: Well, it's, you know, it's really the --

CHAIRMAN JACKSON: It depends on the Ukrainians?

MS. SUOKKO: The Ukrainians really ultimately have to determine what they want to be involved in and we certainly have encouraged and advised them on guidelines for participation and what to get involved in and so on. And it certainly is the case that various countries, various entities, have different interests but, to date, they have all seemed to fit within the general parameters of what the Ukrainians are interested in.

CHAIRMAN JACKSON: So the other countries who actually are involved to date --

MS. SUOKKO: The two most active right now are Germany and Italy. They have both made firm commitments to participate in the center.

CHAIRMAN JACKSON: On a project basis or --

MS. SUOKKO: Yes, I believe they have committed to put in a little bit of seed money, as we did. We committed $3 million initially to help them get off the ground. I believe they have put in some seed money and will identify project-by-project activities that they can undertake.

Yes, that is really the intent, to approach this from a project-by-project basis so ultimately it will be self-sustaining, they won't be relying on, you know, just inputs from -- countries don't have any desire to just be putting a stream of funds in either.

Secondly, we were -- the United States was actually one of the first countries to get involved in the call to do some of the short-term upgrades at the Chornobyl Unit 3 and we have got some activities underway consistent with the rest of the program and, you know, consistent with the ultimate objective of shutting down the unit, working in the fire safety area, emergency instructions, operating instructions, some training and, as we mentioned earlier, a safety parameter display system for Unit 3 at the plant.

Again, it is important to note this is the only RBMK facility in Ukraine and that they really have been isolated in terms of infrastructure and capabilities there so we think we have addressed some of those in a fairly good, quick way.

Then, lastly, there is of course the problem of the sarcophagus. This is a subject of a major, major international effort. We support that effort, we have experts participating in the international meetings to try and identify both the short-term and the long-term solutions to this problem. But one thing that we have seen a great need for and tried to address is they've got some very immediate problems at this site, you know, problems that really impact worker and public health and safety.

So we have committed funds to go in and try to address some of those immediate problems, including things like monitoring systems, alarm systems in the sarcophagus. Personal protective clothing and personal radiation monitors, I mean, these are things that did not exist in this facility.

And then, finally, some safety enhancements, literally things like lights on the -- you know, the pathways that people walk in the sarcophagus. So we have undertaken some of those with the support of our G7 colleagues and then continued to participate in the effort to identify the longer term solutions.

CHAIRMAN JACKSON: Is there any work that -- well, something that might help Chornobyl to shut down the Chornobyl reactors is to improve the efficiency and reliability of the VVER 1000s but U.S. government policy to this point has been on grant assistance focused on these least-safe, most risky reactors. Do you feel that the policy ought to be revisited?

MS. SUOKKO: I think I may defer on that question. I think it is something that we should look at collectively and not just the United States but the international community as a whole. You know, certainly this is an issue, you know, in addressing whether funds should be provided or loaned to complete the existing reactors, the uncompleted reactors at Rivne and Khmelnytskyy. I think it is something that will be under discussion.

COMMISSIONER ROGERS: I would also like to mention AID is providing some funds directed at Ukraine specifically to address some of the issues at the VVER 1000s, I think, recognizing the issue that you raised, that they have all these 1000 units there and they need to be upgraded so they can be operated.

MS. SUOKKO: Yes, I mean, fundamentally, we have been involved in Ukraine as part of this program and the sort of generic activities relating to training and operating procedures and that kind of thing --

CHAIRMAN JACKSON: But the real question has to do with kind of a systematic focus and approach that would have the dollars follow it and whether you think there needs to be a revisitation of the existing policy and you would prefer to defer?

MS. SUOKKO: Yes.

COMMISSIONER ROGERS: Excuse me. Going back to Chornobyl for a moment, what is the danger of a serious recriticality incident at Chornobyl?

MS. SUOKKO: I will leave that to the technical person.

MR. GIESSING: We are not the best experts in detail on that but, from our dialogues both with the Russians as well, who have been involved in that until the split-up of the Soviet Union, they have confirmed repeatedly that it is not a problem. That this is either a problem of moderation or detectors and --

COMMISSIONER ROGERS: You mean these high neutron fluxes or high fluxes that they have seen coming out, bursts --

MR. GIESSING: Right.

CHAIRMAN JACKSON: That's not a problem?

COMMISSIONER ROGERS: That is a detector problem?

MR. GIESSING: Yes, it's not a problem. It's not a real event.

They said early on that they had fission product monitors, airborne that they tried to collect and they saw no increase in those cases. One of the near-term projects which she mentioned was to actually put some improved monitoring equipment in there to duplicate what they already are showing themselves and see if we can't get some better data and that's one of the first projects that is going to take place.

MS. SUOKKO: I guess I will just conclude here and then we can answer any further questions that you have.

Laurin mentioned some of the ways that we try to communicate and coordinate on the program. We do have quite a few materials available, a lot of them come regularly here but I also wanted to make kind of an overall statement that there are materials available that describe exactly what we are doing. Some of them are here; others are available through our offices. So, you know, if there is a need for more information, we are more than willing to provide it.

Laurin also mentioned that we have these periodic meetings with our contractors. We've got one planned and I wanted to extend the invitation to the Commission to, you know, to attend if there was any interest. At any point, I can provide you more information separately.

Finally, the director, the appointed director of the center in Slavotich in Ukraine is going to be in town next week, as well as Mr. Constantine Rudja who is Minister Kostanko's aide. They will be in Washington the first part of next week and, you know, if there is any interest in setting up a meeting, we would be glad to do that.

So, again --

CHAIRMAN JACKSON: George Shea is at the table. He will track that for us.

MR. SHEA: Yes.

MS. SUOKKO: All right.

So, again, I really appreciate the opportunity to do this and we will be happy to answer any more questions.

CHAIRMAN JACKSON: Let me ask you two questions.

Do you have any ideas or thoughts about broadening your international nuclear safety programs beyond Soviet-designed reactors?

MS. SUOKKO: Well, we -- the program is broader in a couple of senses. One area that we are very active is participation in international organizations associated with safety problems, both the International Atomic Energy Agency, the NEA as you know, and through those fora we do have an ongoing dialogue with many other countries.

The Department of Energy has cooperation in both the nuclear technology and in some cases the safety areas with other advanced nuclear nations, countries such as japan, South Korea and so on.

CHAIRMAN JACKSON: But any focus, you know, in terms of the safety upgrade, the risk reduction in other parts of the world, not with our sort of like counterparts but --

MS. SUOKKO: For example, the other places that come to mind that have these kinds of problems, you know, like say India, China, those kinds of places?

We believe that there is a need for cooperation with those countries on the safety aspects of the operation of their power plants and we have made that -- we have made that view very clear. The opportunities have not made themselves quite as clear. I actually think that the Nuclear Regulatory Commission, based on its kind of mandate and role, has a more immediate opening than an operating organization because of the restrictions on cooperation with those countries but, yes, our view is that we should cooperate on nuclear safety.

CHAIRMAN JACKSON: Let me put you on the spot a little bit with regard to the GAO report.

MS. SUOKKO: Okay.

CHAIRMAN JACKSON: Do you agree with the findings and do you plan to follow any of the recommendations in the report?

MS. SUOKKO: That's a good question. We -- I would -- I almost wish I had the report in front of me so we could sort of go through the findings specifically. Do you have a copy of it by any chance?

CHAIRMAN JACKSON: No, we don't have copies here.

MS. SUOKKO: We addressed both with the GAO and in subsequent sort of followup questions with the press and with others who have questioned us on it, you know, our specific reactions to each of the findings. It's -- it is the case that no reactors have been shut down however, I think, though, the GAO very fairly states some of the reasons why that is the case.

I think, you know, in other cases where they -- you know, where they find that the program may have changed from its original intent, which was a very short-term, in terms of both years and activities, program to something with a longer-term scope, you know, I talked about that earlier. The policy is still the same, to do things that address the short-term problems but that, you know, our lessons learned have taught us, you know, it's taking longer than we thought.

So, you know, I think that each of the findings requires -- it is more than just in black and white and, again, we have discussed this with the GAO. I think, in some cases, they have fairly represented our views. And I think that, you know, it's a complicated question.

CHAIRMAN JACKSON: Let me ask you this last question in the regulatory arena. You know, we note the inclusion in your programs of regulatory assistance. Is this based on a perception that the NRC is losing interest in regulatory assistance activities, does not have a role to play? And what is your plan in terms of coordination going forward with the NRC in those areas?

MS. SUOKKO: Well, the answer to the first part of the question is, absolutely, no. We do not see the NRC either losing interest or opportunity. It is -- the way we have incorporated regulatory issues into the programs is really in an effort to more than anything ensure that they get addressed, you know, at a very early stage.

In our programs, I mean, we have had some significant lessons on this front from some of the activities we have been involved in, such as the emergency operating procedures where it became very clear that -- and this is through nothing having to do with the U.S. program, either the NRC's or DOE's, but the fact that the regulator was not involved at an early stage in reviewing the operating instructions. And, as a consequence, we experienced great delays toward the implementation stage.

So that, to us, was a lesson that at very early stages in introducing projects we have got to ensure that the regulator is on board and have got the capabilities to do what they need to do. As I said earlier, in the cases where the NRC is -- has those activities underway or has the potential and the capability for doing that, you know, we seek to see that happen. In other cases, if there are things that we can provide easily through, you know, through the program, we would like to see that happen.

In terms of coordination, I think it is clear that coordination always can be improved upon and, you know, we would be more than happy and willing to consider ways that can happen, whether your suggestion of an MOU or some other more formal structure, we would be happy to have follow-on conversations on that.

You know, we see the NRC and DOE roles as absolutely complementary and absolutely vital components of this effort, you know, that we, the international community, have underway.

CHAIRMAN JACKSON: Okay, Commissioner Rogers.

COMMISSIONER ROGERS: Ukraine expressed some serious interest in establishing an independent fuel fabrication facility a year or so ago. What is the status of that? Have you -- is that involved at all in this program or are you watching that in any way or do you have any concerns about it in any way?

MS. SUOKKO: We are monitoring it but we are not doing anything about it. We're not involved.

It is a much larger policy question than just giving them the capability to fabricate their own fuel. It involves a lot of different aspects. So, while those policy questions get vetted, we are monitoring at this point.

COMMISSIONER ROGERS: The other one, just my recollection is that the South Ukraine project, when it was originally conceived, was a combined hydro and nuclear project, considerably larger than it is right now. There is no hydro element in it now.

Has anybody thought of resurrecting that original concept to help meet their power needs? There are some serious international problems about where the water comes from or where it goes but, nevertheless, it was -- it is a non-nuclear project and it is on the same site and the whole site was designed around that concept and then it was just dropped.

MR. GIESSING: No, we have not had any involvement in that at all.

MS. SUOKKO: I'm not aware of -- I'm not aware of that being revisited but, certainly, we will keep an eye out for that.

COMMISSIONER ROGERS: Well, I mean, if there is an alternative that could be explored, that might possibly be one, although I know it's a tricky -- there are some tricky questions at the moment.

CHAIRMAN JACKSON: Commissioner Dicus? Commissioner Diaz?

COMMISSIONER DIAZ: I have one question and one comment.

The first question is, in the reactor safety program, when you were going through it you stated that safety was the primary emphasis and that purposely you were trying to avoid doing that was life extension. Sometimes those are contradictory statements.

I don't know how the process is going but I would like to get some information on how decisions are being made whether we try to do something with the pressure vessel or we actually, you know, try to, rather than putting band-aids on a confinement, create a pressurized confinement system that reduces the pressure inside of their nonexistent containment.

There are so many options in there and it seems to me like there is a contradiction as far as life extension and safety.

MS. SUOKKO: We would be happy to provide you with more information as to how those determinations are made and you are absolutely right, it is not always easy or clear but there are steps that we take to determine that and we would be happy to provide you with that information.

COMMISSIONER DIAZ: I the primary concern really safety or does economics come into it always as a determinant? That might be a better way of putting that question.

MR. GIESSING: Well, the project, for example, had been proposed to improve the instrumentation and control system in the RBMKs and the concern after looking into it was that they might be able to operate the plant in a manner in which it would reduce the fluence on the tubes and therefore allow them to operate their reactor in a much more -- in a longer period and those kind of upgrades have been the major ones that we have said, hey, that's extending the life of it in that regard.

MS. SUOKKO: Well, it is a safety issue.

COMMISSIONER DIAZ: Because there are some I and C issues like eliminating the Z channel on the VVERs which actually are very cost effective and that actually remove from the operator the ability of shutting down -- of not allowing the reactor to shut down when it is in shutdown mode.

But I think that is a major issue because some of the most serious components at risk at the plant are actually connected with life extensions and I think that safety should prevail rather than life extension.

I have a comment on the core conversion which I am sure Chairman Jackson was waiting for me to comment on. The issue of, having done work on the design, I think, is of course the appropriate move. In concurring with Commissioner Rogers, you might consider -- and I have a little, tiny bit of experience in this on working inside Russia with Russian contracts and so forth, that you might need to put a small QA on those things and let me try to express why.

Intellectual property is something very strange in Russia. There are people like this institute that believe they have all and only they have the whole truth about some scientific process. And then one block down, on the corner, there is another group who maintains exactly the same and they have the same end product but they don't talk to each other.

I think we find that very strange because of the way that information -- but I seriously suggest that you try to have some independent QA in the calculation, especially on the design of the course and changes. I might just cite one example.

I was in one place where we were worrying about high temperature and you're talking about going from aluminum to zirconium. We were going from stainless steel to hafnium carbide, which is about the hardest component in the world, about 3900 degrees Kelvin it would take. And this institute in here said, there is no such material in the world. The other one reaches into a shelf and said, oh, here, you're talking about this.

It is very important that this cross-fertilization that they need be let's say inspired by your push and a small QA element is certainly helpful.

Thank you.

CHAIRMAN JACKSON: Commissioner McGaffigan?

COMMISSIONER McGAFFIGAN: I am just going to go back to a couple questions.

The Europeans, you're saying, overall, pay about 85 percent of the cost of the effort that is going on in Eastern Europe and the former Soviet Union. Do they share the same objectives we do with regard to the channel graphite reactors and the VVER 440/230s?

MS. SUOKKO: Our policy -- our policy is based on an international consensus.

COMMISSIONER McGAFFIGAN: The data point I will give you is, our staff, and I wasn't in the meeting, but our staff met with some Slovaks about a week ago and they are making upgrades on their old VVER 440/230s starting in '94, going to '99. They are intending not only to run them to the end of their life but they think that with these improvements they are making, that they can life extend them.

So somehow we are exceeding plan. And the West Europeans, you would think, the West Europeans would have the most interest because, when I look at the map on your chart here, those plants are among the closest to Western Europe. So, just as a naive question, what's -- why are we exceeding plan there? Is everybody comfortable with what the Slovaks say they are doing? They are making these upgrades and they think with the upgrades they can probably extend life.

MS. SUOKKO: Well, maybe you know more but I think it is cause for concern among the G7 countries.

COMMISSIONER McGAFFIGAN: Did you know where the main aid in Slovakia is coming from? Is it the French? Apparently it is not us.

MS. SUOKKO: No, it's not, it's not us.

MR. GIESSING: Again, we have very small programs in those countries so I am not aware --

COMMISSIONER McGAFFIGAN: In terms of a case in point where the GAO report may be right. It may not be our program, it may be this overall Western program of which we are 15 percent. But that is a data point based on the conversations we had here where we clearly may be not achieving that goal. It may be an unachievable goal.

CHAIRMAN JACKSON: Mr. Shea, do you know the answer to that question about where the aid is coming from for the Slovak upgrades?

MR. SHEA: I don't.

CHAIRMAN JACKSON: Ms. Dunn-Lee, do you have the answer to that question?

MS. DUNN-LEE: The French.

COMMISSIONER McGAFFIGAN: I suspected the French but I wasn't sure.

CHAIRMAN JACKSON: Well, Ms. Suokko, unless you have other comments you would like to make, we would like to thank you for a very comprehensive overview of DOE's international safety programs, what you have done to date, what you have in mind for the future.

In closing, though, I would like to mention a few things to you. You talked about an exit strategy and I just would like to share with you some things that I think come out of our own experience and some of which you have heard from the various commissioners today.

First of all, it is very important both when you go into the project but particularly when you are evaluating for exit that they really are risk reduction metrics that you develop and that you can apply, both in planning and implementing and deciding when to leave a project.

Secondly, our focus has typically been that having basic nuclear legislation in place that deals with many things but includes liability issues is very important.

Third, and this is also undergirded by nuclear legislation, that there really has to be adequate regulatory strength, independence and capability because that is the ongoing mechanism to ensure that any safety enhancements that you think have been put into place go forward. And it also removes us as a country from making the safety judgments.

Fourth, that you think a little bit more about international cooperation mechanisms. Sometimes, the immediate neighbors have ways to band together, particularly if they have like technology but also because of the proximity that gives them a heightened interest.

Fifth, that their turnkey mechanisms beyond the ones I have mentioned for continuity, such as in the training area. Training is an ongoing activity; it is not something that is done once. That is why I pressed you on the issue of involvement with INPO and WANO because that has been, you know, INPO's focus through the years and that they can suggest ways to ensure that you have a robust training regime.

That there is an ongoing maintenance program doesn't mean to upgrade a system that is not taken care of. That doesn't do a lot for you. That there is a systematic ability and focus on doing the right kind of safety analyses, including PRA, which can help show where there are various vulnerabilities.

Then, overall, there is real knowledge transfer as opposed to just technology transfer because, to use a simplified analogy, if I give you a car but you can't drive, I'm not helping you get down the street very far.

In the regulatory arena, I think more coordination is needed, particularly between what you are doing and the NRC. And if it takes an MOU to accomplish that, then I think we ought to do that because it is a question of we are all working to the same ends in addition to needing to leverage our own governmental resources.

Then I think, as you have heard, watch the issue of the life extension trap.

So, unless my fellow commissioners have any further comments, we are adjourned.

[Whereupon, at 3:38 p.m., the briefing was concluded.]

CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING BY DOE ON INTERNATIONAL NUCLEAR SAFETY PROGRAM - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Thursday, November 21, 1996

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Christopher Catchall

Reporter: Mark Mahoney

International Nuclear Safety Programs

Presentation to

U.S. Nuclear Regulatory Commission

November 21, 1996

Office of Nuclear Energy, Science and Technology

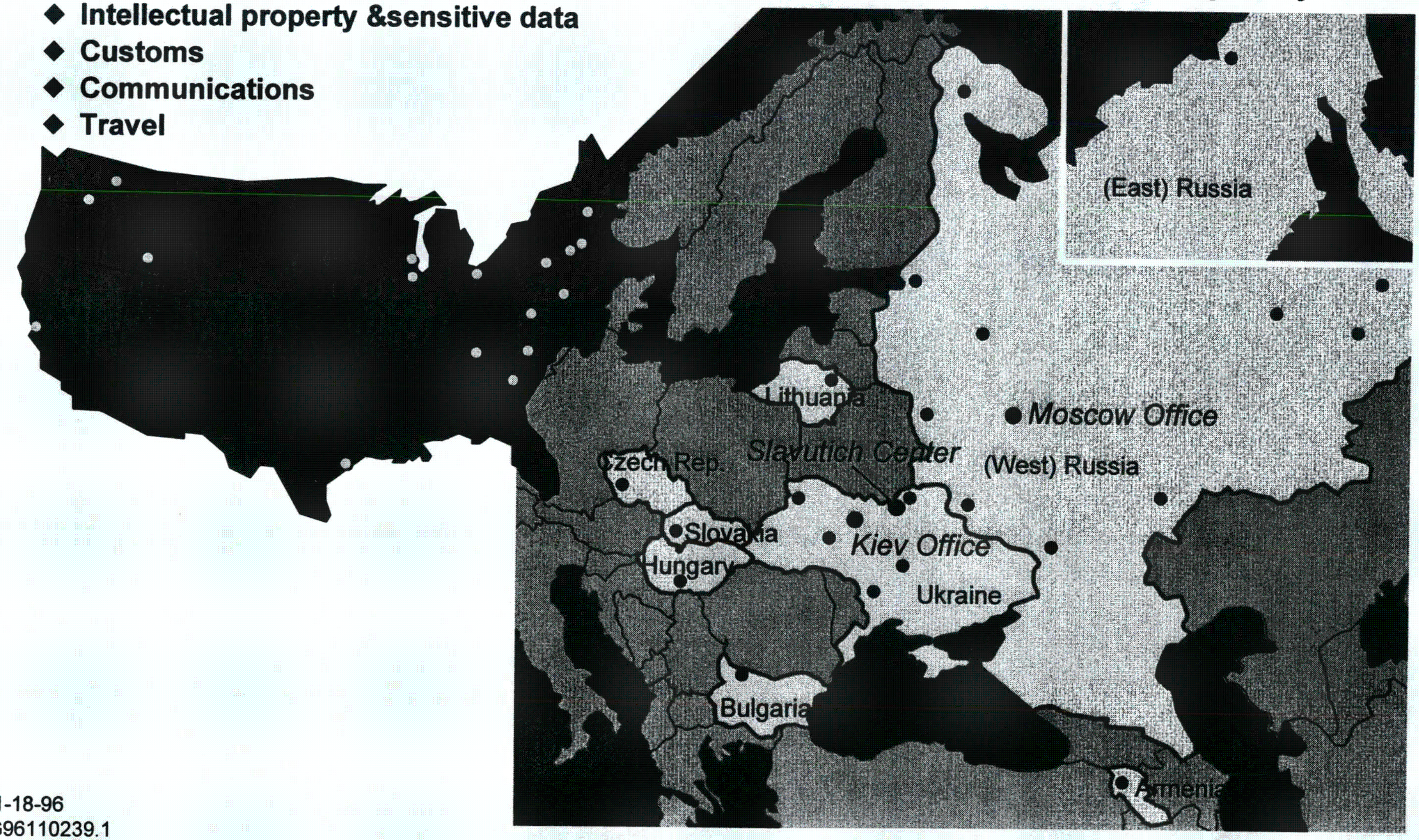
Challenges and Lessons Learned

Challenges

- Coordination
- Contracting
- Intellectual property &sensitive data
- Customs
- Communications
- Travel

Meeting Programatic Goals

- Building trust
- Demonstrating relevance
- Fulfilling commitments
- Achieving safety results



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Agenda

- Introduction, Background, and Strategy
  - Kristen Suokko
- Management and Operational Safety, Plant Safety Evaluations, and Regulatory Support
  - Dan Giessing
- Fire Safety, Safety System Upgrades, Core Conversion
  - Rich Reister
- Implementation
  - Laurin Dodd
- Chornobyl Initiatives
  - Kristen Suokko

Individual Programs

- **Soviet-Designed Reactor Safety**

  Mission: Reduce the risks of Soviet-designed nuclear power plants

- **Nuclear Security**

  Mission: Assist Russians in stopping production of weapons-grade plutonium and promote practices that minimize proliferation risks of weapons-useable nuclear materials

- **Chornobyl Initiatives**

  Mission: Reduce the national security and environmental threats posed by the destroyed unit and the continued operations of 2 reactors

Program Basis

- 1992 G-7 Agreement to improve safety of Soviet-designed reactors.
- Gore/Chernomyrdin June 1994, agreement to shutdown plutonium production reactor and cease use of newly produced plutonium for nuclear weapons.
- G-7/Ukraine MOU on shutdown of Chornobyl.

Office of Nuclear Energy, Science and Technology

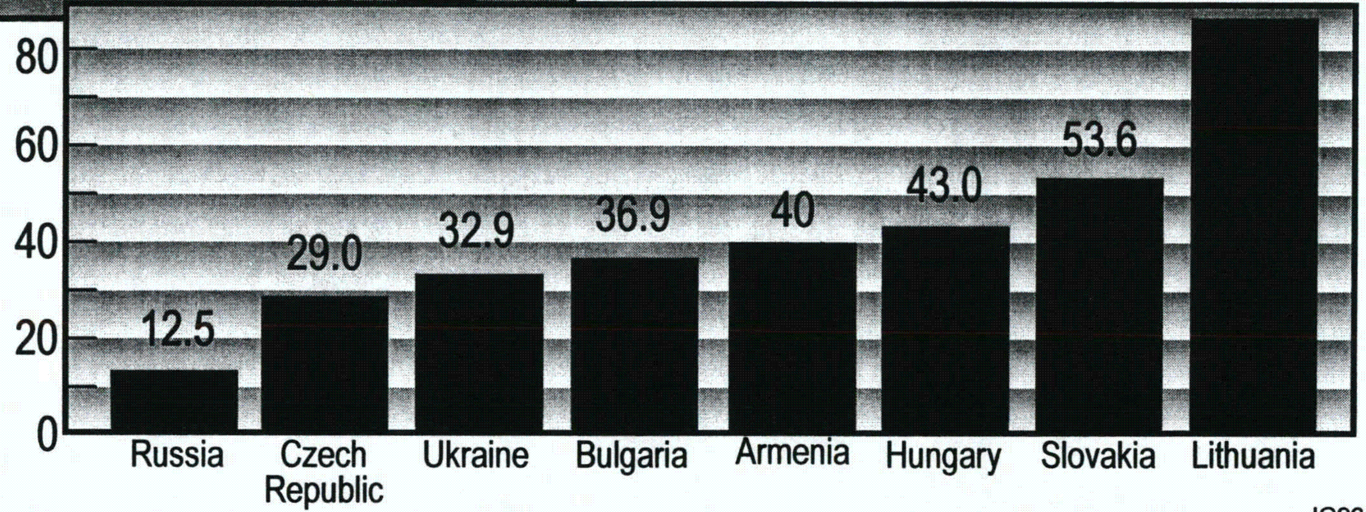
International Nuclear Safety Programs

65 Reactors at 20 Nuclear Power Plants in 8 Countries

Problems:

- Inadequate operating procedures and training
- Design deficiences
- Lack of infrastructure to sustain safe operation
- Inadequate nuclear regulatory authority

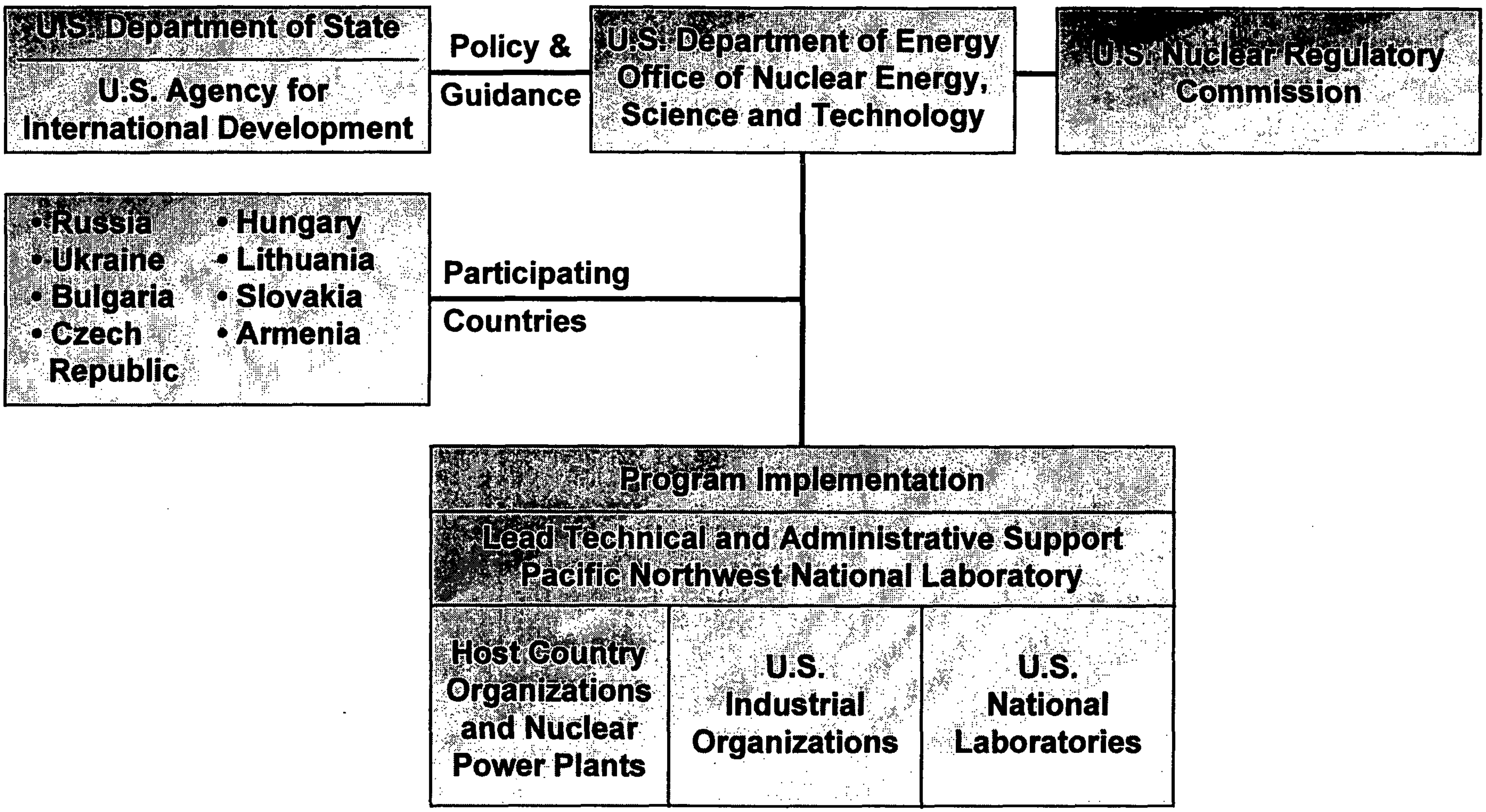
Percent of Electricity from Nuclear Power



A Long-Term Commitment Is Needed to Successfully Address Problems

- The U.S. is working to establish a nuclear safety culture and infrastructure in host countries similar to those in countries with advanced nuclear programs

Program Participants



Program Approach

- Work to be done by host country instead of U.S. contractors where possible.
- Projects mutually selected. Project selection criteria developed. Joint Program Reviews.
- Projects to involve regulator at early stage.
- Host country contributions defined.
- Work done in the U.S. in supplying equipment or expertise primarily from the private sector. Competitive contracting used in most cases.
- Program reports translated and distributed to host countries.

Project Selection

- **First, projects are screened to ensure that they will:**
  - Improve nuclear safety at operating plants,
  - Prevent or contain damage, and
  - Apply established technologies.
- **Then, projects are evaluated using the following criteria:**
  - Impact on safety,
  - Cost effectiveness,
  - Sustainability, and
  - Host country commitment.

Operational Safety

Training:

- Development of training courses based on Systematic Approach to Training.
- Training centers at Balakovo and Khmelnytskyy.
- Technology transfer to other sites.

Simulators:

- Full-scope simulators for Kalinin and Kola in Russia, and South Ukraine Units 1 and 3, Khmelnytskyy, Rivne 3, Zaporizhzhya 2 in Ukraine.

  Analytical simulators for Novovoronezh, Balakovo in Russia and Chornobyl Units 3 in Ukraine.

Operational Safety

Emergency Operating Instructions:

- Based on symptom-based approach used in U.S.
- Initial set implemented at Novovoronezh NPP.
- Being developed for each Soviet design type at pilot plants.
- Transfer technology to other sites.

Management and Operational Control Procedures:

- Based on 16 procedures developed by INPO.
- Completed at pilot plants.
- Host country issues guidelines for all sites.

Plant Safety Evaluation

- Code transfer and training.
- Plant specific safety assessments:

  Russia - Leningrad, Kola, Novovoronezh, Kursk

  Ukraine - South Ukraine #1, Zaporizhzhya
- Independent analysis in Russia by Academy of Science. Resource for regulator.

Dry Cask Storage for Zaporizhzhya

- Transfer technology to Ukraine so it can avoid sending fuel back to Russia for reprocessing.
- Cask baskets, cask transporter, transfer machine and auxiliary equipment shipped.
- Waiting for regulatory approval.

Regulatory Support

- Special support provided to regulator in certain cases related to NPP projects.
- Implementing agreements with Russia and Ukraine on regulation of large research reactors and fuel cycle facilities.

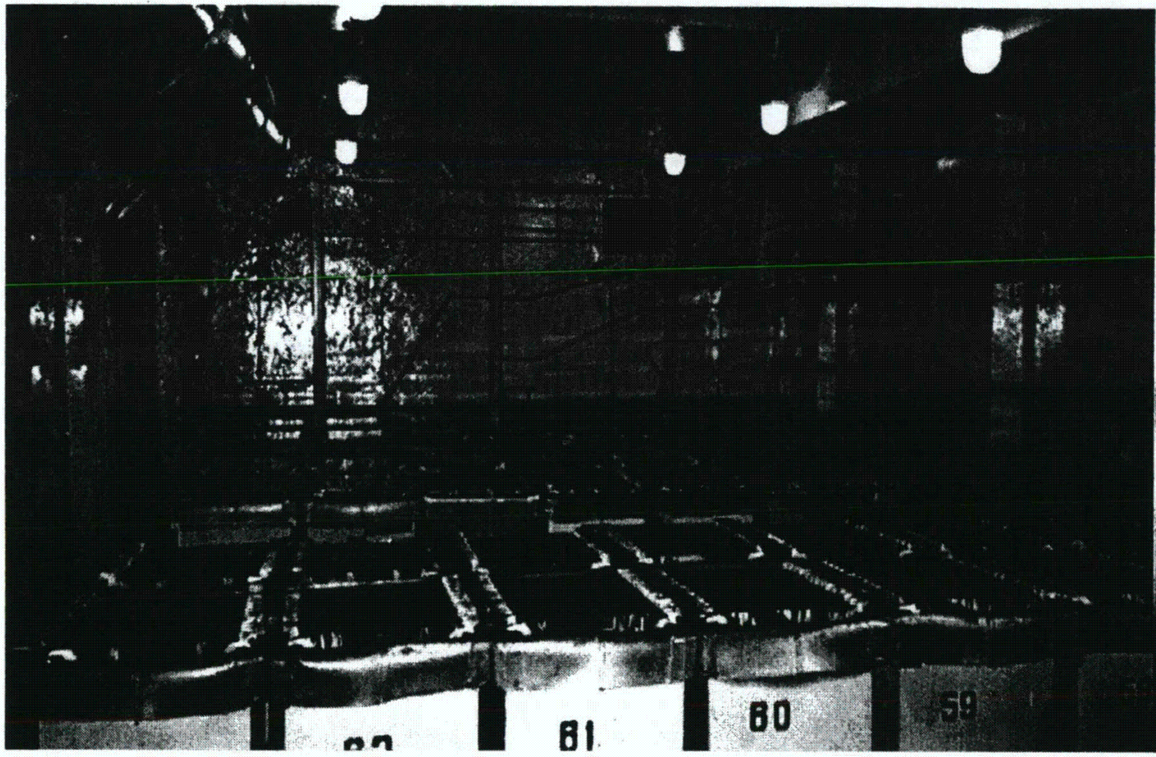
Fire Safety

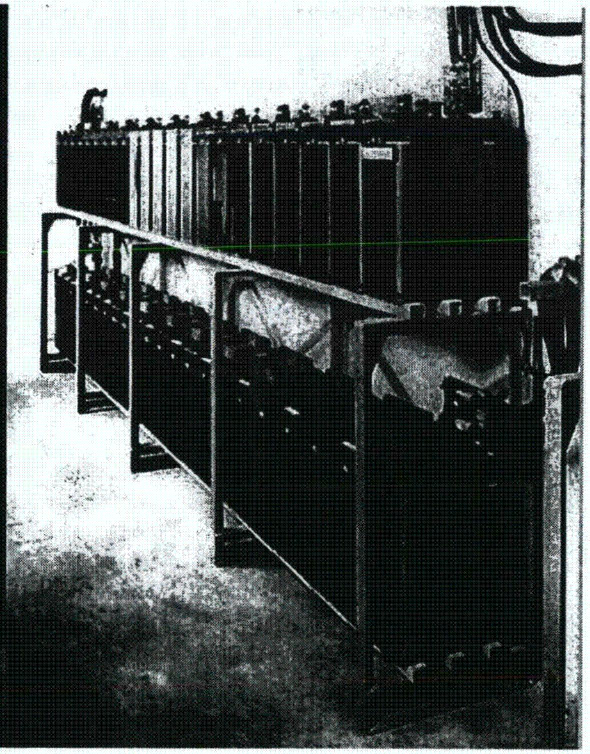
- Plant specific upgrades at Smolensk, Leningrad (Russia), Chornobyl, Zaporizhzhya (Ukraine), and Armenia Nuclear Power Station (Armenia).
- Development of fire hazards analysis guidelines for Soviet-Designed Plants.
- Training in use of fire hazards analysis guidelines at pilot plants.

Safety System Upgrades

- Safety Parameter Display systems for RBMKs and VVERs
- D.C. power supplies
- Confinement leak tightness improvements
- Emergency water supply
- Electronic module replacement
- Ultrasonic test equipment

Reliable DC Power Supply

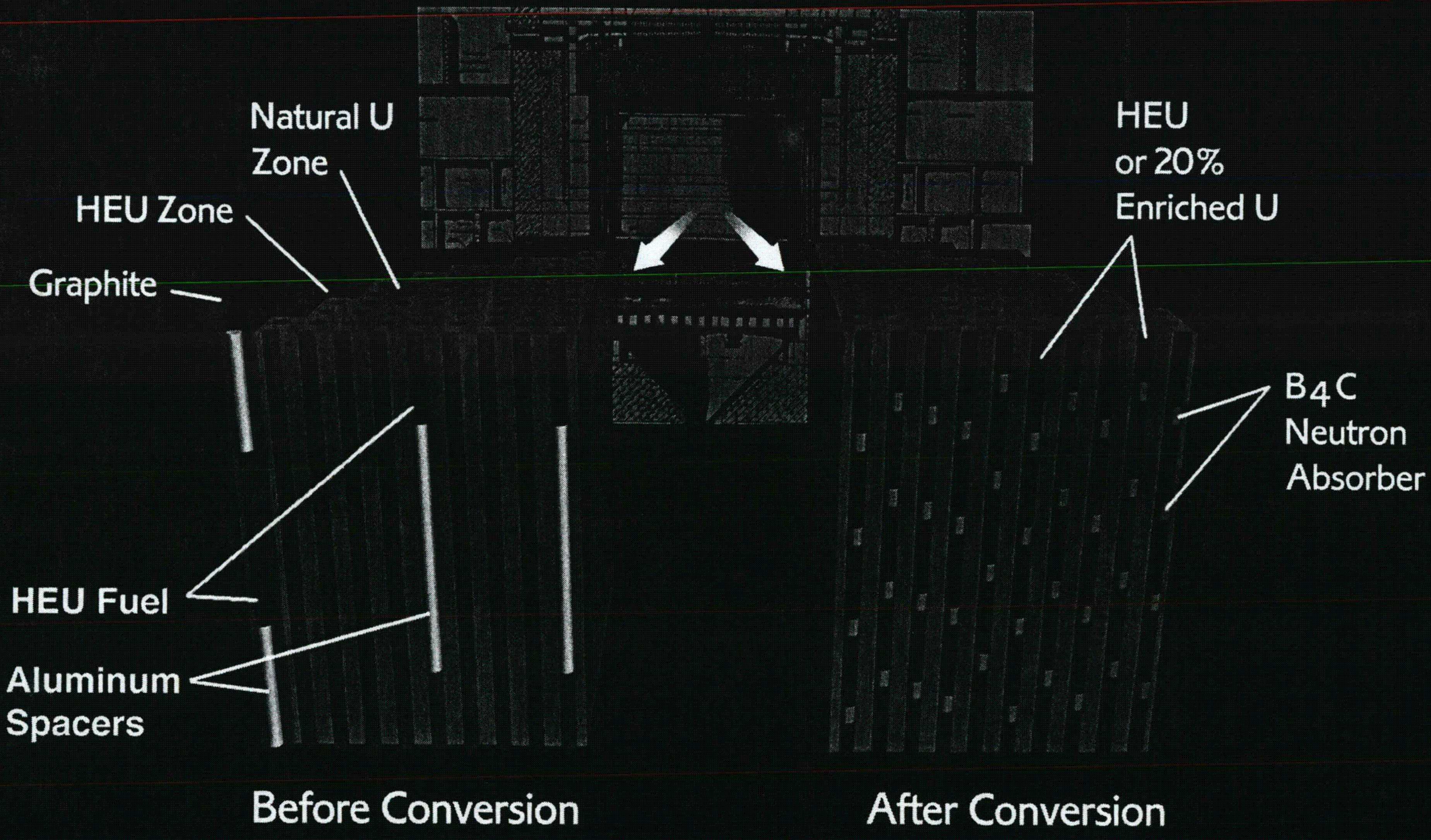




Core Conversion

- Joint U.S. / Russian feasibility study completed December 1995
- Russians fully cooperated
- In June 1996, the Russians agreed to U.S. visiting fuel fabrication plant.
- Project is now proceeding with design and regulatory approval

Core Conversion



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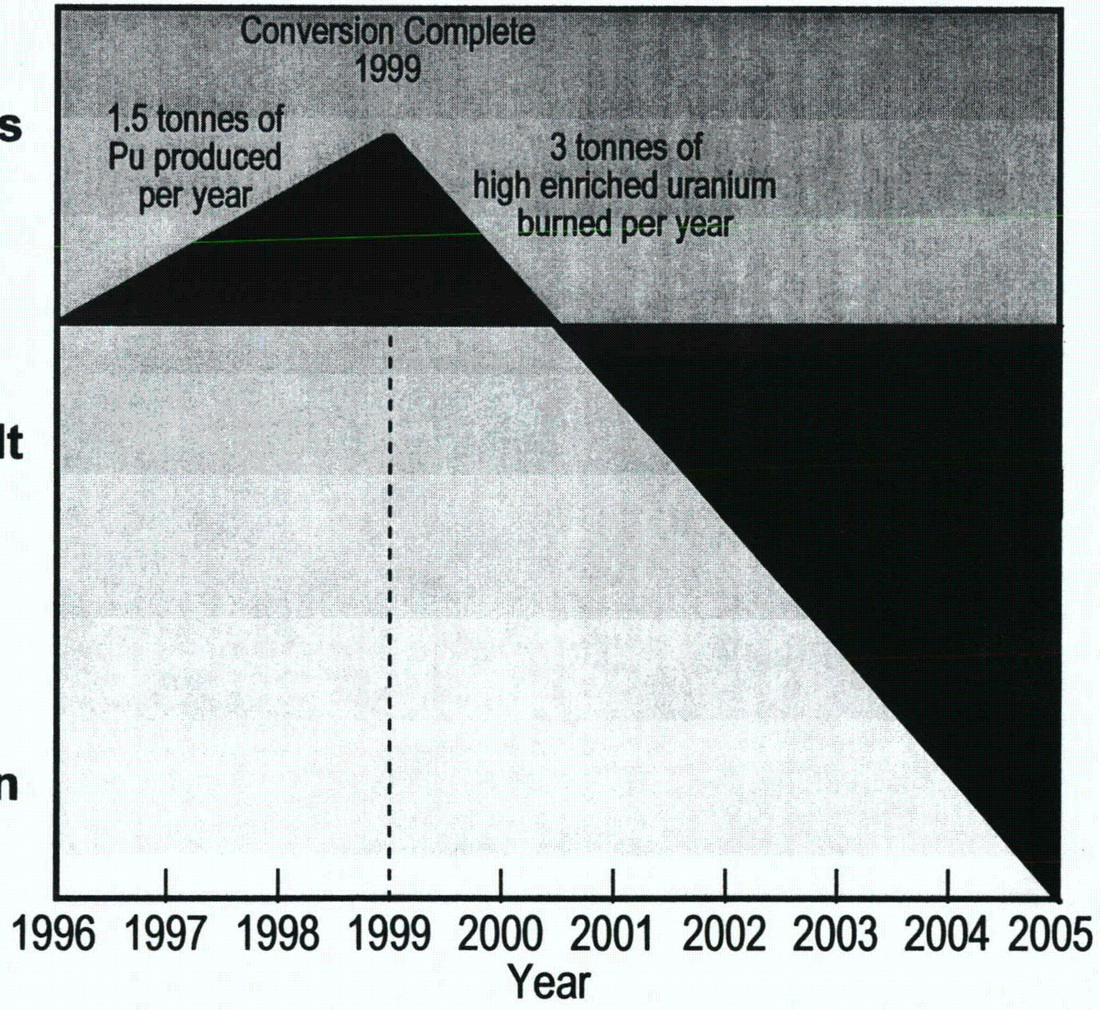
Impact of Core Conversion

- Three Russian plutonium plants continue to operate to meet critical energy needs
- Russia/U.S. completed feasibility study and are proceeding to convert operating mode of plants
- New operating mode will halt plutonium production and consume highly enriched uranium from dismantled warheads
- Conversion supports U.S. goal for worldwide cessation of plutonium production by the year 2000



Phase 2 Scope of Work

- Complete designs for reactor core and plant upgrades
- Conduct reactor tests for fuel and neutron absorbers
- Complete safety analyses/determine safety improvements from upgrades
- Prepare detailed cost estimates for upgrades
- Obtain conversion design approval from GAN

Phase 3 Scope of Work

- Acquire materials and equipment to implement conversion mode
- Perform safety upgrades to reactor plant and supporting facilities
- Install reactor systems and equipment to accommodate core conversion
- Fabricate conversion fuel, unload existing fuel, and load conversion core
- obtain operating approval from GAN
- Perform reactor start-up and operational tests

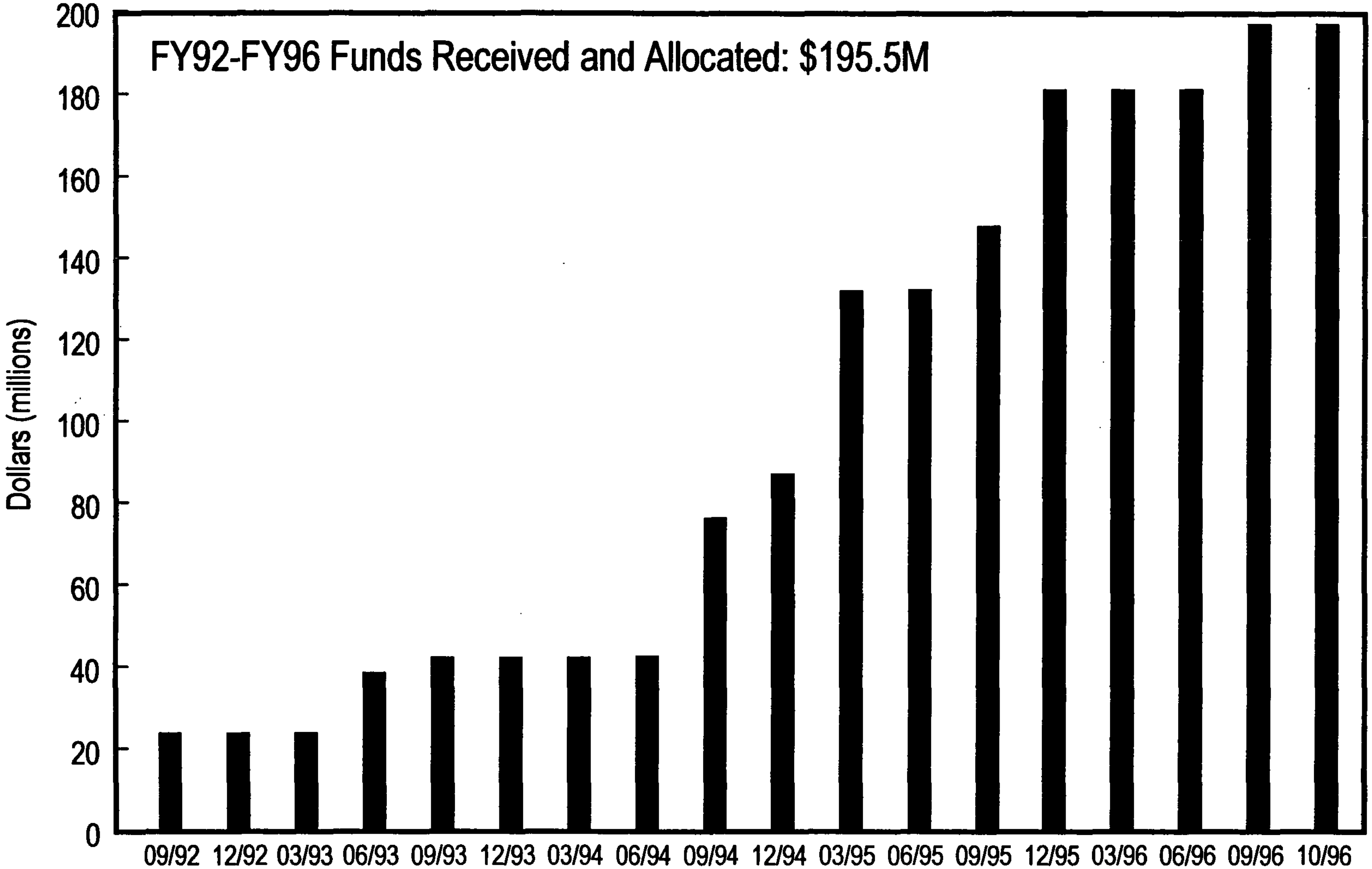
Chornobyl Closure Initiatives

- International Chornobyl Center.
- Dose reduction and worker protection measures.
- Implementation of G-7 short- and long-term measures.

Office of Nuclear Energy, Science and Technology

Funds Received ($M)

October 31, 1996



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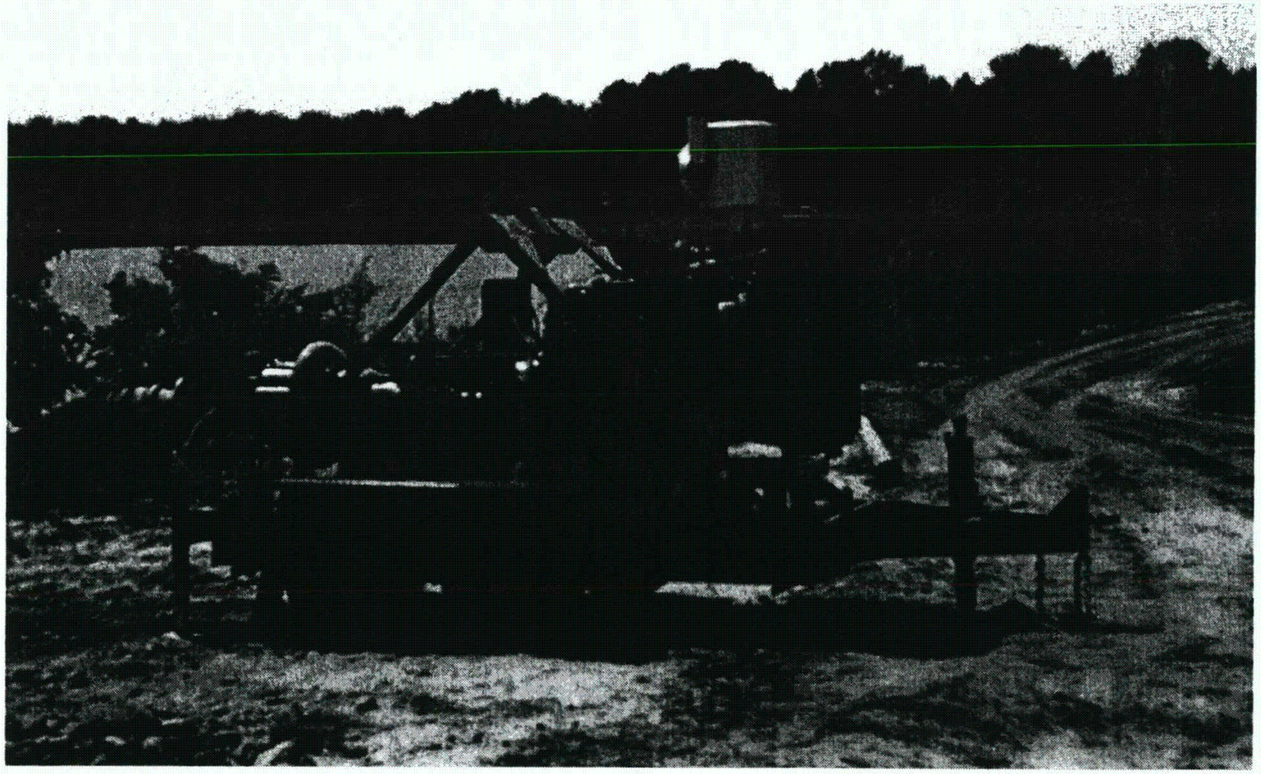
International Nuclear Safety Programs

				FY97 Funding		
	Risk Reduction	Infrastructure Build.	Cessation of Pu Prod.	Energy and Water	Foreign Ops.	Nunn-Lugar
◆ Soviet-Designed Reactor Safety	✔	✔		45	41.5	
◆ Chornobyl Closure Initiatives	✔	✔			25	
◆ Core Conversion	✔		✔	2.5		10

Emergency Pump



Cooperation to Improve the Safety of Soviet-Designed Nuclear Power Plants

U.S. Department of Energy

The U.S. Department of Energy conducts a comprehensive program to increase the safety of Soviet-designed nuclear power plants. The program is designed to provide assistance to Russia, Ukraine, Bulgaria, Czech Republic, Hungary, Lithuania, and Slovakia in their efforts to improve the physical conditions of plants, train plant operators and establish sustainable modern safety technologies and methods. To date, the U.S. has allocated $180 million to this effort.

The program originated from U.S. commitments made at the 1992 G-7 conference to provide assistance to host countries in reducing the risks associated with the older Soviet-designed reactor types - RBMKs and VVER-440/230s. Since 1992, the program's scope has expanded to include a broader range of safety-related activities and four Soviet reactor designs: RBMK, VVER-440/230, VVER-440/213, and VVER 1000.

Benefits

International collaboration to upgrade Soviet-designed nuclear power plants offers significant benefits:

- It aims to prevent a nuclear accident that could destabilize the newly independent countries of Russia, Ukraine and Central and Eastern Europe. Such an accident also could threaten the viability of nuclear power worldwide.
- It supports a stable business climate for U.S. and international investments in the former Soviet Union.
- It provides protection for the public, economic and environmental health of all European countries.

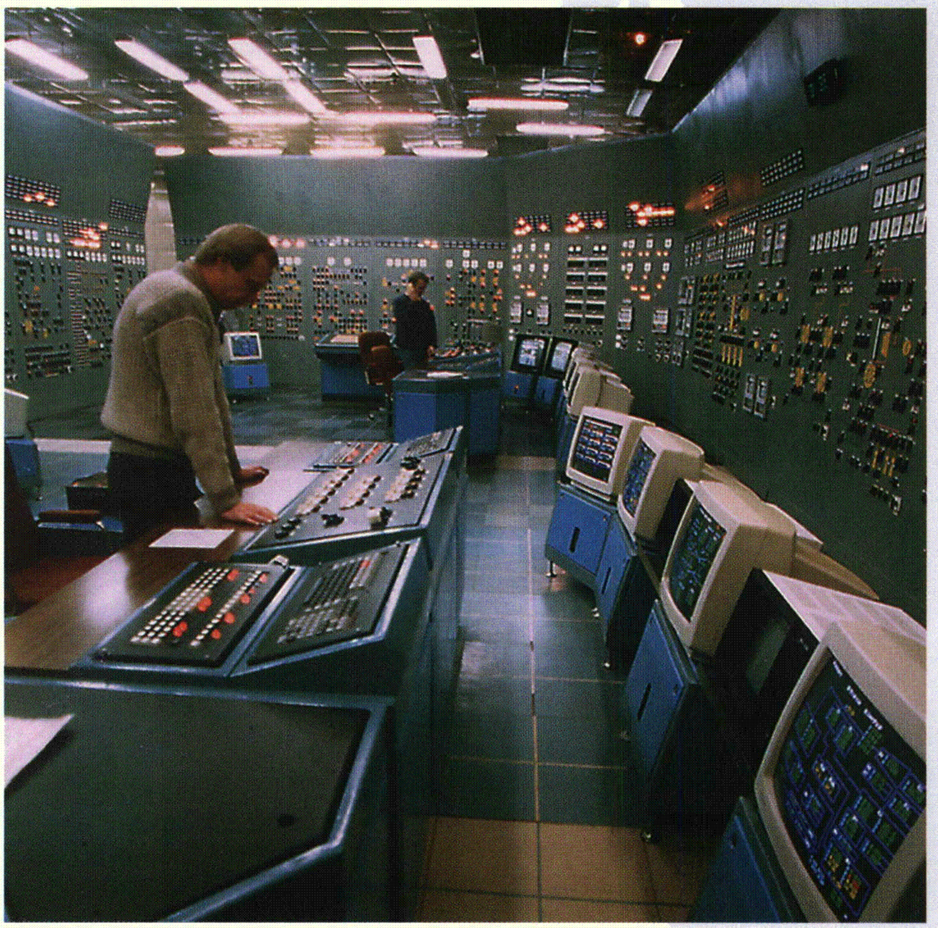
Goals

The U.S. program supports the host countries in their efforts to

- conduct safety evaluations that meet international standards
- obtain technology and skills to create a sustainable indigenous safety infrastructure
- establish a nuclear safety culture in which safety takes priority over other considerations
- develop improved safety procedures and train operators in their use
- establish regional training centers for reactor personnel
- reduce the most significant risks at operating nuclear power plants by upgrading safety systems
- develop a legislative and regulatory framework for nuclear plant design, construction and operation that meets international standards.

Participants

The International Nuclear Safety Program is managed by the Department's Office of Nuclear Energy, Science and Technology. The Department's Pacific Northwest National Laboratory in Richland,



The Balakovo training center in Russia now has a full-scope simulator for training nuclear reactor operators.

Participating Organizations for Nuclear Safety Work in Russia and Ukraine

Russian Participants

Ministry of Atomic Energy (MINATOM)

Gosatomnadzor (GAN)

All Russian Research Design and Development Association (VNIPIET)

ATOMENERGOPR0JECT

General Energy Technologies

GIDROPRESS

Kurchatov Institute

MOHT

Research and Development Institute of Power Engineering (RDIPE)

ROSENERGOATOM (REA)

Russian Academy of Sciences - Institute of Nuclear Safety

Russian Institute for Nuclear Power Plants Operations (VNIIAES)

Russian Nuclear Power Plants

Balakovo

Kalinin

Kola

Kursk

Leningrad

Novovoronezh

Smolensk

Ukraine Participants

State Committee on Atomic Energy Use (Goscomatom)

Ministry of Environmental Protection and Nuclear Safety

Kiev Energo Project

Ukraine Nuclear Power Plants

Chornobyl

Khmelnytskyy

South Ukraine

Rivne

Zaporizhzhya

U.S. Participants

Department of Energy

Department of State

Nuclear Regulatory Commission

Agency for International Development

Pacific Northwest National Laboratory

Argonne National Laboratory

Brookhaven National Laboratory

American Technologies, Inc.

Babcock & Wilcox

Bechtel Power Corporation

Burns & Roe

Control Data

Duke Engineering & Services

Ebasco

General Physics Corporation

Gilbert/Commonwealth Corporation

Haliburton NUS Corporation

Honeywell

International Management Development Corporation

Mariner Engineering Inc.

Matrix International Logistics, Inc.

Orion/Atlantic

Path Training Corporation

Promatec

Raytheon Engineers & Constructors, Inc.

S3 Technologies

Science Application International Corporation

Scientech

Sierra Nuclear Corporation

Stone & Webster, Inc.

Sonalysts, Inc.

Taurus

Westinghouse Electric Co.

Russian reactor personnel get hands-on training in repairing a generator.

Washington, provides technical leadership, with assistance from other U.S. national laboratories, U.S. commercial organizations, and governmental and scientific organizations in the host countries.

The program is conducted in cooperation with similar programs initiated by Western European countries and Japan.

The Department conducts the program in accordance with the guidance and policies of the U.S. Department of State and the U.S. Agency for International Development, in close collaboration with the U.S. Nuclear Regulatory Commission.

Seventeen nuclear power plants with 59 reactor units in seven countries participate in the program, which is reducing risks and improving safety for two basic types of reactors: the RBMK design (a boiling-water, graphite-moderated, pressure-tube reactor) and three VVER designs (pressurized, lightwater-cooled and -moderated reactors). These reactors produce a significant portion of the countries' electricity, ranging from 12.5 percent in Russia to 87.6 percent in Lithuania.

The program has established working agreements with the 17 nuclear power plants, key government agencies, scientific institutions, and engineering and design organizations in all seven host countries.

Contracts have been awarded to 27 U.S. commercial firms for equipment, training, expertise and technology transfer to meet needs identified by the host countries and the program's reactor safety goals.

Key Accomplishments

Program staff have initiated more than 150 safety projects to date. Key accomplishments include:

Safety systems have been upgraded, including:

- fire detection systems, firefighting equipment and metallic fire doors
- backup safety systems, such as a seismically qualified DC-battery emergency power system
- confinement system improvements
- ultrasonic devices to test the structural integrity of equipment
- protective clothing for performing repairs in high-temperature, high-radiation reactor areas
- sealant and isolation valves to tighten barriers against radiation release.

Emergency operating instructions that follow international practices have been put in place or drafted for five plants in Russia and Ukraine.

Reactor simulators are being produced and software developed for operator training.

Projects to improve reactor maintenance are under way at five RBMK reactor sites: Chornobyl in Ukraine, Ignalina in Lithuania, and Leningrad, Kursk and Smolensk in Russia.

The Ukrainian International Research Center on Nuclear Safety, Radioactive Waste and Radioecology is being established in Slavutych, near the Chornobyl site.

Operator exchanges have been conducted. More than 100 staff members from 13 reactor sites in the former Soviet Union have worked with personnel at 11 U.S. nuclear plants to observe operating and safety procedures firsthand.

Nuclear training centers have been established in Russia and Ukraine. To date, more than 700 reactor personnel have been trained there.

Technology transfer and joint ventures between U.S. and host-country companies are enhancing the host countries' ability to manufacture safety equipment, perform safety evaluations and train staff. Transferred technologies include computer display panels for analyzing critical accident parameters and computer codes for conducting safety assessments. A Ukrainian company is manufacturing metallic fire doors according to a U.S.-based design. Training programs also are being "transferred" as host countries develop the capability to conduct most training themselves.

Provision of a dry storage system for spent fuel is under way at the Zaporizhzhya nuclear power plant in Ukraine, which has run out of space in its spent fuel storage pools. Ukrainians have received training and technology for fabricating, using and evaluating concrete casks on site. Cask liners and transporters have been delivered.

High-temperature suits with flexible fabric protect workers against heat, humidity and radiation.

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Locations of nuclear power plants participating in the program to improve the safety of Soviet-designed reactors

Conclusion

Together with the efforts of the host countries and the international community, the U.S. Department of Energy's program will enhance the efforts of Russia, Ukraine, and Central and Eastern Europe to operate their reactors more safely while providing urgently needed electricity. When the program's mission is complete, these countries will have the capability to upgrade and maintain existing reactors according to their own high nuclear standards.

For more information contact:

Kristen Suokko
Office of Nuclear Energy, Science and Technology
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585
E-mail: kristen.suokko@hq.doe.gov
Phone: (202) 586-5559 Fax: (202) 586-8353

L.R. Dodd, Manager
International Nuclear Safety Program Office
Pacific Northwest National Laboratory
PO Box 999
Richland, WA 99352
E-mail: lr_dodd@ccmail.pnl.gov
Phone: (509) 372-4423 Fax: (509) 372-4411
INSP Homepage: http://insp.pnl.gov:2080

L. Walter Deitrich, Director
International Nuclear Safety Center
Argonne National Laboratory
Argonne, IL 60439
E-mail: deitrich@anl.gov
Phone: (708) 252-4571 Fax: (708) 252-4780
INSC Homepage: http://www.ra.anl.gov/INSP

Improving the Safety of Soviet-Designed Nuclear Power Plants

International Nuclear Safety Program
Office of Nuclear Energy, Science and Technology
U.S. Department of Energy

Status Report March 1996

Status Report : Improving the Safety of Soviet-Designed Nuclear Power Plants

March 1996

International Nuclear Safety Program

Office of Nuclear Energy,
Science and Technology

U.S. Department of Energy

LETTER FROM THE DIRECTOR


MH Photography

This status report describes activities and accomplishments through February 1996 to improve nuclear safety under the Soviet-Designed Reactor Safety Program. In this program, the U.S. Department of Energy works cooperatively with seven countries to improve the safety of operating Soviet-designed nuclear power plants in Russia, Ukraine, and Central and Eastern Europe.

The United States' program originated with commitments made in 1992 in support of an international agreement to provide immediate safety assistance to older Soviet-designed power plants. Our efforts, combined with those of others in the international community, have contributed significantly to an improved nuclear safety awareness and culture in many of the countries operating Soviet-designed nuclear power plants. The international community is working cooperatively with authorities in the host countries, who have fundamental responsibility for safely operating their nuclear power plants.

In recent months, key projects have been completed or significant progress has been made. For example, designers began developing computerized display systems for use by nuclear power plant operators in Russia. These systems will calculate and display reactor operating data from 8,000 sensors almost immediately, as opposed to nearly 25 minutes using current computers. United States technical firms are working with the Russian nuclear plant design organization to design, build, and install the systems.

A variety of key equipment for improving the safety of operating reactors has been shipped for installation in Russian nuclear power plants. This equipment will improve fire safety, provide more reliable emergency power systems, enhance the ability to confine radiation in the event of an accident, and upgrade the ability to assess equipment structural integrity through ultrasound imaging.

Reactor personnel training is making a real mark in countries where Soviet-designed reactors operate. After working with the United States and other nations to develop and implement training programs, the host countries are developing the capability to conduct most of the training themselves for their reactor personnel. The increased emphasis on personnel training is reflected at the Balakovo nuclear plant—the pilot training center for Russian reactor personnel—where management has increased training staff from three to 60.

We are hearing from our counterparts in other countries about the benefits of the cooperative work. For example, a Ukraine regulatory agency has called the simulator training projects—which use interactive computer programs to simulate control room operation—the most valuable bilateral cooperation project because of the influence on safety and because the equipment and skills are being transferred to host country personnel.

Over the coming years, we plan to continue fulfilling our commitments to our host country partners to support them in acquiring modern safety technology and methods. This approach will decrease environmental and health risks and support a stable business climate for U.S. commercial investments in these countries.

Terry R. Lash

TERRY R. LASH

Director, Office of Nuclear Energy, Science and Technology
U.S. Department of Energy

PROGRAM OVERVIEW

Program Background

The U.S. Department of Energy conducts a comprehensive program to increase the safety of Soviet-designed nuclear power plants. The program originated from U.S. commitments made at the 1992 G-7 conference to provide assistance to Russia, Ukraine, Bulgaria, Czech Republic, Hungary, Lithuania, and Slovakia in reducing risks associated with the older Soviet-designed reactor types - RBMKs and VVER-440/230s. In 1992, the U.S. Agency for International Development authorized $25 million to fund these commitments. The Department was assigned responsibility to support the seven host countries in meeting the following commitments:

- establishing two regional training centers, one in Russia and one in Ukraine
- implementing and extending the operational safety benefits developed for the VVER-440/230 reactor design to other reactor designs
- implementing improvements in safety-related systems at nuclear power plants
- developing a nuclear safety infrastructure.

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Figure I. Locations of Nuclear Power Plants Participating in a Cooperative Program to Improve Nuclear Safety

Nuclear safety culture is an attitude that puts safety first and that permeates the design, construction, operation, and regulation of nuclear facilities. Nuclear safety culture results in stringent safety goals and measures performance against those goals.

Since 1992, the program's scope has expanded to include a broader range of safety-related activities (described below) and four Soviet reactor designs: RBMK, VVER-440/230, VVER-440/213, and VVER-1000 (described and listed in Appendices A and B). To date, funding allocated to the program totals $180 million.

Currently 17 nuclear power plants with 59 reactor units in seven countries participate in the program (see Figure 1). Program activities are designed to

- support host country efforts to reduce risks associated with reactor operations, including strengthening the safety culture
- transfer technologies to the host countries to enable them to develop and sustain an indigenous safety infrastructure.

Participants

Nuclear safety infrastructure is the capability of staff to do their jobs in a manner consistent with the safety culture. A nuclear safety infrastructure relies on well-trained staff with adequate knowledge and resources to design, construct, operate, and maintain nuclear facilities.

The program is managed by the Department's Office of Nuclear Energy, Science and Technology, and is implemented by U.S. national laboratories, U.S. commercial organizations, and various organizations in the host countries. The program is conducted consistent with guidance and policies established by the U.S. Department of State and the U.S. Agency for International Development and in close collaboration with the U.S. Nuclear Regulatory Commission.

Organizations involved in the design, construction, operation, and regulation of nuclear power plants in the seven participating countries work with their U.S. counterparts to assess safety needs, prioritize safety activities, and support the transfer of technologies to other nuclear power plants in their countries. The Department also works with host country regulatory agencies, such as Russia's Gosatomnadzor and Ukraine's Ministry for Environmental Protection and Nuclear Safety, to strengthen the role of the regulatory agencies in enhancing safety at nuclear power plants.

To date, program staff have placed contracts with 27 U.S. commercial firms (see Appendix G) to provide equipment, training, expertise, and technology transfer consistent with needs identified by the host countries and the program's reactor safety goals. The services and materials provided under these contracts account for some 70% of the program's expenditures.

Activities to Reduce Risk and Improve Safety

The Department, the host countries, and the international community have identified what is needed to reduce risks associated with operating Soviet-designed nuclear power plants. Actions are required to improve 1) procedures and practices for plant operation, 2) physical conditions of plants, 3) capabilities for performing safety evaluations that meet international standards, and 4) legislation to support nuclear plant regulation and domestic indemnification for nuclear liability issues. Projects to address these needs are grouped under the following program elements:

Management and Operational Safety - Projects are directed at increasing the safety of day-to-day operations at Soviet-designed nuclear power plants. This is accomplished by establishing practices and procedures for safe operations, improving training programs, increasing the use of training simulators, transferring modern maintenance methods and technology, and developing and implementing symptom-based emergency operating instructions to improve operator response to emergency events.

Engineering and Technology - Projects are directed at improving the performance of safety systems in Soviet-designed nuclear power plants by transferring the equipment and procedures necessary to upgrade the safety of these plants.

Projects are focused on upgrades to fire safety, confinement, and reactor safety systems. These projects also provide for the transfer of technologies needed to sustain safety upgrades.

Plant Safety Evaluations - Projects are directed at improving the indigenous capability of designers, operators, and regulators of Soviet-designed reactors to evaluate the safety of their plants using internationally accepted computer codes, standards, and methods. Projects include the transfer of technology to perform probabilistic risk assessments and safety evaluations used in determining safe operating limits, to quantify safety margins, and to assess plant systems and operator actions that are important to safety.

Fuel Cycle Safety - The fuel cycle includes all activities associated with fabricating and irradiating nuclear fuel and storing and disposing of radioactive waste or spent nuclear fuel. In Ukraine, projects are directed at ensuring the safe storage of spent nuclear fuel by transferring to Ukraine the technology and equipment to design, manufacture, regulate, and operate safely dry storage systems for spent nuclear fuel. In Russia, work is under way with the regulatory authority to transfer U.S. experience in regulating fuel cycle facilities and large research reactors.

Nuclear Safety Legislative and Regulatory Framework - Projects are directed at supporting the development of legislative and regulatory frameworks in the host countries that promote adherence to international nuclear safety and liability conventions or treaties and domestic indemnification for nuclear liability.

Chornobyl Initiatives - The Department, in cooperation with Ukraine, has initiated two major efforts associated with the Chornobyl nuclear power plant. One is the establishment of a Ukrainian International Research Center on Nuclear Safety, Radioactive Waste and Radioecology at Slavutych. The other initiative is to enhance the near-term safety of the reactors that continue to operate at the Chornobyl plant.

Key Accomplishments

To date, more than 150 safety projects have been put in place. Key accomplishments since the program began in 1992 include the following:

- ***Operator exchanges.* One-hundred eleven staff members from 13 nuclear reactor sites in Russia, Ukraine, and Central and Eastern European countries have worked with personnel at 11 U.S. nuclear power plants to observe, firsthand, practices and procedures for safe operation of U.S. reactors.**

  These exchanges are designed to increase reactor safety by demonstrating operating procedures in U.S. nuclear plants. These procedures then are adapted by host country reactor personnel for use in their plants. The operator visits, which are part of the operator exchange program of the World Association of Nuclear Operators, are conducted with the assistance of the U.S. Institute of Nuclear Power Operations.

- ***Simulators and plant analyzers.* U.S. technical specialists developed the individual computer models for the simulator for Ukraine's Khmelnytskyy nuclear power plant and are working with a Ukrainian company that is constructing the simulator panels. A team of 22 Ukrainian specialists is participating in the development of the Khmelnytskyy simulator; this experience also will enable them to lead the development of simulators for the Rivne and South Ukraine plants later this year. U.S. technical specialists are assembling the simulator**

computers for the full-scope simulators for Russia's Kola and Kalinin plants. Design specifications have been written for analytical simulators for Russia's Balakovo and Novovoronezh nuclear power plants. Two plant analyzers that simulate Bulgaria's Kozloduy nuclear power plant processes have been provided to the Committee for Peaceful Purposes of Atomic Energy, and a plant analyzer has been provided to the Ignalina Safety Analysis Group at the Lithuanian Energy Institute. Specialists from the United States continue to work with representatives of these organizations as they use these plant analyzers to perform detailed safety analyses of nuclear power plants.

Full-scope simulators are full-sized replicas of actual control panels, complete with equipment such as switches, controllers, indicators, and recorders. **Analytical simulators** use computer screens that simulate plant systems; operators enter computer commands to "operate" equipment.

As in the airline industry and the military, simulators have proven to be very effective in improving operator proficiency, particularly operator responses to abnormal events. Simulators are computerized tools that provide a realistic representation of reactor operating conditions, including abnormal situations. Simulators also are used to validate emergency operating procedures. An important part of this work is transferring to the host countries the technology they need to manufacture and maintain simulators. Plant analyzers are computer systems that simulate heat, flow, and fission processes in a nuclear power plant. Plant analyzers are used to analyze reactor safety; these analyses also are used to develop procedures and instructions for normal and emergency operations.

- *Training.* **Nuclear training centers have been established at the Balakovo and Khmelnytskyy nuclear power plant sites in Russia and Ukraine, respectively. Training specialists from these plants now are training other Russian and Ukrainian nuclear plant personnel using a U.S.-developed method that focuses on the knowledge and abilities required to perform essential tasks.**

Training enhances the knowledge and awareness of plant personnel regarding reactor operating characteristics and how they relate to plant safety. Training programs focus on reactor operations, maintenance, management, and safety issues. The use of centralized training centers is an effective and efficient way to transfer systematic, standardized training methods to technical staff at nuclear power plants in Russia and Ukraine. In Russia, 9 of the 18 planned courses have been completed. In Ukraine, 6 of 11 planned courses have been completed. To date, more than 700 reactor personnel have participated in one or more courses at these two centers.

- *Emergency operating instructions.* **Program staff and host country experts are developing and implementing symptom-based emergency operating instructions.**

Emergency operating instructions enhance operational safety by improving the ability of operators to quickly diagnose and respond to abnormal events. Symptom-based emergency operating instructions identify potential accident conditions and actions to mitigate accidents. The instructions enable reactor operators to stabilize the reactor in response to "symptoms," or changing reactor conditions, without performing an evaluation to determine the cause for the changes. This approach leads to faster and more accurate decision making than the event-based instructions currently used in Soviet-designed nuclear plants and formerly used in the United States before the Three Mile Island nuclear plant accident.

Host countries, supported by program staff, have developed 12 guidelines that establish the process for creating symptom-based emergency operating instructions. These guidelines provide the foundation for the in-country capability to develop, validate, and update emergency operating instructions at all Soviet-designed nuclear plants participating in the program.

In conjunction with emergency operating instructions work being undertaken by the program and individual nuclear power plants, Goscomatom (Ukrainian State Committee on Nuclear Power Utilization) issued a decree in April 1995 that all Ukrainian reactor sites must develop and implement symptom-based emergency operating instructions.

At the Novovoronezh nuclear power plant, 22 of 32 emergency operating instructions for the VVER-440/230 reactors have been implemented. In addition, emergency operating instructions at five nuclear plants in Russia and Ukraine have been drafted and are awaiting analyses by host country experts to support verification. This includes all 49 emergency operating instructions for Balakovo's VVER-1000 reactor, 23 of 42 for Kola's VVER-440/213 reactor, half the instructions for Smolensk's RBMK reactors (total number to be determined after development), all 47 for Zaporizhzhya's VVER-1000 reactors, and 19 of 33 for Rivne's VVER-440/213 reactors.

Though emergency operating instructions are not yet implemented fully, the process of developing them already is paying off in improved safety. One plant, using knowledge gained during visits to the United States and during the drafting of their new emergency procedures, was able to avoid a potentially serious reactor operating event. In addition, as a result of conducting safety analyses required to support these procedures, personnel identified several plant design deficiencies that now are being addressed.

- ***Reactor maintenance improvement.* Program staff, working with host country experts, established a project to improve day-to-day maintenance operations at five RBMK reactor sites: Leningrad, Kursk, and Smolensk in Russia; Chornobyl in Ukraine; and Ignalina in Lithuania.**

Proper maintenance of safety-related equipment is essential to assure that it will perform as required. An advisory board involving all five reactor sites ensures that maintenance improvements are implemented and sustained effectively. U.S. support includes transferring state-of-the-art technology and associated training. This support is expected to provide tangible enhancements in safety and maintenance practices within 2 years, as opposed to nearly 7 years to achieve the same benefits with training improvements only.

- ***Systems upgrades.* Equipment for improving safety systems has been shipped for installation in five nuclear power plants. This equipment included fire protection equipment for the Leningrad, Smolensk, and Zaporizhzhya plants; a safety-grade DC power system for emergency power for the Kola plant; equipment to improve the ability of the confinement system to maintain radiation isolation for the Kola plant; ultrasonic testing devices for equipment inspections for the Kursk plant; and protective clothing for working in high-temperature, high-radiation reactor areas for the Kursk plant.**

Equipment and methods for reducing plant risks are being transferred to the host countries. The technology associated with the use and manufacture of safety equipment also is being transferred to develop indigenous capabilities for continued safety improvements. An example of successful technology transfer is a U.S.-based fire door design that now is being manufactured by the Ukraine company Asken for use in Ukraine nuclear power plants.

- *Spent fuel storage.* **The transporter and cask liners for the spent fuel dry storage system have been delivered to Ukraine's Zaporizhzhya nuclear plant. Technology transferred to Ukraine has provided capabilities for fabricating concrete casks on site. To support the Ukraine government in licensing the dry storage system, four Ukrainian regulators received 5 weeks of hands-on training from U.S. experts in using U.S.-developed computer codes to calculate predicted cask conditions.**

  Additional spent fuel storage space is required to prevent Ukraine's Zaporizhzhya nuclear power plant from exceeding the capacity of its spent fuel storage pools. The United States is supporting Ukraine in this effort by transferring the technology for fabricating and licensing the dry cask storage system. After Ukraine regulatory officials approve a construction license in early 1996, the rest of the cask system will be completed in Ukraine. Loading of spent fuel into the first cask is scheduled for late 1996.

Program Progress and Future Direction

The pace of progress has increased significantly during the past 2 years, largely because of the following accomplishments:

- Working agreements have been put in place with all 17 nuclear power plants and with key government agencies, engineering and design organizations, and scientific institutions in the host countries.
- Liability issues have been sufficiently addressed so that U.S. firms now are willing to provide services and equipment to host countries for U.S. government-funded activities. Additional efforts are required, however, to reach final resolution of liability issues so that private sector involvement in improving the safety of these reactors is strengthened.
- Contracts are in place with 27 U.S. commercial companies (see Appendix G) to provide equipment, technical expertise, and services to improve nuclear safety in the host countries.
- Technology transfer is beginning to show results, as evidenced by enhanced capabilities in host countries for manufacturing safety-related equipment for nuclear power plants; enhanced capabilities within the host countries to perform safety evaluations, train staff, and upgrade operational procedures and practices; and formation of joint ventures between U.S. and host country companies.

The Department will continue working to

- reduce the risks that most affect the safety of operating nuclear power plants
- develop, via technology transfer, a sustainable safety infrastructure in the host countries
- establish an enhanced safety culture among plant personnel
- strengthen the role of nuclear regulatory agencies in the host countries
- develop quantitative methods for measuring the effects of safety enhancements on plant operation
- improve the effectiveness of doing business in the host countries by addressing issues such as equipment delivery, contract negotiations, and communication methods.

CONTENTS

FIGURES

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) conducts a comprehensive effort, in cooperation with partners in other countries, to improve nuclear safety worldwide. A major element within the program is to improve the safety of Soviet-designed nuclear power plants in Russia, Ukraine, Bulgaria, Czech Republic, Hungary, Lithuania, and Slovakia.

The Department's program is conducted consistent with guidance and policies established by the U.S. Department of State and the U.S. Agency for International Development and in close collaboration with the U.S. Nuclear Regulatory Commission. The program is managed by the Office of Nuclear Energy, Science and Technology, and is implemented by U.S. national laboratories, U.S. commercial organizations, and various organizations in the host countries. Figure 1.1 shows the organizational relationships of the program participants.

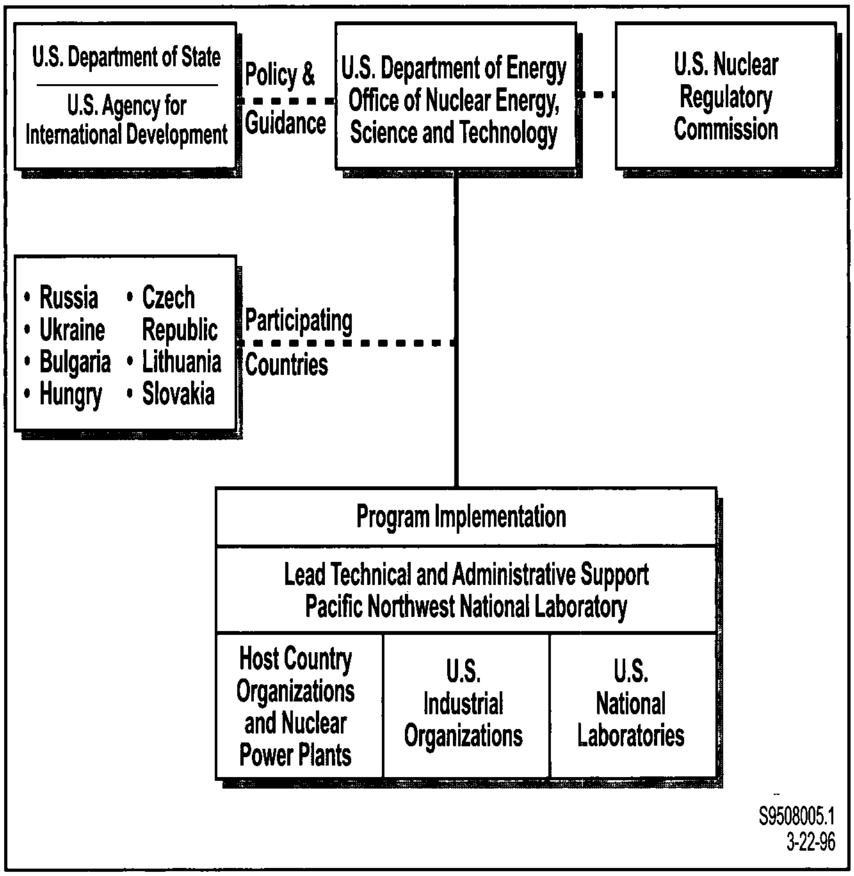

Figure 1.1 Program Participants

Currently 17 nuclear power plants with 59 reactor units in seven countries participate in the program, as shown in Figure 1 in the summary of this report. These plants use reactors of either the RBMK design or one of three VVER designs described further in Appendix A and listed in Appendix B. The percentage of electricity produced from nuclear reactors in the host countries ranges from 12.5% in Russia to 87.6% in Lithuania.

1.1 Program Objective

The overall objective is to support host countries in their efforts to improve the level of safety of the Soviet-designed reactors. To achieve this objective, activities focus on

- strengthening the operational and physical condition of the plants
- enhancing the safety culture among designers, constructors, and operators of the plants
- supporting the development of an indigenous nuclear safety infrastructure for sustaining satisfactory safety levels.

1.2 Report Scope

This report summarizes activities of the program since it began in 1992 through February 1996. Section 2.0 describes program element objectives and approaches. Sections 3.0, 4.0, and 5.0 summarize activities relevant to Russia, Ukraine, and the Central and Eastern European countries, respectively. Each section describes the work and accomplishments by program elements.

The appendices provide additional detail:

-A: brief descriptions of the different reactor types

-B: numbers and locations of Soviet-designed nuclear power plants

-C: the program financial and schedule summary

-D: list of program activities by program element and country

-E: tables for activities in Russia

-F: tables for activities in Ukraine

-G: list of U.S. commercial organizations providing services and materials

-H: list of acronyms and abbreviations used in this report.

2.0 PROGRAM ELEMENTS

Major activities are organized according to the program elements described below. Not all program elements are being implemented in every country (see Appendix D).

2.1 Management and Operational Safety

The objective of this program element is to increase the safety of day-to-day operations at Soviet-designed nuclear power plants. To meet this objective, typical activities are directed toward

- improving the knowledge and understanding of the operators, maintenance technicians, engineers, and managers relative to the safe operating limits of reactors
- establishing procedures and identifying standards for ensuring that reactors are operated within these limits
- fostering the development of the most effective methods to respond to abnormal conditions, including a major accident.

2.2 Engineering and Technology

The objective of this program element is to support improvements in the performance of safety systems by transferring techniques, tools, and equipment needed to upgrade safety. If required, capabilities to manufacture needed equipment are transferred. To meet this objective, plant operators and maintenance personnel receive training so the host sites have staff with the capabilities to perform safety upgrades as needed. Technology exchange between the United States and nuclear organizations within the host countries is an integral part of each project.

2.3 Plant Safety Evaluations

The objective of this program element is to improve the indigenous capability of the designers, operators, and regulators to evaluate the safety of their plants using internationally accepted computer codes, standards, and methods. This is accomplished through technology transfer and support in performing the safety evaluations necessary to 1) establish safe operating limits, 2) quantify safety magins, and 3) establish the importance of various plant systems and operator actions in reducing overall risk.

2.4 Fuel Cycle Safety

The objective of this program element is to improve the safety of fuel cycle activities by assisting operators and regulators to safely handle, move, and store reactor fuel, and safely operate nuclear fuel cycle and research facilities. In Ukraine, efforts have been directed principally toward providing 1) a dry cask storage system for spent fuel from the Zaporizhzhya nuclear power plant and 2) guidance and training of Ukraine regulators and nuclear power plant personnel in analyzing the adequacy and safety performance of spent fuel storage systems. These efforts included the purchase and delivery of three dry storage casks and associated equipment for use at the Zaporizhzhyanuclear power plant, transfer of technology for fabricating the storage casks in Ukraine, and licensing of additional spent fuel storage capacity. In Russia, activities are focused on enhancing the safety of Russian nuclear fuel cycle facilities and research reactors under an agreement with Gosatomnadzor (GAN), the Russian agency for nuclear and radiation safety.

2.5 Nuclear Safety Legislative and Regulatory Framework

The objective of this program element is to support the development of an improved legal framework in countries with Soviet-designed nuclear power plants. This legal framework promotes

- adherence to international nuclear safety and liability conventions or treaties—Such adherence is needed to ensure the effective exchange of information and technology between countries of the former Soviet Union and other countries with advanced nuclear programs, consistent with internationally recognized safety, environmental, and health standards.
- domestic indemnification for nuclear liability—Such laws will enable advanced safety technology to be purchased directly by Soviet-designed nuclear power plant operators.
- establishment of strong, independent regulatory bodies.

Projects undertaken as part of this program element are closely coordinated with the U.S. Nuclear Regulatory Commission. The DOE involves the regulators of the host countries at an early stage in all activities.

2.6 Chornobyl Initiatives

The DOE, in cooperation with Ukraine, has initiated two major efforts associated with the Chornobyl nuclear power plant. One is the establishment of a Ukrainian International Research Center on Nuclear Safety, Radioactive Waste and Radioecology at Slavutych. Center objectives are

- to develop an indigenous capability for providing operational safety support to Ukrainian nuclear power plants
- to provide a focal point for international cooperation for addressing safety and environmental issues at Chornobyl including waste management, cleanup, and entombment of destroyed Unit 4
- to address socioeconomic concerns and issues associated with the future shutdown and decommissioning of the operating Chornobyl reactors.

The other initiative is to enhance the near-term safety of reactors that continue to operate at the Chornobyl plant. Projects that are under way or planned include enhancing the day-to-day safety of maintenance operation, upgrading fire protection, and increasing operational safety.

3.0 RUSSIA

Reactor Types in Russia

- 11 RBMK-1000s*
- 4 VVER 440/230s*
- 2 VVER 440/213s*
- 7 VVER-1000s*
- 1 BN-600 (breeder reactor)
- 4 light-water-cooled, graphite-moderated reactors at Bilibino

*Participate in Soviet-Designed-Reactor Safety Program

Russia has 29 operating nuclear power reactors at nine different nuclear power plants. Together, these reactors produce 12.5% of Russia's electricity. Of the nine power plant sites, seven (containing a total of 24 reactors) participate in the Soviet-Designed-Reactor Safety Program. Figure 3.1 shows the Russian nuclear power plants that participate in the program.

Six types of reactor designs and models are operating in Russia. To date, the Soviet-Designed-Reactor Safety Program has focused on the RBMK and VVER reactors, which represent 97% of the installed nuclear generating capacity in Russia. Appendix A describes the RBMK and VVER reactors in more detail; Appendix B lists their locations.

The major participating organizations and institutes involved in the design, construction, operation, and regulation of these facilities include

Russian Ministry of Atomic Energy (Minatom) - responsible for developing nuclear reactors and for fuel cycle enterprises

Rosenergoatom (REA) - a business concern of Minatom responsible for all nuclear power plant operations except the Leningrad nuclear power plant

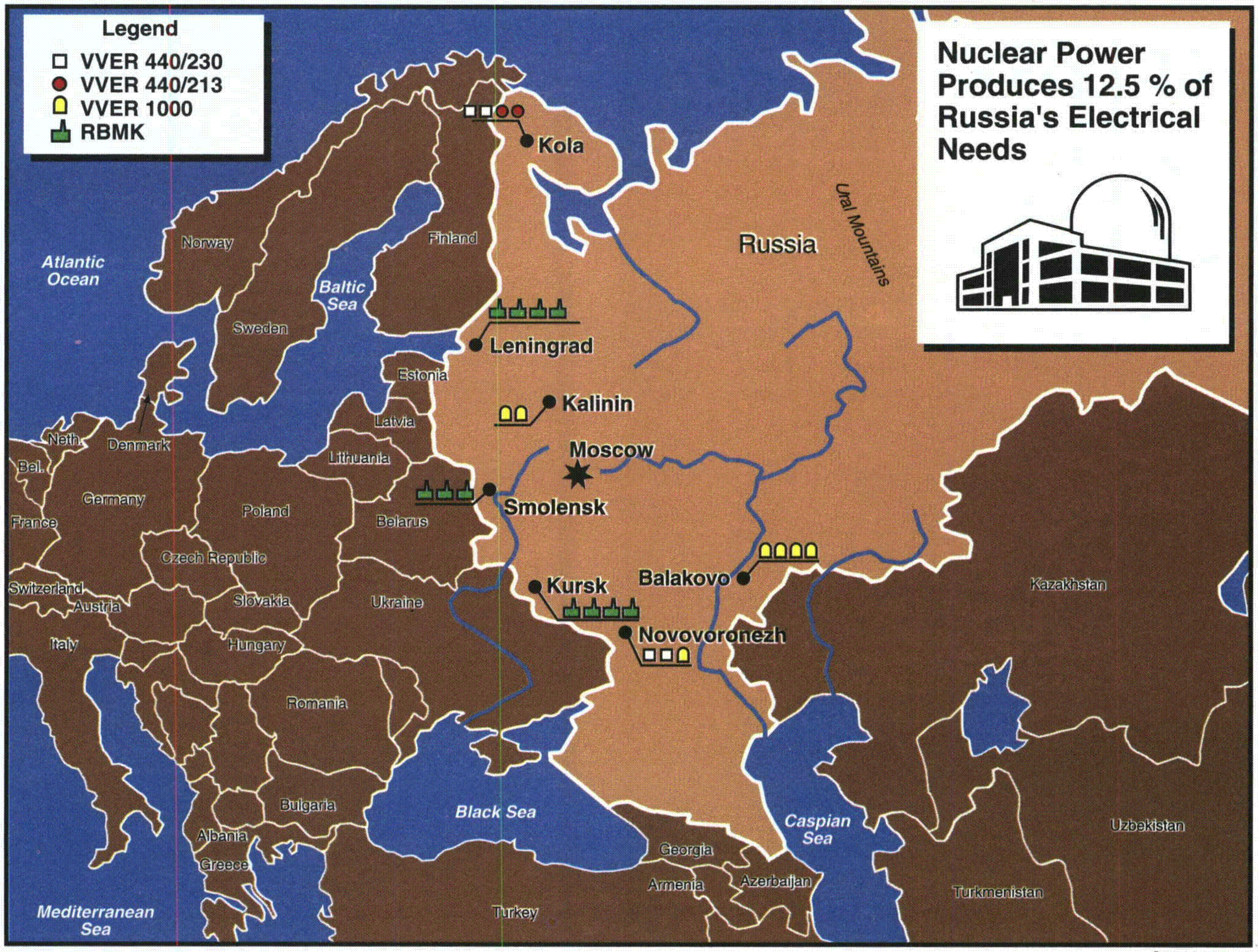

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Figure 3.1. Locations of Russian Nuclear Power Plants Participating in the Soviet-Designed-Reactor Safety Program

The objective of the Management and Operational Safety program element is to increase the safety of day-to-day operations of Soviet-designed nuclear power plants.

Russian Institute for Nuclear Power Plant Operations (VNIIAES) - assists in nuclear power plant startup, operations, and training; manufactures full-scope and analytical simulators

Research and Development Institute of Power Engineering (RDIPE) - main designer of RBMK reactors

Atomenergoproject - VVER and RBMK nuclear facility architect/engineer responsible for the balance of plant design (non-nuclear portion of plant)

Gosatomnadzor (GAN) - Russian organization responsible for regulating the safety of nuclear reactors and fuel cycle enterprises

Russian Academy of Sciences - Nuclear Safety Institute (IBRAE, Moscow) - independent organization specializing in the development of nuclear safety computer analysis methods

Kurchatov Institute - Russian scientific center that designs power reactors, research reactors, fuel, fuel cycle facilities, space nuclear reactors; conducts economic and policy studies, metallurgical research, fusion research

Gidropress - Experimental Design Institute - responsible for VVER reactor design, steam generator design and manufacturing, and thermal-hydraulic code development and testing.

The following sections describe project activities and accomplishments of the Soviet-Designed-Reactor Safety Program for Russia through February 1996. Activities are grouped by each of the following major program elements:

- management and operational safety (Section 3.1)
- engineering and technology (3.2)
- plant safety evaluations (3.3)
- nuclear safety legislative and regulatory framework (3.4).

3.1 Management and Operational Safety

Projects in this program element are grouped into the following categories:

- conduct of operations (Section 3.1.1)
- operator exchanges (3.1.2)
- training/simulators (3.1.3)
- emergency operating instructions (3.1.4)
- emergency management and planning (3.1.5)
- maintenance technology transfer and training (3.1.6).

3.1.1 Conduct of Operations

The focus of this activity is the improvement of management and operational safety practices at Russian nuclear power plants. A working group composed of representatives from the nuclear power plants, U.S. industry, the Institute of Nuclear Power Operations, and DOE is developing improved operating procedures for Soviet-designed plants.

Activities Completed ▶

The working group has developed 16 standard guidelines describing how various operational activities will be conducted. These 16 guidelines are based on U.S. Institute of Nuclear Power Operations "Good Practices" and have been modified as appropriate for use at Soviet-designed nuclear power plants. Plant-specific procedures are developed and implemented at various plants, based on these generic guidelines. Currently, Balakovo nuclear power plant personnel have implemented eight such procedures at their plant, which is the pilot plant for this work in Russia. Table E.1 inAppendix E provides the status of each guideline. REA will finalize and distribute these guidelines for implementation when the plant-specific procedures developed from these guidelines have been tested at pilot sites.

One of the ways used to assess the effectiveness of developing standard guidelines and procedures for management and operational controls is to examine how the plant has implemented the plant-specific procedures that are developed from the general guidelines. The Management and Operational Controls Working Group conducted such an assessment on three procedures: conduct of operator (equipment) rounds, operator logkeeping, and control room shift turnover. The assessment revealed one area of special interest in identifying and correcting deficiencies. In November 1995, to address this issue, U.S. utility experts presented information on self-assessment programs to the working group.

3.1.2 Operator Exchanges

Operator exchanges enable Russian nuclear power plant operators to visit U.S. nuclear power plants to observe U.S. approaches to operational safety, especially in the areas of conduct of operations, training, and emergency operating instructions. These exchanges, which began in 1989, are coordinated by the World Association of Nuclear Operators in cooperation with various U.S. nuclear utilities. Beginning in 1994, DOE agreed to assist with this activity by funding some of these operator exchanges. Table E.2 in Appendix E lists the exchanges.

Activities Completed ▶

In January 1995, staff from the Smolensk and Kursk reactor sites visited the Duane Arnold plant in Iowa. Representatives from the Smolensk and Leningrad plants traveled to the United States in May 1995 to visit the Hatch nuclear plant in Georgia. In addition, Leningrad operators visited the Zion nuclear plant in Illinois.

In September 1995, the Point Beach (Wisconsin) nuclear power plant hosted staff members from the Kola plant at an exchange focused on understanding U.S. operating procedures with an emphasis on

3.1 Management and Operational Safety

Key Accomplishments

- A project aimed at enhancing safety by improving day-to-day maintenance operations has been put in place at five RBMK sites: Leningrad, Kursk, and Smolensk in Russia; Ignalina in Lithuania; and Chornobyl in Ukraine.
- All 16 standard guidelines for procedure development for Soviet-designed nuclear power plant operations have been drafted. These will be finalized when plant-specific procedures have been tested at the pilot nuclear power plants. Eight such procedures have been implemented at the Balakovo plant, which is the pilot plant in Russia. Three of the guidelines have been issued in final form by Rosenergoatom.
- Design specifications were written for analytical simulators at the Balakovo and Novovoronezh nuclear power plants and full-scope simulators at the Kola and Kalinin nuclear power plants. S3 Technologies staff are assembling the simulator computers for the simulators for the Kola and Kalinin plants.
- At the Novovoronezh site, 22 out of 32 emergency operating instructions for the VVER-440/230 reactors were verified and implemented. All 49 of the emergency operating instructions for the Balakovo VVER-1000 reactor have been drafted, and Balakovo has completed task one of emergency operating instruction development. Twenty-three of 42 emergency operating instructions were drafted for the VVER-440/213 reactors at the Kola site. Half the instructions for Smolensk's RBMK reactors have been drafted and are being verified by the host country.
- Forty-eight Russian engineers and scientists representing five Russian nuclear power plants visited the United States during 1995 to observe how operating procedures are developed and implemented in U.S. nuclear power plants.
- Six of 12 general training courses and three of six specialized courses have been completed at Balakovo.
- The instrumentation and control electronic soldering training course presented by Balakovo trainers to other Balakovo staff occurred in March 1994, one month ahead of schedule.
- The instrumentation and control maintenance course developed for the Balakovo site was modified for implementation at Khmelnytskyy, and was delivered to the Khmelnytskyy nuclear power plant in Ukraine in July 1995.

The **Systematic Approach to Training** is a U.S.-developed method for establishing qualification requirements and training programs based on the knowledge and abilities required to perform job tasks. This approach provides a standardized framework for developing training materials and providing training.

U.S. activities to provide simulators for the VVER plants at Balakovo, Kola, and Kalinin began in February 1995. This effort, valued at approximately $10 million, includes the computer hardware and software for full-scope simulators for the Kola and Kalinin nuclear power plants, plus analytical simulators for the Novovoronezh and Balakovo nuclear power plants.

For each of the pilot training courses, training specialists from the Balakovo nuclear power plant travel to the United States to participate in course development. They receive instructor training and practice teaching the training courses at Sonalysts, Inc., in Connecticut. After returning to Russia, these trained Balakovo specialists then present the courses to other plant staff.

emergency operating instructions. The four Kola VVER-440/213 plant staff toured the Point Beach and Kewaunee facilities, observed an emergency preparedness exercise, received orientations on emergency operating instruction use and developments, and observed and participated in simulator sessions using the Point Beach emergency procedures. Informal sessions were held with the group on a variety of management and operations topics. The group also met with representatives of the U.S. Professional Reactor Operators Society.

Six representatives from RDIPE and the Smolensk, Kursk, and Leningrad nuclear power plants visited the Duane Arnold (Iowa) facility in September 1995. The objective of their visit was to study U.S. approaches to safe operations, particularly in the area of emergency operating instructions.

3.1.3 Training/Simulators

Training approaches, programs, and equipment are being transferred to the host countries so they can develop and implement improved training for nuclear power plant personnel.

The training effort is focused on improving the qualifications of nuclear power plant personnel in Russia. This is accomplished, in part, by 1) working with personnel at the Balakovo Training Center to improve training programs, 2) teaching the Systematic Approach to Training, and 3) providing the basic equipment necessary for the specific courses being developed at the training center.

Simulator hardware and software are also being provided to Russia for operator training and use in validating emergency operating procedures. The Soviet-Designed-Reactor Safety Program is providing computer equipment and related hardware and software for the development of full-scope or analytical simulators at four Russian reactor sites: Balakovo, Kola, Kalinin, and Novovoronezh. VNIIAES will assist in simulator construction and software development.

These Balakovo Training Center staff are providing specialized training for Russian nuclear power plant personnel. Laser alignment equipment, soldering stations, refueling simulators, and other equipment are being provided to the Balakovo Training Center for use in training courses.

Activities Completed ▶

Training. The Balakovo nuclear power plant was established as the pilot training site for Russia, and a U.S. contractor, Sonalysts, Inc., was selected to assist with developing the training programs at Balakovo. A training needs analysis was performed in cooperation with Balakovo plant managers that identified program development requirements and priorities. Training programs focus on job-specific operations (such as reactor, turbine, and refueling activities); maintenance (such as instrumentation and control, mechanical, and electrical systems); and personnel (such as shift supervisors). In addition, specialized courses are developed that focus on general safety issues.

Brookhaven National Laboratory staff provided basic equipment for the training center at Balakovo. The equipment includes personal computers and other office and classroom equipment necessary to support these training activities. In addition, course-specific equipment is being provided for each course developed. Examples include soldering stations, laser alignment equipment, and a refueling simulator.

Since 1994, six of 12 general courses have been completed and training provided. Six additional courses are being developed. Since 1993, three of the specialized courses have been completed and training provided; three additional specialized courses are being developed. Table E.3 in Appendix Eshows the current status of training program development activities for Russian operators.

A U.S.-sponsored joint Russia-Ukraine International Nuclear Safety Training Program Conference was held June 14-16, 1995, in St. Petersburg. The conference met its objectives: to communicate the ongoing programs at the Balakovo and Khmelnytskyy training centers and to initiate the transfer of technology to other nuclear plants. Twenty-six representatives participated from Russia, including those from nine nuclear power plants, Minatom, Rosenergoatom, Atomenergoproject, VNIIAES, the Smolensk and Novovoronezh Training Centers, Obninsk, and GAN. U.S. participants included representatives from DOE, Pacific Northwest National Laboratory, Brookhaven National Laboratory, Sonalysts, General Physics Corporation, and Millstone Nuclear Training Center.

> "You have chosen excellent people to lead this [Smolensk Maintenance Training Center] project and I have great confidence that they can make it a big success."
>
> *The Lord Marshall of Goring*
>
> Founding chairman of the World Association of Nuclear Operators, Users Group of Soviet-Designed Reactor Operators, United Kingdom

Representatives from DOE, Brookhaven National Laboratory, Sonalysts, General Physics, and Path Training met in Washington, D.C., in October to review the Russian and Ukrainian training program. The reviewers

Russian and Ukrainian Nuclear Training Programs Are a Step Toward Improved Safety

Countries where Soviet-designed reactors operate are improving their safety culture and awareness through more formalized training of nuclear power plant personnel.

Three years ago, the Soviet-Designed-Reactor Safety Program established nuclear training centers at the Balakovo nuclear reactor site in Russia and at the Khmelnytskyy reactor site in Ukraine. These centers were established to help the countries develop a structured approach to training plant workers, which focuses on the specific knowledge and abilities required to perform various tasks.

Program staff are working hand-in-hand with plant personnel to create 12 job-specific training programs for each facility. The programs are based on training guidelines established by the U.S. Institute of Nuclear Power Operations. (This type of training was developed in the United States relatively recently in response to problems at U.S. nuclear power plants.) Training centers are provided also with the necessary equipment to conduct training courses, such as computers, copiers, overhead projectors, and course-specific material. Balakovo and Khmelnytskyy training staff now can take their knowledge to other nuclear power plants to assist in adapting the program for use at other plants.

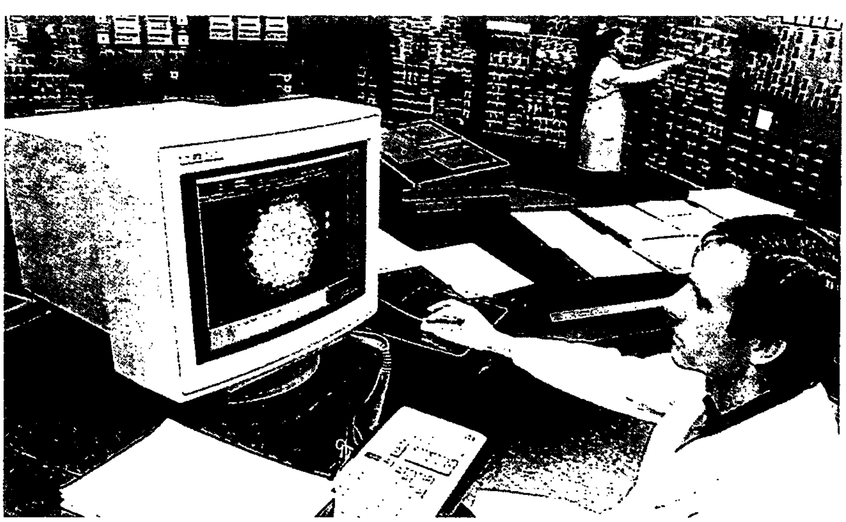
Establishing these training centers and completing more than 50% of the training programs concludes the first phase of a process that will eventually lead to a systematic approach to training throughout Russia and Ukraine consistent with that used in other countries with advanced nuclear power programs.

Full-scope simulators use full-sized physical replicas of actual control panels, complete with equipment such as switches, controllers, indicators, and recorders. **Analytical simulators,** which cost much less, use computer screens that simulate plant systems; operators enter computer commands to "operate" equipment, rather than using switches and controllers as they would in the actual control room or with a full-scope simulator. Both full-scope and analytical simulators use interactive computer programs that simulate control room operation.

determined that the training program was well defined and that training activities are proceeding on schedule.

Simulators. Responsibilities associated with full-scope simulators for the Kola and Kalinin nuclear power plants, as well as for an analytical simulator for the Balakovo plant are as follows, according to July 1995 memoranda of understanding:

- VNIIAES develops the simulator specifications.
- The Kola and Kalinin nuclear power plants supply the building that houses the simulators; fund simulator design specifications; develop simulator models; and test, assemble, and ship the simulators. For the Balakovo plant, the Pacific Northwest National Laboratory and Brookhaven National Laboratory develop the specifications and convert Balakovo's full-scope model to the new analytical simulator. The Balakovo plant reviews and approves the specifications and supplies the building that houses the simulators.
- S3 Technologies provides computer equipment.
- For the Kola and Kalinin nuclear power plants, General Energy Technologies (a joint venture of VNIIAES and S3 Technologies) provides the power supply and computer/control board communication systems. (These are not needed for the Balakovo plant because there is no control board for the analytical simulator.)
- DOE, Pacific Northwest National Laboratory, and Brookhaven National Laboratory provide technical oversight and assist with testing. In addition, DOE provides simulator development funding.



At the Balakovo nuclear power plant, reactor personnel receive training using computer simulators that mimic reactor control room systems.

Contracts were awarded to S3 Technologies to develop the full-scope simulators for the Kola and Kalinin nuclear power plants. S3 Technologies will supply computer hardware and system software for the Kola simulator. The first efforts will result in a comprehensive design for the Kola Unit 4 control room mockup to be used in the simulator. S3 Technologies also will purchase and deliver the computer system and associated software for the Kalinin full-scope simulator.

In December 1995, Brookhaven National Laboratory issued a technical specification for an analytical simulator to the Novovoronezh nuclear power plant for review. Accompanying the technical specification was a draft memorandum of understanding that defined the responsibilities of the organizations involved in the project.

Work in Progress ▶

Sonalysts, Inc., continues to develop pilot training courses for key plant staffing positions that will make use of the new simulators. Russian specialists are conducting training for reactor operators and shift supervisors involved in refueling operations (see Table E.3 inAppendix E). Sonalysts, Inc., is developing additional specialized courses, including instructor training, procedure development, and supervisory skills.

Personnel from the Balakovo nuclear power plant, Pacific Northwest National Laboratory, and Brookhaven National Laboratory are evaluating options for the Balakovo analytical simulator. General Energy Technologies (a joint venture of VNIIAES and S3 Technologies) began designing the Kola Unit 4 control room mockup for the full-scope simulator.

A Russian instructor evaluates the proficiency of reactor personnel in performing a task at the Balakovo nuclear power plant.

3.1.4 Emergency Operating Instructions

Emergency operating instructions aid in the operation, management, and control of plant events and help prevent or mitigate the consequences of accidents. This activity is directed toward the transfer of U.S. methods for developing symptom-based emergency operating instructions for the VVER-440/230, VVER-440/213, VVER-1000, and RBMK nuclear power plants in Russia. Working groups are helping the pilot plants in the development of their site-specific emergency operating instructions. The nuclear power plants prepare the final instructions, then verify and validate them (see the box called "Emergency Operating Instructions—Their Purpose and Development"). The working groups then extend the instructions to other Russian nuclear power plants of similar design.

Activities associated with emergency operating instruction development are highlighted here.

Activities Completed ▶

VVER-1000 Working Group. The VVER-1000 Working Group met at the Zaporizhzhya (Ukraine) nuclear power plant in September 1995. Discussions between Gidropress and the Balakovo, Zaporizhzhya, and Kozloduy (Bulgaria) nuclear power plants resulted in a separate signed agreement with a final prioritization and schedule for reactor analysis work and documentation of technical bases for the emergency operating instructions. The Zaporizhzhya and Kozloduy plants initially will finance the analysis work so it can begin immediately. The work will require 12 months to complete. Zaporizhzhya plant personnel presented Pacific Northwest National Laboratory with the first deliverable for the emergency operating instruction contract. The Kozloduy plant presented a summary of the newly initiated emergency operating instruction development program and delivered a timeline for emergency operating instruction development. All three plants also requested funding for additional working group sessions to supplement the scheduled quarterly working group meetings. These additional meetings address detailed activities required for emergency operating instruction development, verification, validation, and information exchange. A schedule for these meetings is being developed.

The VVER-1000 Working Group met at Kozloduy nuclear power plant in Bulgaria during December 1995. The purpose of the meeting was to conduct an emergency operating instruction development seminar to assist the Kozloduy plant in beginning its emergency operating instruction development activities. Representatives from the

Emergency Operating Instructions — Their Purpose and Development

Emergency operating instructions define the actions to be used by the reactor operators to stabilize the reactor and mitigate the consequences of an accident or other abnormal event.

There are two general types of emergency operating instructions: event-based and symptom-based. Event-based emergency operating instructions require the operators to first identify the cause of the problem(s) and then follow the specified actions for that event(s) (e.g., loss of power, steam generator tube leak, loss of coolant). This type of procedure was used at U.S. nuclear power plants before the Three-Mile Island accident occurred, and is currently used at all Soviet-designed nuclear power plants.

Symptom-based emergency operating instructions specify operator actions based on various plant parameters (e.g., reactor pressure, water level, containment/confinement pressure). Operators take actions in response to changes in reactor operating parameters. This enables them to stabilize the reactor without first having to determine the cause for the changing reactor conditions, which leads to faster and more accurate decision making. This symptom-based approach is currently in use at all U.S. and many other Western nuclear power plants.

Developing symptom-based emergency operating instructions involves several steps:

- Critical safety parameters are identified.
- Mitigation strategies are developed for the critical safety parameters.
- Draft instructions are developed.
- Safety analyses are performed to ensure that the mitigating strategies meet the intent of the procedures.
- Procedures are verified to be technically correct, then validated (usually carried out using a simulator) to ensure that they work as intended.
- Instructions are approved by the plant personnel, owner, and regulator.
- Reactor plant operators are trained to use the approved instructions.
- The instructions are implemented—placed at the reactor plants for use as required.

Balakovo and Zaporizhzhya nuclear power plants, VNIIAES, Goscomatom, and Gidropress assisted representatives from the Institute of Nuclear Power Operations, Pacific Northwest National Laboratory, and U.S. utilities with presentations on key emergency operating instruction development tasks. In addition, the working group members shared lessons learned from their own emergency operating instruction development projects. The Balakovo nuclear power plant has requested that the next Working Group meeting be held at their plant in February 1996.

VVER-440/213 Working Group. The VVER-440/213 Working Group met at the Paks nuclear power plant in Hungary during November 1995. To resolve the approach to analysis, a special ad hoc working group was formed to work outside the normal meeting. The ad hoc group, consisting of representatives from the Kola and Rivne (Ukraine) nuclear power plants, Gidropress, VNIIAES, and the Kurchatov Institute, provided additional details on the analysis needs to support the development of emergency operating instructions. The ad hoc group agreed to emphasize structuring the analysis needs so that timely progress can be made on analyses to support emergency operating instructions development.

Pacific Northwest National Laboratory has contracted the U.S. company NUS to modify PRONET software to make it more user friendly. PRONET is a word processing software, converted to use the Cyrillic alphabet, that enables the writers to develop and manage the set of emergency operating instructions. The modified software will enable users to easily find and concurrently update all applicable procedures to reflect plant modifications or other changes.

VVER-440/230 Working Group. The VVER-440/230 Working Group met at the Kozloduy (Bulgaria) nuclear power plant in December 1995. The meeting was held in conjunction with the VVER-1000 Working Group meeting. Representatives from the Kozloduy and Bohunice (Slovakia) nuclear power plants participated in the emergency operating instruction development seminar presented by representatives from the Balakovo and Zaporizhzhya plants, the Institute of Nuclear Power Operations, Pacific Northwest National Laboratory, U.S. utilities, VNIIAES, and Gidropress. In addition, the Working Group reviewed and commented on three emergency operating instructions drafted by Kozloduy plant personnel. The next meeting is scheduled for April 1996 at the Kozloduy nuclear power plant.

RBMK Working Group. The RBMK Working Group met in December 1995 at the Smolensk nuclear power plant. Participants included representatives from the RBMK nuclear power plants, RDIPE, REA, Institute of Nuclear Power Operations, and Pacific Northwest National Laboratory. This meeting marked the end of event-specific emergency operating instruction development and the transition to symptom-based emergency operating instruction integration (see box, "Emergency Operating Instructions—Their Purpose and Development"). Issues requiring additional attention involve nuclear power plant taxation (U.S. payments to the nuclear power plants for emergency operating instruction development work are being delayed per the host country, until country taxation issues are resolved), the lack of sufficient training infrastructure at some plants to implement emergency operating instructions, and the availability of the necessary reactor analyses to support emergency operating instruction development.

Smolensk nuclear power plant management indicated that they will increase their support for emergency operating instruction development. This announcement is in recognition of upcoming development activities and project milestones.

Gary Boyer (left, from the Wolf Creek, Kansas, nuclear plant) talks with Shamil Akhmetov and Konstantin Sobin from Russia's Balakovo plant about the use of emergency operating instructions for reactor control room operations.

Operators Welcome New Emergency Procedures

Operators at Russia's Novovoronezh nuclear power plant site are using new emergency operating instructions adopted by their facility.

The "symptom-based" instructions are tied to plant symptoms (e.g., changes in reactor pressure, water level, containment/confinement pressure) and can be obtained by operators in seconds. The previous, event-based system at Novovoronezh required operators to determine the cause for changing reactor conditions before taking corrective action.

This often took several minutes to determine, and even longer to implement.

The emergency operating instructions complement new management and operational controls implemented at the plant site. The controls address three basic areas:

- Shift turnover—During daily shift changes, plant operators follow specific procedures to transfer control of critical functions to the new shift.
- Operator rounds—Operators use formal practices to monitor plant systems and performance.
- Control room log keeping—All plant activities and occurrences during each shift are recorded in a log that can be referenced by later shifts.

VVER Seminars. Westinghouse Energy Systems (Brussels, Belgium) presented a 3-week seminar on the Westinghouse dual-column format for emergency operating instructions for pressurized water reactors and its application to VVER plants which are similar to the Westinghouse pressurized water reactor. In a dual-column format, one column identifies required action(s) and the other column identifies an alternate action should the primary action prove ineffective. Classroom lectures and simulator scenarios were used to present the Westinghouse accident mitigation strategies to representatives from the Kozloduy (Bulgaria), Bohunice (Slovakia), and Paks (Hungary) nuclear power plants.

Project Review Meeting. The Kurchatov Institute in Moscow hosted meetings to develop plans for completing emergency operating instructions at Russia's Novovoronezh, Kola, Balakovo, and Smolensk nuclear power plants. Russian attendees included representatives from REA, VNIIAES, GAN, Gidropress, the Kurchatov Institute, MOHT, RDIPE, Atomenergoproject, and the four nuclear power plants. U.S. attendees included representatives from DOE, Pacific Northwest National Laboratory, and the Institute of Nuclear Power Operations.

All affirmed the importance of, and commitment to, completing the emergency operating instructions so that operators can transition away from the event-based approach to the symptom-based one when responding to changing reactor conditions. REA will assume a stronger role in project management and coordination. GAN provided written guidance on regulatory requirements for emergency operating instruction approval. Draft joint project plans were developed. Participants from Russia and the United States will work together to finalize these plans during the next several months.

Technical Exchange. Twelve Russian, Ukrainian, and Bulgarian specialists associated with development of symptom-based emergency operating instructions for VVER-1000 reactors visited the Wolf Creek (Kansas) nuclear power plant during October 1995. These specialists represented training, operations, and engineering organizations from Balakovo, Zaporizhzhya, and Kozloduy nuclear power plants as well as the reactor engineering and design organizations, VNIIAES, and Gidropress. Training and procedure experts from the Wolf Creek plant presented the U.S. approach to verification and validation of emergency operating instructions using classroom lectures and simulator scenarios. In addition, engineers from the Wolf Creek plant presented the methodology and basis for analytical calculations that support the mitigation strategies of the emergency operating instructions. Representatives from Gidropress will apply this newly acquired knowledge to their work on the calculations that support the technical basis documents for the VVER-1000 emergency operating instructions.

Novovoronezh. Twenty-two of 32 emergency operating instructions for the VVER-440/230 reactors have been implemented at the Novovoronezh nuclear power plant.

VNIIAES. U.S. program officials purchased two computer systems in Moscow and delivered them to VNIIAES. These computers are in support of emergency operating instruction development.

Work in Progress ▶

Contract negotiations were completed for the development of symptom-based emergency operating instructions for the Kola VVER-440/213 units and the Balakovo VVER-1000 units. Pacific Northwest National Laboratory staff are purchasing the associated computer and office equipment for the Kola and Balakovo reactor units.

Pacific Northwest National Laboratory staff are coordinating development of emergency operating instructions for RBMK reactors with the Ignalina (Lithuania) nuclear power plant and with Sweden.

3.1.5 Emergency Management and Planning

Emergency management and planning helps reduce the risk of health and environmental impacts, should a plant accident occur.

Activities Completed ▶

Workshops on emergency management and planning were held in Washington, D.C., and Springfield, Illinois, in January 1995 and in Moscow and St. Petersburg in July 1995. Russian attendees represented major nuclear-related governmental agencies, scientific institutes, and nuclear power plants. The objectives of the workshops were to obtain a better understanding of the Russian emergency planning philosophy and methodology and to identify specific areas where U.S. support could be provided.

In December 1995, representatives from DOE and Pacific Northwest National Laboratory met with Minatom to review the status of the emergency preparedness project for Russian nuclear power plants. The discussions resulted in a revised plan, submitted to DOE for review, that better clarifies project details for all stakeholders.

Work in Progress ▶

The Kalinin nuclear power plant is expected to provide its existing emergency response plan. Once this plan is received and reviewed, agreement can be reached on proceeding with emergency response work for that plant.

3.1.6 Maintenance Technology Transfer and Training

The need to strengthen the effectiveness of maintenance at Soviet-designed reactors has been widely recognized and is the basis for U.S. discussions with the international community and the operators of Soviet-designed nuclear power plants. Maintenance activities focus on RBMK reactors, although maintenance technology transfer and training will be applicable to all Soviet-designed reactors.

Activities Completed ▶

In June 1995, an initial agreement was reached between Russian representatives and a U.S. maintenance team regarding the scope of the maintenance project. Russian organizations involved in the meeting to develop the agreement were Rosenergoatom, Atomenergoproject, the Smolensk Training Center, and the Smolensk and Kursk nuclear power plants. U.S. participants included staff from DOE, the Electric Power Research Institute, and Pacific Northwest National Laboratory. In addition, representatives from the Ignalina and Chornobyl nuclear power plants were present during parts of the meeting.

The agreement provides for

- technology transfer of Western maintenance methods, focusing on safety-related information accuracy improvements
- establishment of a maintenance experience information data bank to communicate critical maintenance information among nuclear power plants
- improvement of the maintenance course curricula to reflect current reactor maintenance safety needs
- establishment of an RBMK plant maintenance advisory board to deal with maintenance improvement issues.

In October 1995, the Maintenance Chief of REA met with program participants in the United States. The visit included a tour of defense and commercial reactor operations and maintenance facilities at DOE's N-Reactor and Washington Public Power Supply System's Unit 3 at the Hanford (Washington) site.

The Maintenance Chief also toured a major utility repair facility, two standards-grade instrument manufacturing plants (metrology laboratories certified under the National Voluntary Laboratory Accreditation program by the National Institute for Standards and Technology), and the Electric Power Research Institute Nuclear Maintenance Applications Center in North Carolina. These tours provided examples of some of the infrastructure available in the United States for the support and improvement of maintenance. The REA representative signed a memorandum of understanding with DOE officials to pursue, in parallel, a project aimed at maintenance technology transfer as well as a training project.

In November 1995, the U.S. maintenance team met with representatives from the Chornobyl, Leningrad, Ignalina, Kursk, and Smolensk nuclear power plants; REA; Atomenergoproject; and the Smolensk Training Center. The objective was to obtain site-specific maintenance needs and basic project structure agreements from all RBMK nuclear power plants and REA (the Smolensk Training Center reports to Minatom through REA). The U.S. team was successful in reaching agreement among all parties for the activities and direction of the maintenance improvement initiative.

Maintenance Upgrades Improve Safety at Nuclear Power Plants

According to information presented by the Kozloduy maintenance manager at a nuclear maintenance conference in June 1995, up to 42% of safety-related accidents are traceable to errors in the performance of maintenance.

A new project is aimed at enhancing the safety of day-to-day operations at five sites: Leningrad, Kursk, and Smolensk in Russia; Ignalina in Lithuania; and Chornobyl in Ukraine. The goal of this project will be an increase in operational safety through improving the performance of maintenance.

There are two aspects of this project. The first aspect involves the transfer of modern maintenance methods, technology, and equipment to the plants. The second aspect involves training staff at the Smolensk Training Center to train staff at the plants that are to receive the equipment.

The transfer of state-of-the-art maintenance technology is vital to the success of the effort. With technology transfer, enhancements in safety and maintenance practices should be tangible within 2 years, as opposed to nearly 7 years to achieve the same benefits with training improvements only.

A maintenance improvement advisory board involving countries with RBMK reactors is being formed to ensure that improvements continue after completion of this project.

Work plans were prepared, based on the memoranda of agreement between the United States, REA, and the plants. Risk assessment experts from Pacific Northwest National Laboratory categorized and prioritized requests for advanced technology maintenance equipment using the existing probabilistic risk assessment done for the Ignalina (Lithuania) nuclear power plant. A list of technologies that would most improve operational safety was provided to the Maintenance Advisory Board for consideration.

RBMK plant representatives selected technologies from the list that they felt would provide the most rapid improvement in maintenance performance at the plants. Pacific Northwest National Laboratory staff began procuring the first of the requested advanced technology maintenance equipment, laser alignment/vibration analysis.

Representatives from each RBMK plant, REA, and the United States signed the Maintenance Advisory Board charter in February 1996. By signing the charter, all RBMK plants agreed to participate in the RBMK maintenance improvement initiative as defined by the charter.

Work in Progress ▶

The U.S. team is preparing a resource allocation scheme. The final resource plan will provide for 1) direct funding of training center improvements and training program developments; 2) a common information-sharing network that, per U.S. experience, contributes significantly to common maintenance solutions; 3) fast-track technology transfer of a recognized generic maintenance need; and 4) plant-directed choices from the DOE list of prioritized risk-significant maintenance improvements. The last item allows for project flexibility to take advantage of improvements being provided by other international programs.

Transfer of funding to the Smolensk Training Center to implement the proposed training center improvements is awaiting REA signature on a basic ordering agreement.

3.2 Engineering and Technology

Activities in this program element are focused on upgrading fire safety systems, confinement systems, and engineered safety systems. The focus is to transfer to the host country the techniques, tools and equipment, and practices and procedures needed to improve plant safety. Training in the use of these transferred items also is provided to ensure that indigenous capabilities for performing plant safety improvements are established in the host country.

The objective of the Engineering and Technology program element is to improve the performance of safety systems in Soviet-designed nuclear power plants by transferring the tools, equipment, and procedures needed to upgrade the safety of these plants.

Plants Use Special Materials to Upgrade Fire, Containment Safety

Fires or accidents in nuclear power plants can have widespread consequences. Work is under way at plant sites to identify and reduce fire risks and improve the structures that contain the radioactive material in the event of an accident.

Within the Soviet-Designed Reactor Safety Program, a Texas company, Promatec, is providing its passive fire protection technology to the Smolensk nuclear power plant in Russia. The technology involves replacing a combustible penetration seal material with a fire-retardant penetration seal substance and coating the trays carrying electrical cables with a fire-retardant material.

Electrical cables can be highly flammable because of the composition of their insulation and jackets. The penetrations in the walls and floors through which these cables pass are sealed with a material known as Kamium. Kamium is designed to provide fire-proofing, but in at least one case, a fire broke out when hot metal particles from a welding project fell on the Kamium and it was ignited. The trays that carry the electrical cables also lack effective fireproof barriers that would help prevent a fire from spreading down the cable trays.

At Russia's Kola nuclear power plant, another of Promatec's technologies was used to seal containment building leaks, which could allow the release of radioactive substances to the environment during an accident. Training provided to Russian workers will enable them to install additional containment seal materials in the future.

If an accident should occur, quick-acting **isolation valves** would close piping systems to keep radioactive material from leaking into the environment.

The engineering and technology safety system upgrades for Russian nuclear power plants are described below and summarized in Table E.4 inAppendix E.

Activities Completed ▶

Fire hazards analysis guidelines. Fire hazards analysis is an important aspect of reducing fire risk in U.S. nuclear power plants. Burns & Roe Company and Bechtel Power Corporation staff developed the initial version of *Reactor Core Protection Evaluation Guidelines for Fires at Soviet-Designed Nuclear Power Plants* to help transfer the U.S. experience in performing safe shutdown analyses to partner countries. A working group guided the development of these guidelines. Members of the working group include DOE, Pacific Northwest National Laboratory, Brookhaven National Laboratory, Bechtel, Burns & Roe, Science Applications International Corporation, and the U.S. Nuclear Regulatory Commission. Members of the nuclear industry providing consultation to the working group include General Public Utilities, Arizona Public Service, Engineering Planning and Management, and the Tennessee Valley Authority.

In November 1995, an independent peer review group of technical experts from the United States, Russia, and Ukraine provided comments on the draft guidelines. The peer review group recommended an in-depth review of the guidelines, which now is being performed by fire hazard evaluation experts in Russia and Ukraine. A final version of the guidelines will be issued in July 1996.

Fire safety equipment. The following equipment and materials have been provided to Russian nuclear power plants.

Kola

- Gaskets and sealant material to reduce leakage from the radiation confinement system
- Radiation confinement isolation valves
- Safety-grade DC power system (batteries, racks, and panels)

Kursk

- Hand-held ultrasonic test equipment for leak detection
- Protective suits for use in inspecting high-temperature, high-radiation areas for leaks

At the Kursk nuclear power plant, workers are receiving protective suits similar to that shown for inspecting reactor coolant piping leaks in high-temperature, high-radiation areas.

Open-cell glass batteries such as these can produce large amounts of hydrogen, which could cause an explosion. Glass batteries at Russia's Kola plant are being replaced with seismically qualified, safety-grade direct-current batteries.

Fire safety upgrade tasks begin with improving basic fire detection and suppression capabilities and reducing the amount of combustibles in critical areas. These activities reduce the risk of fire and are necessary to help ensure that the plant can be safely shut down if a fire were to occur. Fire safety activities also include training in fire prevention and fire hazard evaluation techniques.

Smolensk

- Fire protection equipment for fire brigades
- Fire suppression equipment
- Surface preparation equipment and non-flammable surface coating material
- Compressor for self-contained breathing apparatus

Leningrad

- Fire detection equipment

Additional discussion about completed safety upgrade activities follows.

Kursk. Burns & Roe performed the detailed design for a reliable DC power supply for the Kursk plant (similar to the reliable DC power supply system being provided to the Kola site). The most urgent need is for two batteries to be used in the redesigned electrical system that provides improved separation between the safety-related and non-safety-related electrical power supply systems. These batteries have been manufactured and are in transit to the plant.

3.2 Engineering and Technology

Key Accomplishments

- Draft guidelines were developed for fire hazard analyses for Soviet-designed nuclear plants. The guidelines identify ways to prevent fires and reduce the risk of radioactive releases from fire-initiated accidents.
- Direct-current (DC) power supply batteries were provided to the Kola nuclear reactor site in Russia. The seismically qualified, safety-grade batteries, which were manufactured in the United States, will replace the glass batteries formerly used in the reactor and provide the facility with a more reliable DC power supply system.
- The ability of fire brigades to respond to fires at the Smolensk nuclear power plant has been improved by providing fire fighters with protective equipment and fire suppression systems. Fire detection and alarm equipment has been supplied to the Leningrad nuclear power plant.
- The leak-tightness of the Kola reactor Unit 1 and 2 radiation confinement systems has been improved by providing gaskets and sealant materials. Isolation valves also have been supplied to Unit 2. A post-accident radiation monitor has been manufactured, which will indicate when isolation valve closure is required.
- Hand-held ultrasonic test equipment has been provided to the Kursk nuclear power plant for the detection of leaks in reactor coolant system piping. Protective suits also have been provided to the Kursk nuclear power plant to enable visual inspection of leaks in high-temperature, high-radiation areas of the plant. The design of an automated ultrasonic test system for regions that are inaccessible during plant operations also has been completed and a vendor has been selected.

Sites in Russia, Ukraine, Lithuania to Receive Safety Parameter Display Systems

Operators at Kursk, Novovoronezh, and other Soviet-designed nuclear power plant sites soon will have the same tool their American counterparts are using to make informed, timely decisions in abnormal or emergency situations.

Safety parameter display systems were developed as a result of lessons learned from the Three Mile Island accident in 1979 and have been installed in all U.S. nuclear power plants. The system automatically displays the status of critical safety functions, such as the control of the nuclear chain reaction, reactor core cooling, and leak-tightness of the radioactive material confinement system. The safety parameter display system determines whether these functions are within their safe ranges and displays this information in a convenient and easy-to-understand format. As a result, operators can quickly assess the need to implement emergency operating instructions, rather than use valuable time surveying the entire control room.

Russia's Kursk nuclear power plant site will receive the first display system, expected to be operational by late 1996. Kursk is one of three Russian nuclear power plant sites with RBMK reactors. A system also is being developed for the Novovoronezh site, which has VVER reactors. In addition, plans are being made to install the display systems in all operating RBMK reactors in Russia, Ukraine, and Lithuania.

The **safety parameter display system** provides plant operators with information needed to control the plant in the event of an accident. The efforts to provide operators with emergency operating instructions and safety parameter display systems are closely related. The signals displayed to the operator on the safety parameter display system are based on the critical safety functions defined in the development of emergency operating instructions.

Westinghouse Electric Company was selected to provide a safety parameter display system for Kursk reactor Unit 2. Westinghouse is being supported by RDIPE through a joint venture, WESTEK, in providing this system. A unit is being provided to RDIPE to assist in the development of software and displays.

In November 1995, Gilbert/Commonwealth and Westinghouse Electric staff met in Moscow to discuss the conformed specification for the Kursk Unit 2 safety parameter display system. The meeting was hosted by RDIPE and included participation by each of the RBMK nuclear power plants, REA, Atomenergoproject, and GAN. Most technical issues were resolved. Concurrence on the specification was obtained from all parties. The conformed specification was reviewed with DOE and Pacific Northwest National Laboratory staff in December 1995. Also in December, Westinghouse submitted a proposal to DOE for renegotiation of the contract to provide the Kursk safety parameter display system to the conformed specification. Options will be provided for the purchase of up to ten additional systems for RBMK units.

A test was performed at the Kursk nuclear power plant with the simulated electronic characteristics of the safety parameter display system, to verify that the system will not affect the performance of the reactor operating system. This static test was completed successfully in December 1995.The dynamic test with actual safety parameter display system equipment will be performed in 1996.

Kola. A post-accident radiation monitoring system is being delivered to the Kola site to monitor airborne radioactivity within the confinement structure after an accident. This equipment has been manufactured and will be shipped to the plant in March 1996.

Work in Progress ▶

The fire hazards evaluation guidelines are to be completed in July 1996. A training session also will be undertaken at that time for nuclear power plant staff.

Kursk. Another protective suit for the Kursk plant is awaiting Russian Customs clearance. (As with the first suit that was delivered to the Kursk site in January 1996, this suit has been modified based on recommendations from Kursk plant representatives.)

The Kursk nuclear power plant will receive a mobile water pumping unit to provide a mobile emergency water supply.

A Burns & Roe report, *Emergency Water Supply at the Kursk Nuclear Power Plant*, describes the specific components selected for the unit. During the first quarter of 1996, Burns & Roe will purchase and deliver the equipment to the plant site.

Another Burns & Roe report, *Automatic Ultrasonic Testing Equipment Upgrade at the Kursk Nuclear Power Plant*, concluded that automated equipment can be employed successfully to perform weld inspections remotely. The company ABB-CE has been selected to manufacture this equipment.

Novovoronezh. A task order was established with Gilbert/Commonwealth to start Phase I of the taskon the mobile water pumping unit for Novovoronezh Units 3 and 4.This system will provide a mobile emergency water supply for the plant. The initial phase is to develop preliminary equipment specifications and to establish the contractual agreements with the project participants. Staff from Gilbert/Commonwealth and Pacific Northwest National Laboratory met at the Novovoronezh nuclear power plant in December 1995 and in February 1996 with Gidropress, Atomenergoproject, Rosenergoatom, and Novovoronezh plant staff to begin this process.

Vendor selection for the safety parameter display system for the Novovoronezh plant is anticipated during the second quarter of 1996. In addition to the purchase of a safety parameter display system for Novovoronezh Unit 3, a developmental unit will be provided to ConSyst for use in developing displays.

3.3 Plant Safety Evaluations

Activities to support enhanced plant safety evaluations include

- transfer of safety computer codes
- validation of codes
- training in use of new codes
- performance of plant-specific safety evaluations.

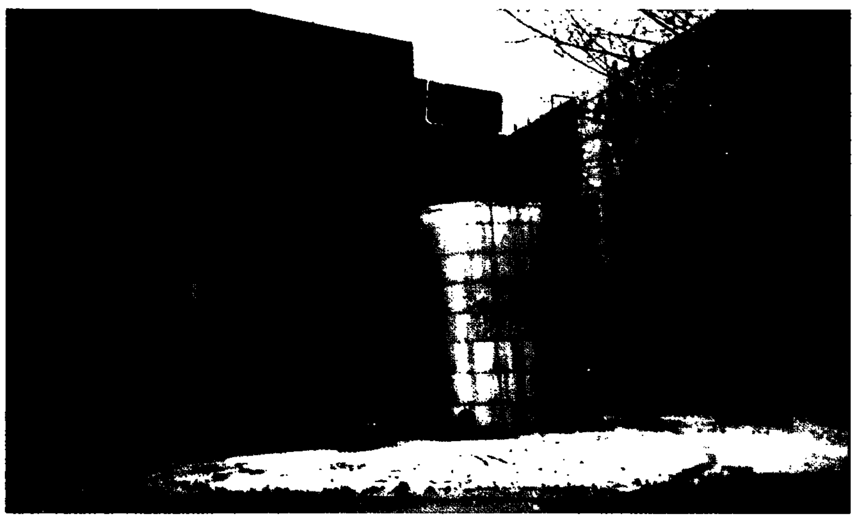
"I would like to thank you and your engineers...for supporting the Smolensk Nuclear Power Plant in their Safety Upgrade Program. We look forward to your continued support."

Vladimir Zaharenkov
Assistant Chief Operating Engineer, Smolensk Nuclear Power Plant

The objective of the activities in this category is shared by other bilateral and international assistance programs. The U.S.-sponsored activities, therefore, have been carefully coordinated with other donor countries.

Activities Completed ▶

Information on best-estimate approaches to analyzing potential accidents at VVER nuclear power plants was shared during a



A new trailer-mounted pumping system will withdraw water from these storage tanks to provide a mobile emergency water supply for the Novovoronezh nuclear plant.

The objective of the Plant Safety Evaluations program element is to upgrade the methodologies, techniques, and expertise that enable the designer, owners, and regulators of Soviet-designed nuclear power plants to conduct safety assessment using improved methodologies and to set priorities for future safety upgrades.

June 1995 meeting in Vienna of consultants for the International Atomic Energy Agency's Extrabudgetary Program. Participants from Belgium, Hungary, Russia, Slovakia, Ukraine, and the United States recommended how best-estimate calculations can be used to improve nuclear safety. A draft report with recommendations was prepared for submittal to the VVER Steering Committee.

Safety culture in nuclear installations was addressed at an April 1995 meeting in Vienna. One hundred sixty-five participants from 25 countries took part in the meeting. It was agreed that the strongest contributing factors to improved safety cultures at nuclear plants appear to be projects that involve many people-to-people interactions such as training programs, simulator and analysis activities, and infrastructure-building programs.

3.3 Plant Safety Evaluations

[illegible]

- Agreement was reached with Sweden and the United Kingdom to sponsor a joint in-depth safety assessment of the Leningrad (Unit 2) plant. This is the pilot project of the RBMK plant-specific safety assessments planned under the Plant Safety Evaluation activities. The technical work for this assessment is to be performed by the Leningrad plant and Russian design and scientific institutes, with technical assistance from U.S., Swedish, and British experts.
- Phase I of an update of the VVER reactor design description "redbook" (*Overall Plant Design for VVER Water Cooled, Water Moderated Energy Reactor*, DOE-NE-0084) was completed by the Nuclear Safety Institute of the Russian Academy of Sciences. This document provides a generic description of VVER reactor designs currently found in Russia and the former Soviet Union.
- Planning is well under way by DOE and the Russian Science and Engineering Center for Nuclear and Radiation Safety to perform a detailed safety analysis of the Novovoronezh nuclear power plant.
- DOE, IVO International of Finland, and the Kola nuclear power plant are working together to perform an in-depth safety analysis of the Kola plant.

Phase I of an update of the VVER reactor design description "redbook" (*Overall Plant Design for VVER Water Cooled, Water Moderated Energy Reactor*, DOE-NE-0084) was completed by the Nuclear Safety Institute of the Russian Academy of Sciences. This document provides a generic description of VVER reactor designs currently found in Russia and the former Soviet Union.

Four Russian specialists—two from the Novovoronezh nuclear power plant, a representative from GAN, and a representative from the Kurchatov Institute—spent five weeks at Brookhaven National Laboratory, where they received hands-on training in the use of the RELAP5 thermal-hydraulics code. During their stay, this team developed an initial RELAP5 input deck for the Novovoronezh nuclear power plant Unit 5.After returning to Russia, members of the team performed deterministic safety analyses to support the probabilistic risk assessment (SWISRUS project) now in progress.

RDIPE provided the program with several deliverables in support of code development for RBMK reactors. These deliverables provide computer code verification and validation for selected computer codes and data that will be used for RBMK plant evaluations.

The Nuclear Safety Institute of the Russian Academy of Sciences is developing recommendations for improving the operational safety of prestressed reinforced concrete containment structures of VVER–1000 nuclear power plants. Detailed computer models were developed that simulate how well the concrete containment structure can withstand various pressure loadings. The Institute issued a preliminary report, *Development of Recommendations to Improve Operational Safety of the VVER–1000 Prestressed Reinforced Concrete Containment*. The report is being peer reviewed.

Two scientists from the Russian Kurchatov Institute completed a 6-month internship at the Pacific Northwest National Laboratory in Washington state under the Special American Business Internship Training program. The internship provided training on performing safety analyses and risk assessments on Russian reactors.

Work in Progress ▶

A project was initiated to provide support in development, verification, and validation of the transient thermal-hydraulic and neutronic analysis computer codes at RDIPE, the primary designer of RBMK reactors. These codes will provide capabilities for the analysis of events such as loss of cooling. The project also will provide the appropriate tools for analyzing overpressure scenarios in the reactor confinement structure.

Two projects are being planned with the Nuclear Safety Institute of the Russian Academy of Sciences. The objective of the first is to develop a technique to provide prioritized lists of safety upgrades proposed for representative RBMK power plants. In this project, the analysis will be based on the consideration of the dominant accident sequences at the Kursk nuclear power plant. The second project will develop recommendations to improve the operational safety of prestressed reinforced containment. This will be done by conducting a strength analysis of the reinforced containment and its prestress system under operational and design accident conditions. This work began in July 1995.

Kola. DOE, IVO International of Finland, and the Kola nuclear power plant staff are working together on the KOLISA project, an in-depth safety analysis of the Kola plant. Participants will conduct deterministic and probabilistic analyses to support safe plant operation and provide an analytical basis for prioritizing the planned physical upgrades.

The KOLISA project coordination group met twice in Moscow, in October and December 1995 to define the objectives and scope of work, identify the project organization and team, develop an approach and schedule, and identify the quality assurance and peer review team and approach. The first task order was signed in December.

Kola nuclear power plant personnel will seek a quality assurance review by GAN independent of the formal project organization and work plan. In addition, the quality assurance and peer review team will, along with the project team, be trained in plant safety analysis methods.

The significant technical progress largely results from the strong leadership role taken by Russian representatives from the Kola nuclear power plant and the Kurchatov Institute.

Novovoronezh. The Novovoronezh in-depth safety analysis (NOVISA), similar to the project discussed above for Kola, is planned for the Novovoronezh nuclear power plant. Staff from the Russian Science and Engineering Center for Nuclear and Radiation Safety delivered a proposal to DOE for completing a probabilistic risk assessment study of Novovoronezh Units 3 and 4.A task order has been placed with the Science and Engineering Center to compile and document the data, methods, and results from a previous unfinished analysis. This deliverable will be used as the basis for finishing a full-scope probabilistic risk assessment project with the Novovoronezh nuclear power plant.

3.4 Nuclear Safety Legislative and Regulatory Framework

The objective of the Nuclear Safety Legislative and Regulatory Framework program element is to support the development of basic nuclear laws and regulations in countries with Soviet-designed nuclear power plants.

Activities under this program element support the development of a legal framework in countries with Soviet-designed nuclear power plants. This legal framework promotes

- adherence to international nuclear safety and liability conventions or treaties—Such adherence is needed to help ensure the effective exchange of information and technology between nuclear programs, consistent with internationally recognized safety, environmental, and health standards.
- domestic indemnification for nuclear liability—Such laws will enable advanced safety technology to be used to a greater extent than under the DOE program to increase the safety of Soviet-designed nuclear power plants.
- establishment of strong, independent regulatory bodies.

Projects undertaken as part of this program element are closely coordinated with the U.S. Nuclear Regulatory Commission. The DOE involves the regulators of the host countries at an early stage in all activities.

Activities Completed ▶

A workshop on international nuclear liability was held in Washington, D.C., in April 1995 for U.S. and Russian experts to review upcoming Russian nuclear liability legislation. Draft legislation was reviewed and commented upon. Participants included Russian representatives from GAN, Minatom, the Russian Institute of State and Law, the Ministry of Foreign Affairs, the State Supervisory Insurance Agency, the ESKO Insurance Company, and the Socio-Ecological Union. U.S. representatives from DOE, the Nuclear Regulatory Commission, the Ad-Hoc Contractors International Group on Nuclear Liability, the American Nuclear Insurers, and U.S. national laboratories also participated.

In October 1995, a workshop was held in the United States with representatives of GAN to exchange information and develop protocols for cooperation in the area of nonlicensed research reactors and fuel cycle facilities.

Two protocols on cooperation were negotiated and signed to improve GAN's regulation of fuel cycle facilities and research reactors for fiscal year 1996. These protocols provide for the exchange of technical information and analytical tools and the training of inspectors.

GAN representatives toured the High Flux Beam Reactor at Brookhaven National Laboratory; the High Flux Isotope Reactor at Oak Ridge National Laboratory; and F Canyon, H AreaTank Farm, the Offsite Fuels Receiving Basin, and Defense Waste Vitrification Plant at the Savannah River Site.

4.0 UKRAINE

Reactor Types in Ukraine

- 2 RBMK-1000s
- 2 VVER-440/213s
- 11 VVER-1000s

Ukraine has 15 operating Soviet-designed nuclear power reactors at five different sites, which provide 32.9% of Ukraine's electricity (see Figure 4.1). Of these 15 reactors, 2 are RBMK-1000s, 2 are VVER-440/213s, and 11 are VVER-1000s. More detail regarding types and locations of reactors are provided in Appendices A and B.

Some of the major organizations and institutes that participate in the Soviet-Designed-Reactor Safety Program and that are involved in the design, construction, operation, and regulation of these facilities include

Goscomatom - responsible for the operations of all nuclear power plants in Ukraine

Ministry for Environmental Protection and Nuclear Safety (MEPNS) – Nuclear Regulatory Administration (part of MEPNS, formerly SCNRS) - Ukrainian nuclear regulatory authority

Kiev Energo Project - Ukrainian architect/engineer

Ukraine Academy of Sciences - parent organization of many scientific and technical institutes with nuclear-related functions.

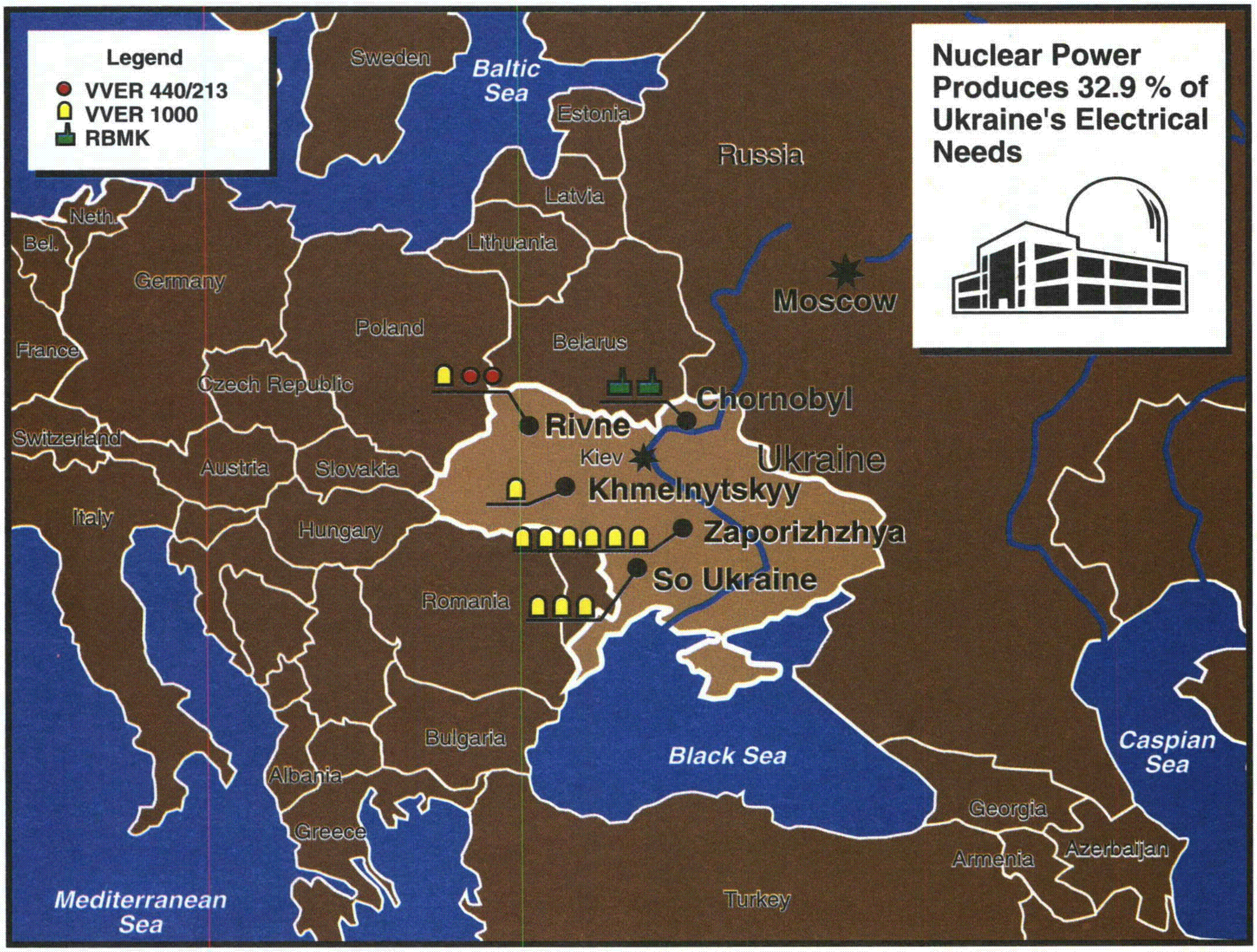


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Figure 4.1 Locations of Ukrainian Nuclear Power Plants Participating in the Soviet-Designed-Reactor Safety Program

The objective of the Management and Operational Safety program element is to increase the safety of day-to-day operations of Soviet-designed nuclear power plants.

Activities in Ukraine are categorized according to the following program elements:

- management and operational safety (Section 4.1)
- engineering and technology (4.2)
- plant safety evaluations (4.3)
- fuel cycle safety (4.4).

Section 4.5 describes activities and accomplishments specifically associated with establishment of the Ukraine International Research Center on Nuclear Safety, Radioactive Waste and Radioecology and projects to upgrade the safety of operating Chornobyl reactors.

Vladimir Ashtamenko (Wisconsin Electric), R. Ashley Erwin (World Association of Nuclear Operators), and Alexandre Rybtchouk (Rivne Nuclear Power Plant) discuss operating procedures during a tour of Point Beach Nuclear Power Plant, Wisconsin.

4.1 Management and Operational Safety

Activities in this program element are grouped into the following categories:

- conduct of operations (Section 4.1.1)
- operator exchanges (4.1.2)
- training/simulators (4.1.3)
- emergency operating instructions (4.1.4).

4.1.1 Conduct of Operations

The focus of this activity is to support improved management and operational safety practices at Ukrainian nuclear power plants. Participants in this effort include representatives from the Soviet-designed nuclear power plants, U.S. industry, and DOE. This working group is developing guidelines and procedures for Soviet-designed nuclear power plants operating in Ukraine. Guidelines describe how various operational activities will be conducted. The working group developed 16 guidelines based on the Institute of Nuclear Power Operations "Good Practices" and modified them as appropriate for use at Soviet-designed nuclear power plants. Plant-specific procedures are developed and implemented at various plants, based on these generic guidelines.

Activities Completed ▶

Eight plant-specific procedures have been implemented at the Zaporizhzhya nuclear power plant, the pilot plant in Ukraine. Recently, one guideline was approved and issued to all Ukrainian nuclear power plants. Table F.1 in Appendix F provides the status of the guidelines and procedures.

The U.S. maintenance team met with representatives from the Chornobyl nuclear power plant as part of a trip to obtain information on site-specific maintenance needs. The U.S. team also toured the Chornobyl plant.

4.1 Management and Operational Safety

Key Accomplishments

- Goscomatom issued a decree in April 1995 that *all* Ukrainian reactor sites must develop symptom-based emergency operating instructions and that Zaporizhzhya would take the lead role in accomplishing this activity.
- All 47 of the emergency operating instructions for the VVER-1000 reactors at the Zaporizhzhya base plant have been drafted and are being verified by host country experts.
- Nineteen of 33 emergency operating instructions for the VVER-440/213 reactors at the Rivne base plant have been drafted and are being verified by host country experts.
- The Crimea Scientific Center signed an agreement with Pacific Northwest National Laboratory for future emergency operating instructions development work in Ukraine.
- All 16 standard guidelines for Soviet-designed nuclear power plants have been drafted. Eight such procedures have been implemented at the Zaporizhzhya pilot plant. One of the guidelines has been issued in final form.
- A memorandum of understanding, defining responsibilities of each organization, was signed for the development of a full-scope simulator for the South Ukraine Units 1 and 3 and the Rivne Unit 3 nuclear power plants. A similar agreement was signed to begin work on an analytical simulator for the Chornobyl plant.
- Detailed design specifications for the full-scope simulator planned for Khmelnytskyy have been completed. The contract for the simulator was awarded to S3 Technologies. S3 Technologies staff are integrating the computer models and working with a Ukranian company that is constructing the simulator panels. A team of 22 Ukrainian specialists is participating in development of the Khmelnytskyy simulator at the S3 Technologies facility in Maryland.
- Three of eight general courses (job-specific) and all three of the specialized courses (systematic approach to training, safety culture, and general employee safety training) have been completed for the Khmelnytskyy plant.
- The mechanical maintenance motor-operated valve repair course that was developed for Khmelnytskyy was modified and transferred to Balakovo for use at the training center.
- Eight Ukraine personnel representing all Ukraine nuclear power plants received 2 months of training in the United States on Western approaches to designing and developing training programs for plant personnel.
- Six operator exchanges occurred, involving 26 staf members from Ukrainian nuclear power plants. This completes all planned operator visits associated with Ukraine.
- During November and December 1995, eight training specialists from the Khmelnytskyy nuclear power plant worked at General Physics Corporation in Aiken, South Carolina. They prepared to teach the reactor vessel repair technician program at the Khmelnytskyy nuclear power plant, which took place in January 1996.

4.1.2 Operator Exchanges

The operator exchange task enables Ukrainian nuclear power plant personnel to visit U.S. nuclear plants and observe U.S. approaches to operational safety, especially in the areas of conduct of operations, training, and emergency operating instructions. These exchanges, which began in 1989, are coordinated by the World Association of Nuclear Operators in cooperation with various U.S. nuclear utilities. The information obtained from these visits is used to determine how the techniques could be adapted to their plants.

Activities Completed ▶

Six operator exchanges, including 26 staf members from Ukrainian nuclear power plants, have occurred through February 1996. Table F.2 in Appendix F lists the exchanges.

4.1.3 Training/Simulators

Training approaches, programs, and equipment are being transferred to the host countries so they can develop and implement improved indigenous training programs for nuclear power plant personnel.

The focus of the effort is to improve the training of nuclear power plant personnel in Ukraine. This is accomplished, in part, by 1) working with personnel at the Khmelnytskyy reactor site to establish training programs, 2) teaching the systematic approach to training, and 3) providing the necessary equipment for the development of a training center and for the specific courses being created. Table F3 in Appendix F summarizes all of the completed, ongoing, or planned training activities.

A full-scope control room simulator for the Khmelnytskyy nuclear power plant is being provided for operator training and use in validation of emergency operating procedures. In addition, in a joint effort with the South Ukraine nuclear power plant, the United States is supporting the purchase of computer hardware and software for a full-scope simulator.

Activities Completed ▶

General Physics Corporation, a U.S. firm that specializes in nuclear training, was selected to provide support in developing the training programs. Specialists from the Khmelnytskyy plant helped develop

Full-scope simulators use full-sized physical replicas of actual control panels, complete with equipment such as switches, controllers, indicators, and recorders. **Analytical simulators**, which cost much less, use computer screens that simulate plant systems; operators enter computer commands to "operate" equipment, rather than using switches and controllers as they would in the actual control room or with a full-scope simulator. Both full-scope and analytical simulators use interactive computer programs that simulate control room operation.

During a mechanical maintenance course at Ukraine's Khmelnytskyy nuclear power plant, reactor personnel receive hands-on specialized training in the latest maintenance technologies.

courses at General Physics Corporation. General Physics Corporation staff visited the Khmelnytskyy nuclear power plant to assist with the courses on control room operators, refueling operator, and reactor vessel repair technician. During November and December 1995, eight training specialists from the Khmelnytskyy nuclear power plant worked at General Physics Corporation in Aiken, South Carolina. They prepared for implementation of the reactor vessel repair technician training program at the Khmelnytskyy nuclear power plant, which took place in January 1996.

Two shipments of training materials were sent to the Chornobyl nuclear power plant as part of the agreement negotiated during a visit to the plant by Brookhaven National Laboratory staff.

Representatives from all Ukraine nuclear power plants received 2 months of training in the United States on the systematic approach to training methodology. This training consisted of 5 weeks of classroom training and 3 weeks visiting and observing training practices at three different U.S. commercial nuclear power plants.

Three of eight general courses (job-specific) and all three of the specialized courses (systematic approach to training, safety culture, and general employee safety training) have been completed for the Khmelnytskyy plant.

In June 1995, a U.S.-sponsored joint Russia-Ukraine international nuclear safety training program conference was held in St. Petersburg. The objectives of the conference were to review and demonstrate the results of the U.S.-supported training efforts at the Khmelnytskyy and Balakovo nuclear power plants, review initiatives and programs from other plants and Russia/Ukraine organizations, and discuss methods for transferring the technology to other plants. Participants included 13 Ukrainians representing the Ukrainian nuclear power plants, Goscomatom, the Ministry of Environmental Protection and Radiation Safety, and the Engineering Center on Personnel Training for the Nuclear Industry.

Detailed specifications for the full-scope simulator planned for Khmelnytskyy have been completed. The contract for the simulator was awarded to S3 Technologies. A training course in computer programming was presented by Brookhaven National Laboratory and S3 Technologies to prepare the Khmelnytskyy plant staff for software modeling for the simulator.

The Ukraine firm Energotraining, with the help of staff from the Khmelnytskyy plant, completed the shipment of simulator control panels from the reactor site to Energotraining's facilities. The panels will be modified to replicate the Khmelnytskyy Unit 1 control room.

DOE, Brookhaven National Laboratory, Pacific Northwest National Laboratory, and Goscomatom staff met to discuss the status of the equipment requested for the Ukraine Simulator Support Center. The equipment list was reviewed, and Goscomatom will send Brookhaven National Laboratory a modified specification taking into account the proposals made during the meeting. Staff from the Ukraine Simulator Support Center and Goscomatom stated that specific software courses would be very desirable; U.S. representatives will consider this request within the allotted funding.

A memorandum of understanding was signed to establish the responsibilities of the participants who are involved in developing the analytical simulator for Chornobyl. Signatories included representatives from the Chornobyl nuclear power plant, Goscomatom, DOE, Brookhaven National Laboratory, and Pacific Northwest National Laboratory.

DOE, Brookhaven National Laboratory, Pacific Northwest National Laboratory, South Ukraine nuclear power plant, General Energy Technologies (a joint venture of VNIIAES and S3 Technologies), and Goscomatom staff held a project meeting in October 1995 at Kiev to discuss the development of a full-scope simulator for the South Ukraine nuclear power plant. The proposed memorandum of understanding, defining responsibilities of each organization, was reviewed, finalized, and signed by each of the project participants.

Work in Progress ▶

The Kursk simulator will be used as the base for the Chornobyl analytical simulator. To adapt the Kursk simulator, staff from Chornobyl met with VNIIAES staff in Moscow to begin identifying the site-specific differences between Chornobyl and Kursk.

Following the completion of their initial studies at S3 Technologies in Columbia, Maryland, 22 Ukrainian specialists are involved in all aspects of simulator development. These aspects include the design phase and software development, which are instrumental in transferring the technology for simulator development.

4.1.4 Emergency Operating Instructions

This activity is focused on transferring U.S. methods for developing symptom-based emergency operating instructions for the VVER-440/213, VVER-1000, and RBMK nuclear power plants in Ukraine. Working groups (representing power plants of similar design) are preparing the instructions for each type of plant. DOE and U.S. utility experts are assisting in this effort. Once the symptom-based emergency operating instructions for these plants have been completed, the working groups will extend them to other nuclear power plants in Ukraine. (See information box "Emergency Operating Instructions—Their Purpose and Development" in Section 3.1.4.)

Goscomatom issued a decree in April 1995 that all Ukrainian reactor sites must develop symptom-based emergency operating instructions and that representatives from Zaporizhzhya would take the lead role in accomplishing this activity. December 1, 1996, was set as a milestone for implementing these instructions.

Activities Completed ▶

VVER-1000 Working Group. The VVER-1000 Working Group met at the Zaporizhzhya nuclear power plant. Discussions between Gidropress and the Zaporizhzhya, Balakovo (Russia), and Kozloduy (Bulgaria) nuclear power plants resulted in a separate signed agreement with a final prioritization and schedule for reactor analysis work and documentation of technical bases for the emergency operating instructions. The Zaporizhzhya and Kozloduy plants initially will finance the analysis work so it can begin immediately. The work will require 12 months to complete. Zaporizhzhya plant personnel presented Pacific Northwest National Laboratory with the first contract deliverable for the emergency operating instruction contract. Kozloduy plant personnel presented a summary of the newly initiated emergency operating instruction development program and delivered a timeline for emergency operating instruction development. All three plants also requested funding for additional working group sessions to supplement the scheduled quarterly

Zaporizhzhya nuclear power plant personnel discuss "emergency" actions during a simulated reactor accident. Such exercises help ensure that emergency operating instructions work as intended while providing operator training.

working group meetings. These additional meetings address detailed activities required for emergency operating instruction development, verification, validation, and information exchange. A schedule for these meetings is being developed.

Since the program began, all 47 emegency operating instructions have been drafted for the Zaporizhzhya plant. Further development is awaiting completion of the needed analysis. An agreement defining the scope, schedule, and cost for the analysis work was signed by the nuclear power plant and Gidropress. Computer equipment for developing emergency operating instructions was delivered to the plant.

The VVER-1000 Working Group met at the Kozloduy nuclear power plant in Bulgaria during December 1995. The purpose of the meeting was to conduct an emergency operating instruction development seminar to assist the Kozloduy plant in initiating its emergency operating instruction development activities. Representatives from the Balakovo and Zaporizhzhya plants, VNIIAES, Goscomatom, and Gidropress assisted representatives from the Institute of Nuclear Power Operations, Pacific Northwest National Laboratory, and U.S. utilities with presentations on key emergency operating instruction development tasks.

VVER-440/213 Working Group. Emergency operating instructions are being developed in Ukraine for the Rivne nuclear power plant. The VVER-440/213 Working Group, of which Ukraine is a member, met at the Paks nuclear power plant in Hungary during November 1995. To resolve the approach to analysis, a special ad hoc working group was formed. The ad hoc group, consisting of representatives from the Kola and Rivne plants, Gidropress, VNIIAES, Goscomatom, and the Kurchatov Institute, provided additional details on the analysis needs to support the development of emergency operating instructions. The ad hoc group agreed to emphasize structuring the analysis needs so that timely progress can be made on analyses to support emergency operating instructions development.

Since the program began, 19 of 33 emergency operating instructions have been drafted for the Rivne nuclear power plant. Development of the additional drafts requires additional analysis. Rivne nuclear power plant signed an emergency operating instructions development contract with Pacific Northwest National Laboratory.

Technical Exchange. Twelve Ukrainian, Russian, and Bulgarian specialists associated with development of symptom-based emergency operating instructions for VVER-1000 reactors visited the Wolf Creek (Kansas) nuclear power plant during October 1995. These specialists represented training, operations, and engineering organizations from the Zaporizhzhya, Balakovo, and Kozloduy nuclear power plants as well as the reactor engineering and design organizations, VNIIAES, and Gidropress. Training and procedure experts from the Wolf Creek plant presented the U.S. approach to verification and validation of emergency operating instructions using classroom lectures and simulator scenarios. In addition, engineers from the Wolf Creek plant presented the methodology and basis for analytical calculations that support the mitigation strategies of the emergency operating instructions. Representatives from Gidropress will apply this newly acquired knowledge to their work on the calculations that support the technical basis documents for the VVER-1000 emergency operating instructions.

The Crimea Scientific Center signed a basic ordering agreement with Pacific Northwest National Laboratory for future work on emergency operating instructions development in the Ukraine.

The objective of the Engineering and Technology program element is to improve the performance of safety systems in Soviet-designed nuclear power plants by transferring the tools, equipment, and procedures needed to upgrade the safety of these plants.

4.2 Engineering and Technology

Activities in this program element are focused on upgrading fire safety systems. Upgrades involve providing fire detection and suppression equipment to the Zaporizhzhya and Chornobyl nuclear power plants. In addition, reactor core protection guidelines are being developed, with completion scheduled for July 1996. A training session on these guidelines is planned for July 1996.

Activities Completed ▶

Under the direction of a U.S. working group, Burns & Roe Company and Bechtel Power Corporation staff developed the initial version of *Reactor Core Protection Evaluation Guidelines for Fires at Soviet-Designed Nuclear Power Plants*. The guidelines were peer-reviewed in November 1995. Russian and Ukranian fire hazard evaluation experts are performing an in-depth review of the guidelines; the guidelines will be issued in July 1996.

Staff of the Zaporizhzhya nuclear power plant and the State Fire Protection Institute of Ukraine attended a fire hazards evaluation training program in November 1995. In addition to receiving classroom training on the history of U.S. fire hazards analyses, the Ukrainians visited the Catawba and Oconee plants in the United States to see how the results of fire hazards analyses have been implemented to decrease the likelihood of a fire resulting in core damage.

Fire suppression equipment supplied by the Grinnell Company and Pyrotronics fire detection panels and equipment supplied by Ellenco have been shipped to the Zaporizhzhya nuclear power plant. Test reports for Transco and No-Fire Engineering products were provided to the National Fire Department of Ukraine (GUPO), which subsequently approved their use in Ukrainian nuclear power plants.

Bechtel shipped samples of fire protection and detection equipment to the Chornobyl plant for evaluation. Bechtel staff subsequently met with plant staff to demonstrate equipment and prioritize equipment to be provided to the plant.

Work in Progress ▶

Zaporizhzhya nuclear power plant personnel determined that 122 fire doors (including frames and hardware) will be required and provided a schedule of requirements by door size. Burns & Roe issued the contract for manufacturing these fire doors to the Ukraine company, Asken.

4.2 Engineering and Technology

Key Accomplishments

- Ukrainian-manufactured Asken fire doors passed safety tests conducted by the Swedish National Testing Institute. The doors are now certified to international fire safety standards. Asken is currently manufacturing doors for the Zaporizhzhya nuclear power plant and is negotiating a contract for manufacturing Chornobyl fire doors.
- Fire detection and suppression equipment was delivered by the U.S. company Burns & Roe to the Zaporizhzhya plant.
- A fire hazards evaluation training program was completed by staff of the Zaporizhzhya nuclear power plant and the State Fire Protection Institute of Ukraine. They received classroom training on the history of U.S. fire hazards analyses and visited the Catawba and Oconee plants in the United States to see how the results of fire hazards analyses have been implemented to decrease the likelihood of a fire resulting in core damage.

A contract has been signed with the plant to allow them to procure portable fire extinguishers and self-contained breathing apparatus from local vendors.

4.3 Plant Safety Evaluations

Activities to support enhanced plant safety evaluations include

- transfer of safety computer codes
- validation of codes
- training in use of new codes
- performance of plant-specific safety evaluations.

Activities Completed ▶

During meetings in June 1995, agreement was reached to provide Goscomatom with U.S. safety analysis codes and the necessary computers and training for using these codes.

Work in Progress ▶

Activities associated with plant safety assessments are typically carried out in three phases. Phase I, now in progress, includes the delivery of state-of-the-art safety analysis computer codes to several Ukrainian institutes, with the computer hardware and training necessary to run these codes.

A second phase will include adaptation of the safety analysis tool for applicability to Ukrainian reactors. A key part of this phase is the definition of nuclear plant situations, based on international generic safety problems, to verify the computer codes and models and ensure consistency of code implementation. A third phase will include using the codes to perform plant-specific safety assessments for Ukrainian nuclear power plants. Experts from the International Nuclear Safety Program will assist Ukrainian institutes in these phases as necessary.

An internationally accessible plant-specific database is being designed by Argonne National Laboratory for performing plant-specific safety analyses and risk assessments.

Efforts are under way to obtain Ukrainian membership in the U.S. Nuclear Regulatory Commission Code Analysis Maintenance Program. Membership would provide access to the Nuclear Regulatory Commission safety analysis codes.

The objective of the Plant Safety Evaluations program element is to upgrade the methodologies, techniques, and expertise that enable the designers, owners, and regulators of Soviet-designed nuclear power plants to set priorities for future safety upgrades.

4.4 Fuel Cycle Safety

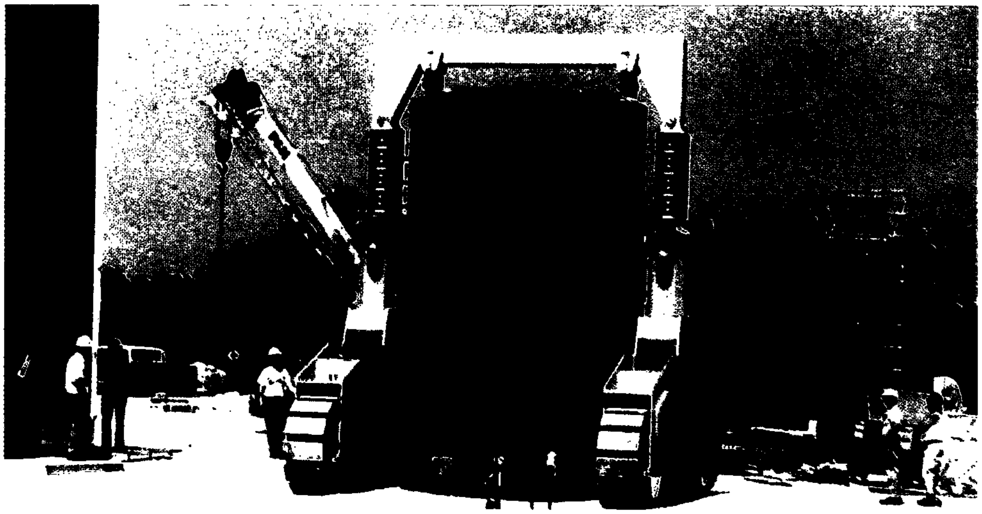
Fuel cycle safety efforts in Ukraine have been directed principally toward providing a dry cask storage system for Zaporizhzhya spent fuel. The six-plant nuclear power facility is running out of spent fuel storage capacity.

Activities Completed ▶

An agreement was signed by the Ukrainian Deputy Minister of the Ministry for Environmental Protection and Nuclear Safety and the Pacific Northwest National Laboratory Director to enable laboratory staff to work with the Ministry on projects associated with spent fuel dry storage cask licensing.

Duke Engineering & Services has a contract to provide a dry cask storage system to the Zaporizhzhya nuclear power plant. The contract includes three ventilated concrete casks, a cask transporter, and several items of ancillary equipment. The ventilated concrete cask liner materials and the cask transporter were delivered to the Zaporizhzhya nuclear power plant. A functional and load test was performed on

The objective of the Fuel Cycle Safety program element in Ukraine is to improve the safety of fuel cycle activities at nuclear reactor sites by developing systems to handle, move, and store reactor spent fuel safely.



The Zaporizhzhya nuclear plant will receive dry cask storage units similar to the one shown here. The casks will provide urgently needed storage space for the plant's spent nuclear fuel.

4.4 Fuel Cycle Safety

Key Accomplishments

- An agreement was signed by the Ukrainian Deputy Minister of the Ministry for Environmental Protection and Nuclear Safety and the Director of the Pacific Northwest National Laboratory to enable Laboratory staff to work with the Ministry on projects associated with spent fuel dry storage cask licensing.
- Development of Zaporizhzhya-specific operating procedures for the dry cask storage system was completed in June 1995.
- A contract was awarded to Duke Engineering & Services, Inc., to provide three dry storage casks, a cask transporter, and associated services and training. The cask transporter and cask liners were delivered to the Zaporizhzhya nuclear power plant. Duke Engineering & Services released purchase orders for the vacuum drying and welding systems portion of the dry cask storage system.
- Training was provided to Ukraine regulators on the regulation of spent fuel transportation and storage and on specific computer codes for shipping cask analysis.
- Zaporizhzhya staff observed cask loading at the Palisades Nuclear Facility in Michigan to obtain firsthand knowledge of cask operations. On-the-job training of Zaporizhzhya plant staff has been completed. The training consisted of work on concrete cask liner fabrication and concrete construction practices.

Improved Safety Through Dry Storage

Through technology transfer, the Zaporizhzhya nuclear power plant in Ukraine will be able to increase its spent fuel storage capacity safely. The six-plant nuclear power facility is running out of spent fuel storage capacity.

The Soviet-Designed-Reactor Safety Program is supporting Zaporizhzhya in building and operating a dry cask storage facility that will meet Ukrainian government regulations and comply with international safety standards. Over the next several months, the project's contractor, Duke Engineering, will deliver the liners, rebar, and forms to build three dry cask storage units. Assisted by Duke engineers, Ukrainian personnel will then pour the concrete to make the casks. The first fuel is scheduled to be loaded later in 1996.

The project's overall goal is to transfer U.S. technology and expertise to enable Zaporizhzhya staff to manufacture about 12 casks per year onsite and to make the plant self-sufficient in managing spent fuel. In addition, Duke Engineering will build the transportation system needed to move the casks between the fuel loading area and the dry storage facility, and build the storage pad for the casks.

the cask transporter at J&R Engineering before it was shipped to Ukraine. Zaporizhzhya staff observed cask loading at the Palisades Nuclear Facility in Michigan to obtain first-hand knowledge of cask operations.

Development of Zaporizhzhya-specific operating procedures for the dry cask storage system was completed in June 1995.To support the Ukraine government in licensing the dry storage system, U.S. experts provided Ukrainian regulators with five weeks of hands-on training in 1995 in using U.S.-developed codes to calculate predicted cask conditions.

Pacific Northwest National Laboratory staff provided software used in the workshop to the Ukraine regulators.

Work in Progress ▶

Duke Engineering & Services is developing a revised schedule to address delays encountered because of 1) unanticipated design changes by the Zaporizhzhya nuclear power plant and 2) greaterthan-anticipated time to obtain a Ukrainian construction license. The initial dry cask loading date has been rescheduled to later in 1996, dependent on receipt of Ukraine regulatory approval to begin construction.

"...[The spent fuel dry cask storage] is the first project of such type in Ukraine. Ukrainian regulators passed training course in the NRC and they are very grateful for this opportunity.

We believe the performance of works by American side completely corresponds to our expectation taking into consideration the potential delays and other known difficulties. We also are very grateful to American Government for moral and financial support."

T. G. Plokhy

First Deputy General Director,
Zaporizhzhya Nuclear Power Plant

4.5 Chornobyl Initiatives

DOE, in cooperation with Ukraine, has initiated two major efforts associated with the Chornobyl nuclear power plant. One of these efforts is the establishment of a Ukrainian International Research Center on Nuclear Safety. Radioactive Waste and Radioecology at Slavutych, near Chornobyl. The other is to implement near-term safety enhancements at the Chornobyl nuclear reactors that are currently operating.

4.5.1 International Research Center on Nuclear Safety, Radioactive Waste and Radioecology

The United States is planning with Ukraine the establishment of an International Research Center on Nuclear Safety, Radioactive Waste and Radioecology. The Center will be located at the city of Slavutych, near Chornobyl. The principal objectives of this Center are

- to develop an indigenous capability for providing operational safety support to Ukrainian nuclear power plants
- to provide a focal point for international cooperation for addressing environmental issues at Chornobyl—The Center provides a foundation for better understanding the transport of radioisotopes after a nuclear accident, for developing and demonstrating remediation technologies, and for facilitating more effective and efficient methods for cleanup.
- to address socioeconomic concerns and issues associated with the future shutdown of the operating Chornobyl reactors—The Center provides a starting point for diversifying Chornobyl's economic base, as well as a means of maintaining reactor personnel during and after reactor shutdown.

The Center will enable Ukraine to develop an indigenous capability for providing operational safety support to nuclear power plants throughout Ukraine and solving nuclear contamination problems at Chornobyl. The United States Government is working with the Ukrainian Government to develop the Center, transfer and develop nuclear safety and environmental management technology, and apply that technology in addressing the needs at Chornobyl and throughout Ukraine.

A draft plan for U.S./Ukrainian cooperation in establishing the Center is under review. The plan contains specific actions for developing the Center's computing and telecommunications infrastructure; broadening international interest and involvement in the Center; providing cross-training, cooperative research and development, and technology transfer in areas of mutual scientific, engineering, and management interest; and undertaking specific joint project activities to initiate the Center's operations. It was agreed that the first project to be undertaken should be a risk assessment for Chornobyl Unit 3 in the event of the collapse of the sarcophagus covering the adjacent Unit 4 destroyed in the 1986 and 1991 accidents.

Pacific Northwest National Laboratory contracted with the U.S. company Orion/

4.5 Chornobyl Initiatives

- A task order was awarded to Bechtel Power Corporation to provide fire detection and protection equipment and materials to the Chornobyl nuclear power plant for their evaluation. Chornobyl nuclear power plant staff identified the portion of this equipment for their plant that Bechtel will purchase.

Atlantic in March 1996 to install satellite equipment in Slavutych. This equipment, which should be operable in mid-1996, will enable the transmission of voice, facsimile, and electronic mail to and from the Center anywhere in the world. This system will foster interaction and data exchange between scientists and engineers at the Center and their counterparts in the United States. The system design also enables the future addition of videoconferencing capabilities, which would encourage collaborative training opportunities.

4.5.2 Near-Term Safety Enhancements at the Chornobyl Nuclear Power Plant

The Chornobyl nuclear power plant lacks redundant fire protection systems which could result in a loss of capability to control the reactor. Fire safety upgrades are being implemented at Chornobyl reactor Unit 3 that will reduce the likelihood and consequences of fires.

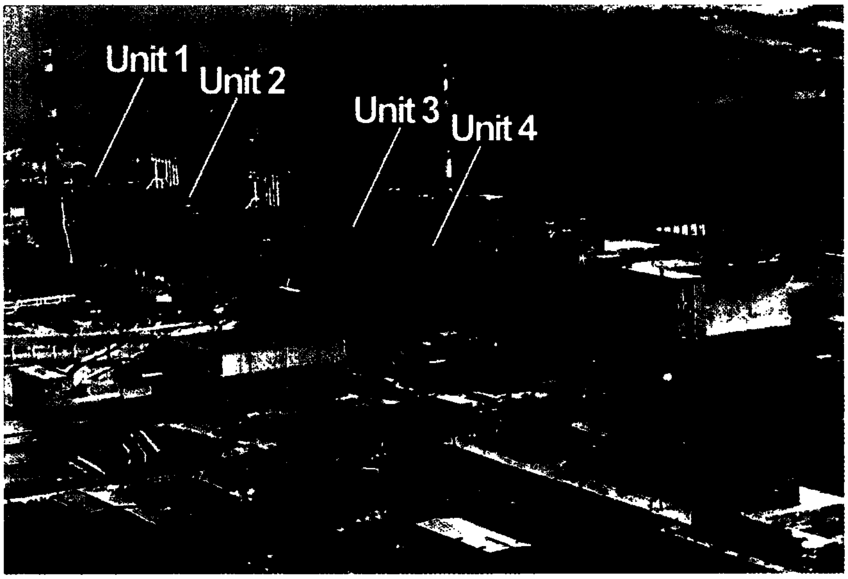
A task order was awarded to Bechtel Power Corporation to provide candidate equipment and materials for fire detection and protection to the Chornobyl plant for evaluation. Chornobyl nuclear power plant staff identified the portion of this equipment for their plant that Bechtel will purchase.

Pacific Northwest National Laboratory received a proposal from the Chornobyl plant to supply fire doors manufactured by the Ukraine Asken Company. Asken representatives visited the Chornobyl plant to discuss the list of fire doors that Chornobyl staff identified. Program staff are working out an agreement with Chornobyl plant representatives regarding payments to Asken. Bechtel Power Corporation staff visited the Chornobyl plant in February 1996 to demonstrate the operation of sample fire protection equipment and the application of fire-resistant floor coating material. Bechtel and Chornobyl staff identified a list of fire safety equipment to be provided to the plant.

A Chornobyl maintenance worker uses a drill press to manufacture a replacement part for operating reactor Unit I. U.S. and Ukraine officials are working together to implement near-term safety enhancements at the sites's reactors that continue to operate.

Computer equipment needed by the Chornobyl nuclear power plant to support operational safety projects was delivered to the plant in February 1996.

Fourteen Chornobyl plant staff members visited the Brunswick nuclear power plant in North Carolina to observe U.S. implementation of operational safety practices. Presentations included development and



Though Chornobyl reactor units 2 and 4 are shut down, Units I and 3 continue to operate, providing heat and electricity for nearby communities. Ukraine and U.S. officials have agreed to estimate the risks to Unit 3 in the event of a collapse of the concrete "sarcophagus" that encases adjacent Unit 4.

implementation of emergency operating instructions, conduct of operations procedures, and quality assurance procedures. These presentations were supplemented by facility tours and by performance of simulator exercises requiring use of emergency operating instructions.

A Pacific Northwest National Laboratory staff member visited the Chornobyl nuclear power plant for two weeks in December 1995 to support continued development of draft emergency operating instructions. Plant personnel requested that U.S. experts present a series of seminars to Chornobyl operating staff on emergency operating instruction development. Pacific Northwest National Laboratory staff are identifying contractors to do these seminars.

5.0 CENTRAL AND EASTERN EUROPEAN COUNTRIES

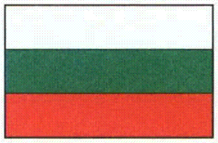
Reactor Types in the Central and Eastern European Countries

- 2 RBMK-1500s
- 6 VVER-440/230s
- 10 VVER-440/213s
- 2 VVER-1000s

The following sections describe accomplishments and work under way in five Central and Eastern European countries where Soviet-designed nuclear power plants operate:

- Bulgaria (Section 5.1)
- Czech Republic (5.2)
- Hungary (5.3)
- Lithuania (5.4)
- Slovakia (5.5).

Figure 5.1 shows the locations of nuclear power plants in these countries. Appendices A and B provide more detail on these plants.



5.1 Bulgaria

Bulgaria has six operating nuclear power plants at the Kozloduy site. Together, they provide 36.9% of the country's electricity.

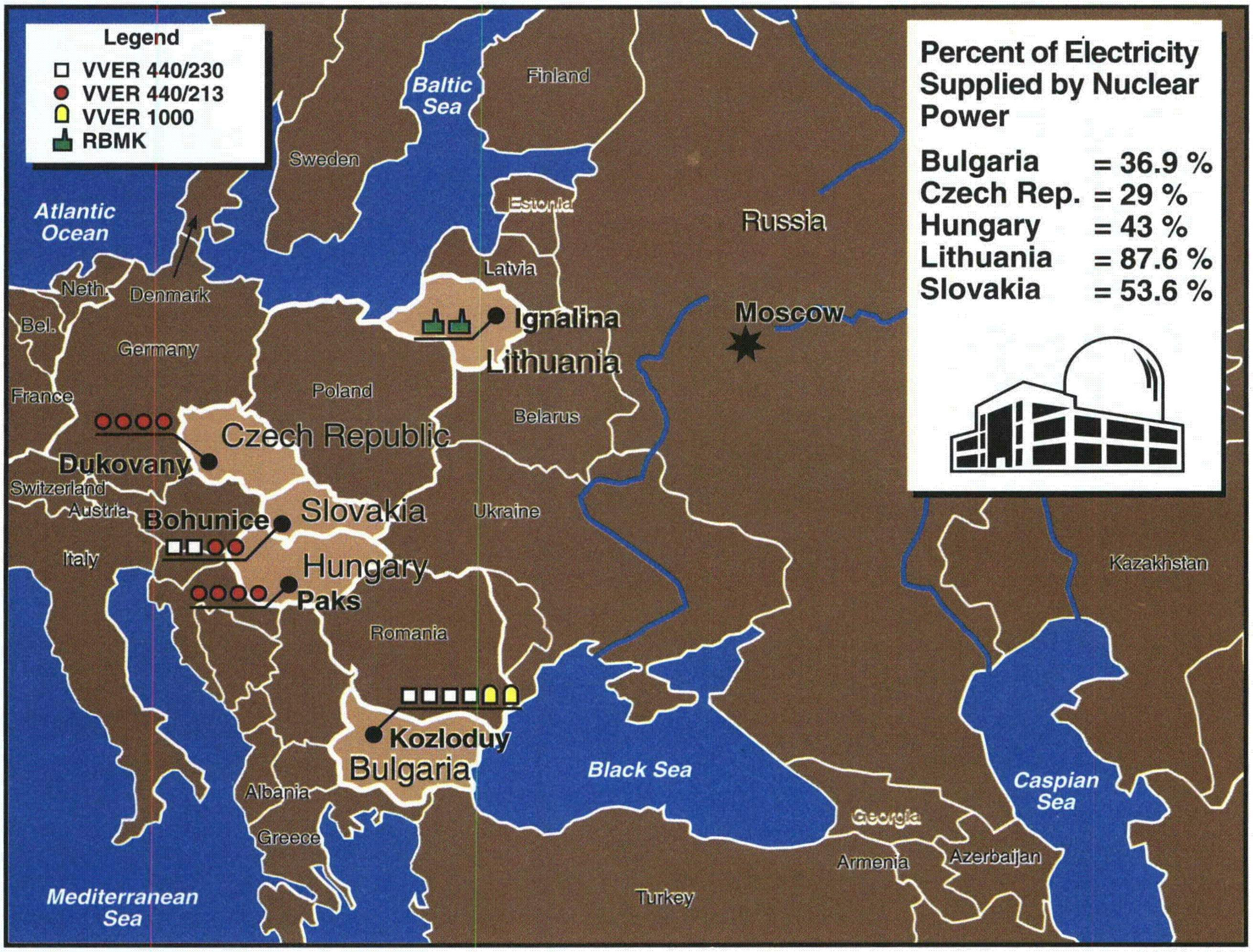


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Figure 5.1. Locations of Nuclear Power Plants in Central and Eastern European Countries Participating in the Soviet-Designed-Reactor Safety Program

5.0 Central and Eastern European Countries

Key accomplishments

- A 1000-kW backup diesel generator was delivered to the Kozloduy reactor site in Bulgaria. This generator provides an additional backup power source to operate key reactor safety systems if an emergency should make both the offsite and existing emergency onsite power systems unavailable.
- A VVER-440/230 plant analyzer (hardware and software) has been transferred from the Committee on the Use of Atomic Energy for Peaceful Purposes to the Kozloduy reactor site for use by staff. In addition, Bulgarian scientists and Brookhaven National Laboratory staff collaborated to develop a preliminary VVER-1000 computer model for the Kozloduy plant analyzer.
- Firefighting equipment and protective suits for firefighters were delivered to the Kozloduy reactor plant. Equipment included two fire trucks (a Class A pumper and a smaller crash truck), communications equipment, and radiation monitoring dosimeters.
- Descriptions of reactor safety systems (plant parameters) were documented in the *Ignalina Plant Parameter Source Book*. The Source Book, available in English and Lithuanian, is the most definitive source of data available on RBMK-1500 reactor safety systems and has received broad distribution worldwide.
- Pacific Northwest National Laboratory performed a peer review on the initial phase of the probabilistic risk assessment for the Ignalina nuclear power plant reactors. The review was requested by Barselina Project participants.
- A comprehensive safety assessment program conducted at the nuclear power plant sites of Dukovany, Czech Republic, and Bohunice, Slovakia, is being used to identify design weaknesses and prioritize safety upgrades. Science Applications International Corporation has developed a computerized tool to use the assessment results to support configuration management and maintenance planning activities at both sites.
- Nuclear power plant representatives from Kozloduy, Paks, and Bohunice attended a workshop presented by Westinghouse Energy Systems Europe S.A. The workshop focused on development of symptom-based emergency operating instructions.

A **plant analyzer** is a computer system that runs a coupled thermal-hydraulic and neutronic model of a nuclear power plant. The analyzer enables plant staff to predict and understand heat and flow characteristics as well as transient behavior of an operating nuclear reactor. Plant analyzers are engineering tools used for performing safety analyses, conducting specific calculations, and providing the analytical basis for operating procedures and emergency operating instructions.

The primary organizations involved with the Soviet-Designed-Reactor Safety Program include

Committee on the Use of Atomic Energy for Peaceful Purposes - Bulgarian nuclear regulatory authority

Committee on Energy - responsible for all energy-related matters in Bulgaria

National Electric Company - owner and operator of all Bulgarian electrical generation, transmission, and distribution equipment

Kozloduy Nuclear Power Plant - operator of the six Bulgarian nuclear power reactors.

Activities Completed ▶

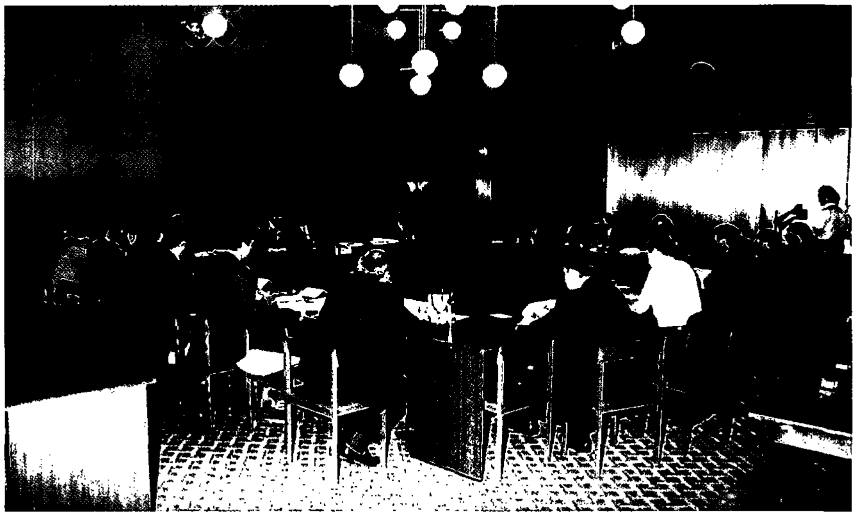
Firefighting equipment and protective suits for firefighters were delivered to the Kozloduy reactor plant. Equipment included two fire trucks (a Class A pumper and a smaller crash truck), communications equipment, and radiation monitoring dosimeters.

A 1000-kW backup diesel generator was delivered to the Kozloduy reactor plant. This generator provides an additional backup power source to operate key reactor safety systems if an emergency should make both the offsite and existing emergency onsite power systems unavailable.

The proposed plant analyzer work scope for fiscal year 1996 funding was discussed during a meeting in the Sofia, Bulgaria, offices of Energoproekt. Energoproekt and the Kozloduy nuclear power plant staff are interested in performing a validation and verification of the RELAP5 models used on the Kozloduy plant analyzer for the VVER-440 model V230 and VVER-1000 model V320 (currently under development). In addition, a review of the first 6 months of the Kozloduy plant analyzer project was held at the headquarters of the Committee on the Use of Atomic Energy for Peaceful Purposes. As part of the project, two Bulgarian experts have been working at Brookhaven National Laboratory to help evaluate project progress.

One of two VVER-440/230 plant analyzers (hardware and software) has been transferred from the Committee on the Use of Atomic Energy for Peaceful Purposes to the Kozloduy site for use by staff.

Representatives of Kozloduy visited the Wolf Creek (Kansas) nuclear power plant in October 1995. The visit also involved representatives from Russia's reactor engineering and design organizations, VNIIAES and Gidropress; Russia's Balakovo nuclear power plant; and



At a VVER-1000 working group meeting, members signed an agreement to prioritize and schedule upcoming reactor analyses and procedures work that can be applied to all VVER-100 reactors. Bulgaria's Kozloduy plant has two VVER-1000 reactors.

Ukraine's Zaporizhzhya nuclear power plant. Participants studied how Wolf Creek emergency operating instructions were developed and implemented.

Kozloduy representatives have agreed to provide initial financing of a year-long project involving analysis work and technical basis documents for emergency operating instructions. The project is among the activities being undertaken by the VVER-1000 Working Group. During a working group meeting, Kozloduy staff presented a summary of the newly initiated emergency operating instruction development program and delivered a schedule. In December 1995, the group met at Kozloduy to assist Kozloduy's emergency operating instruction development team in starting their project.

Representatives of the Kozloduy plant attended a workshop presented by Westinghouse Energy Systems Europe S.A. The workshop focused on development of symptom-based emergency operating instructions and

> "I would like to appreciate your support ... with the effort on continuation of the Configuration Management Programme for Kozloduy Nuclear Power Plant Phase 2. We started successfully our work now in the beginning of November 1995. Taking in to account the importance of this program for KNPP, I hope to have your support in the future."
>
> *K. Kuzmanov*
>
> General Manager,
> National Electric Company,
> Kozloduy Nuclear Power Plant
> Bulgaria

included representatives from Hungary's Paks nuclear power plant and Slovakia's Bohunice nuclear power plant.

Work in Progress ▶

Contractor Gilbert/Commonwealth is conducting a seismic evaluation of the cable shelves in the shield building surrounding the reactor containment structure at Kozloduy Unit 5. The structural integrity of the building must be verified to ensure that it would not damage surrounding equipment or disrupt power supplies during a seismic event.

Eleven of 16 site-specific documents containing guidelines to improve management and operational controls have been completed and implemented. The documents include procedures for operator logkeeping, shift turnover, operator rounds, and other activities. In addition, U.S. and Kozloduy experts have begun working together to develop emergency operat-ing instructions for VVER-1000 and VVER-440/230 units. Draft emergency operating instructions have been completed for the VVER-1000 units.

A preliminary VVER-1000 computer model for the Kozloduy plant analyzer was delivered to the plant in January 1996. Contracting also is under way to provide training courses, hardware, and software to further develop the Bulgarian training center capabilities.

5.2 Czech Republic

The Czech Republic has four operating nuclear power reactors at the Dukovany site. These provide 29% of the Czech Republic's electricity. In addition, two more plants are being constructed at the Temelin site. The primary organizations involved with the Soviet-Designed-Reactor Safety Program include

State Office of Nuclear Safety - Czech nuclear regulatory authority

Ministry of Industry and Trade, Section for Nuclear Area Administration - responsible for nuclear power plants and fuel cycle

Nuclear Research Institute - nuclear research and development and operator of research reactor

Dukovany Nuclear Power Plant - operator of the four nuclear power reactors at the Dukovany site

Temelin Nuclear Power Plant - operator of the two nuclear power reactors under construction at the Temelin site.

Assessments Enhance Safety of Central European Power Plants

A comprehensive risk assessment program conducted at the nuclear power plant sites of Dukovany, Czech Republic, and Bohunice, Slovakia, is helping to identify design weaknesses and prioritize safety upgrades. Dukovany and Bohunice each have four VVER Soviet-designed reactors.

The purpose of the program is to conduct a probabilistic risk assessment at the plants, to apply the assessment results to evaluate the quality of plant design features and operating procedures, and to develop a computerized tool to support risk management decisions. The risk assessment, completed at Dukovany in December 1994 and Bohunice in June 1995, is a standard technique for gathering risk data used by nuclear utilities and regulatory authorities worldwide. Results from the assessment can be used to identify plant vulnerabilities to severe accidents.

As part of the project, Science Applications International Corporation has provided training, technology transfer, and safety analytical support at the two sites. The company has developed a computerized tool called the Safety Advisory System to use the risk assessment results to support day-to-day configuration management and maintenance planning activities at both plants. The system is linked to the U.S. Nuclear Regulatory Commission's IRRAS computer code, which performs probabilistic risk assessment calculations using a logic model of the plant systems.

Activities Completed ▶

Since the program began, 10 of 16 site-specific documents containing guidelines for improving management and operational controls have been completed and implemented. The documents provide procedures for operator log keeping, shift turnover, operator rounds, and other work and operations activities.

Work in Progress ▶

A Dukovany-specific maintenance database was developed and completed in March 1995 to support the Level 2 probabilistic risk assessment. Using the database, plant staff can predict reactor system performance under various conditions. An important component of the database is a series of calculated predictions of the percentage of time that specific equipment is operable versus inoperable because of maintenance activities. The purpose of the 3-year assessment is to study the effectiveness of the accident localization system (confinement) under various abnormal conditions. In the Level 2 stage, experts investigate the probability of radioactivity moving outside the containment structure after an off-normal event, to assess containment performance under various conditions. (During the Level 1 assessment, the conditions, or scenarios that could cause core damage were defined. During Level 3, potential health and environmental consequences of radioactive releases are evaluated.)

5.3 Hungary

Hungary has four operating reactors at the Paks site. These provide 43% of Hungary's electricity.

The primary organizations involved in the Soviet-Designed-Reactor Safety Program include

National Committee for Technological Development - ministerial-level organization with responsibility for nuclear power development and policy

Hungary Atomic Energy Commission - Hungarian nuclear regulatory authority

Institute for Electric Power Research - nuclear power research and development

Hungarian Power Company - Hungarian national utility, owner and operator of Paks nuclear power plant

Paks Nuclear Power Plant - operator of the four nuclear power reactors at the Paks site.

Activities Completed ▶

Since the program began, 5 of 16 site-specific documents containing guidelines designed to improve management and operational controls have been completed and implemented. The documents address work and operations activities, such as shift turnover procedures and equipment labeling.

Representatives of the Paks plant attended a workshop presented by Westinghouse Energy Systems Europe S.A. The workshop focused on developing symptom-based emergency operating instructions and included representatives from Bulgaria's Kozloduy nuclear power plant and Slovakia's Bohunice nuclear power plant.

The U.S. company Scientech developed and supplied a bar code reader system to automate reactor operator training evaluations. This system, delivered in February 1996 to the Hungarian Institute for Electric Power Research, enables instructors to quickly and accurately enter codes for training evaluations directly into a computerized database. The Institute is evaluating the performance of operators who are using reactor control panel simulators, then using the results of that evaluation to improve the training program.

Work in Progress ▶

Development of symptom-based emergency operating instructions is continuing. Contracting also is under way to provide the Paks Maintenance Training Center with a series of networked computers loaded with maintenance training software.

5.4 Lithuania

Lithuania has the world's two largest operating nuclear reactors at its Ignalina site. Each of the two RBMK-1500 reactors is capable of producing 1500 megawatts of electricity. Together, the two reactors provide 87.6% of Lithuania's electricity.

The primary organizations involved in the Soviet-Designed-Reactor Safety Program include

Lithuanian Nuclear Power Safety Inspectorate - Lithuanian nuclear regulatory authority

Ministry of Energy - responsible for nuclear power

Ignalina Nuclear Power Plant - operator of the two reactors at the Ignalina site

Lithuania Energy Institute/Ignalina Safety Analysis Group - responsible for safety analyses for the Ignalina nuclear power plant.

Activities Completed ▶

Since the program began, 4 of 16 site-specific documents containing guidelines for improved management and operational controls have been completed and implemented. The documents address procedures for shift turnover, verbal communications, equipment labeling, and maintenance of operating documents.

A peer review was conducted by Pacific Northwest National Laboratory on the initial phase of the probabilistic risk assessment for the Ignalina plants. The assessment was derived from existing assessments by the Swedes, Lithuanians, and Russians (Barselina Project). The hardware required to use the U.S. Nuclear Regulatory Commission computer code for conducting probabilistic risk assessments was purchased and delivered to the Ignalina Safety Analysis Group. The U.S. Nuclear Regulatory Commission and Brookhaven National Laboratory contributed training and collaboration on the use of this code.

A plant analyzer and computer workstation were delivered to the Ignalina Safety Analysis Group, with additional hardware to support the expansion of the Ignalina plant analyzer to multiple simultaneous users. Staff from Brookhaven National Laboratory and Science Applications International Corporation conducted training workshops for the Ignalina Safety Analysis Group at the Lithuanian Energy Institute on the use and modification of plant analyzers.

The data collection phase was completed for developing a computer input deck that models thermal-hydraulic conditions in an RBMK-1500 reactor type. This activity supports the plant analyzer project by providing input describing RBMK-1500

Plans are under way to design display systems similar to that shown above, for all operating RBMK reactors in Lithuania, Russia, and Ukraine. Using these systems, control room operators can access reactor operating data rapidly for abnormal or emergency situations.

heat and flow characteristics, which were previously unavailable at this level of detail.

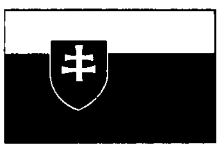
Science Applications International Corporation presented a plant analyzer training workshop for the Ignalina Safety Analysis Group. The workshop covered problems Ignalina personnel are experiencing with the analyzer.

Descriptions of reactor safety systems (plant parameters) were documented in the *Ignalina Plant Parameter Source Book.* The book, available in English and Lithuanian, is the most definitive source of data available on the RBMK-1500 reactor safety systems, and has received broad distribution worldwide.

Work in Progress ▶

Progress is being made on a configuration management program. Contractor Stone & Webster, Inc., is working with the Lithuanians to develop a program that will enable staff to track the exact design of the plant through engineering modifications and upgrades. This program will support the Lithuanians in developing document control and establishing the design basis of the Ignalina plant. The design basis provides the parameters that safety systems must meet.

Collaboration continues on the development and expansion of the Ignalina plant analyzer capabilities. Draft symptom-based emergency operating instructions are 50% complete. Once the drafts are finished, analysis and verification activities will begin.



5.5 Slovakia

Slovakia has four operating nuclear power reactors (two VVER-440/230s and two VVER-440/213s), all located at the Bohunice site. They provide 53.6% of Slovakia's electricity. Four more VVER-440/213 reactors are under construction at the Mochovce site.

The primary organizations involved with the Soviet-Designed-Reactor Safety Program include

Nuclear Regulatory Authority - Slovakia Republic

Nuclear Power Plant Research Institute (VUJE) - nuclear research and development, analysis, and training at Trnava

Bohunice Nuclear Power Plant - operator of the four reactors at the Bohunice site

Mochovce Nuclear Power Plant - operator of the four reactors under construction at the Mochovce site.

> "All [those who attended the training course on emergency response guidelines] confirmed that the quality of the course including commitment of Westinghouse staff was excellent. I would like to express our thanks to the government of USA for funding this excellent course."
>
> *Jan Nano*
>
> Department of Operations
> Division of Operational Modes
> Bohunice Nuclear Power Plant
> Slovakia

Activities Completed ▶

Since the program began, 6 of 16 site-specific documents containing guidelines for improved management and operational controls have been completed and implemented. The documents address work activities and operations, including operator log keeping and shift turnover procedures.

Two computer workstations and software were delivered for use with the VVER-440/230 plant analyzer model; two workstations and software were delivered for use with the simulator upgrade for the same reactor type. Brookhaven National Laboratory conducted two training workshops on using the plant analyzer model for personnel from VUJE (a Slovakian research institute) and UJD (the Slovak Nuclear Regulatory Authority).

Representatives of Bohunice attended a workshop presented by Westinghouse Energy Systems Europe S.A. The workshop focused on developing symptom-based emergency operating instructions and included representatives from Bulgaria's

Kolozduy nuclear power plant and Hungary's Paks nuclear power plant.

Work in Progress ▶

Work continues on upgrading the simulator for the VVER-440/230 plant in collaboration with the Slovakian Nuclear Power Plant Research Institute (VUJE), Brookhaven National Laboratory, and Scientech, Inc. A software called SAMMI has been identified and provided to the plant. SAMMI will allow multiple inputs to a single process, which enables more productive interactions between the simulator and workstations. The developer of SAMMI, Kinesix, will provide two weeks of intensive training.

Work continues on the development of emergency operating instructions.

Work continues on a study to support the Bohunice instrumentation and control upgrade program. The upgrade program has been offered by the European Community. The study will help the Slovaks develop a technical specification for a safety parameter display system.

Science Applications International Corporation has initiated efforts to upgrade the existing Trnava Training Center, which is near the Bohunice nuclear power plant site. Science Applications International Corporation will prepare hardware and computer model recommendations, establish a training program curriculum, and upgrade the VVER-440/213 simulator.

"During the week of 19-23 June 1995, a Training Course/Expert Mission was conducted in Trnava, Slovakia on the subject of "Planning and Preparedness for Potential Radiological Emergencies in the Operation of Nuclear Power Plants" (with interface to Accident Management). This Training Course was part of the above-reference program and was organized by Argonne National Laboratory; it was co-sponsored by a number of Slovak organizations including the Nuclear Regulatory Authority (UJD), the Nuclear Power Plant Research Institute (VUJE), and the Bohunice Nuclear Power Plant (EBO).

On behalf of the Government of the Slovak Republic and the above-mentioned Slovak organization, I wish to express again our sincere appreciation to the US Government for the support we have been receiving in the form of this and previous Training Courses conducted under this program. We also wish to express our great appreciation to the highly-qualified US experts who have been willing to make a major effort and to the US companies and organizations who contributed to the program by allowing the US experts to participate and by donating their time.

We have found that these Training Courses are very effective in fostering an excellent exchange of information and experience between the US experts and our experts and are particularly beneficial in promoting and extending the knowledge-base important to operational safety and safety culture.

In view of the above we wish to express our continued interest in this program and our continued willingness to serve as host country of Training Courses/Expert Missions in the area of Operational Safety. The specific topics of possible future Training Courses can be decided at a later date in joint consultation and agreement between the various interested parties. As in the past, we continue to be ready to receive participants from surrounding countries.

We hope that it will be possible to continue this program of high usefulness and relatively low cost. Please accept in advance our thanks for your continued interest and support."

Jozef Misák

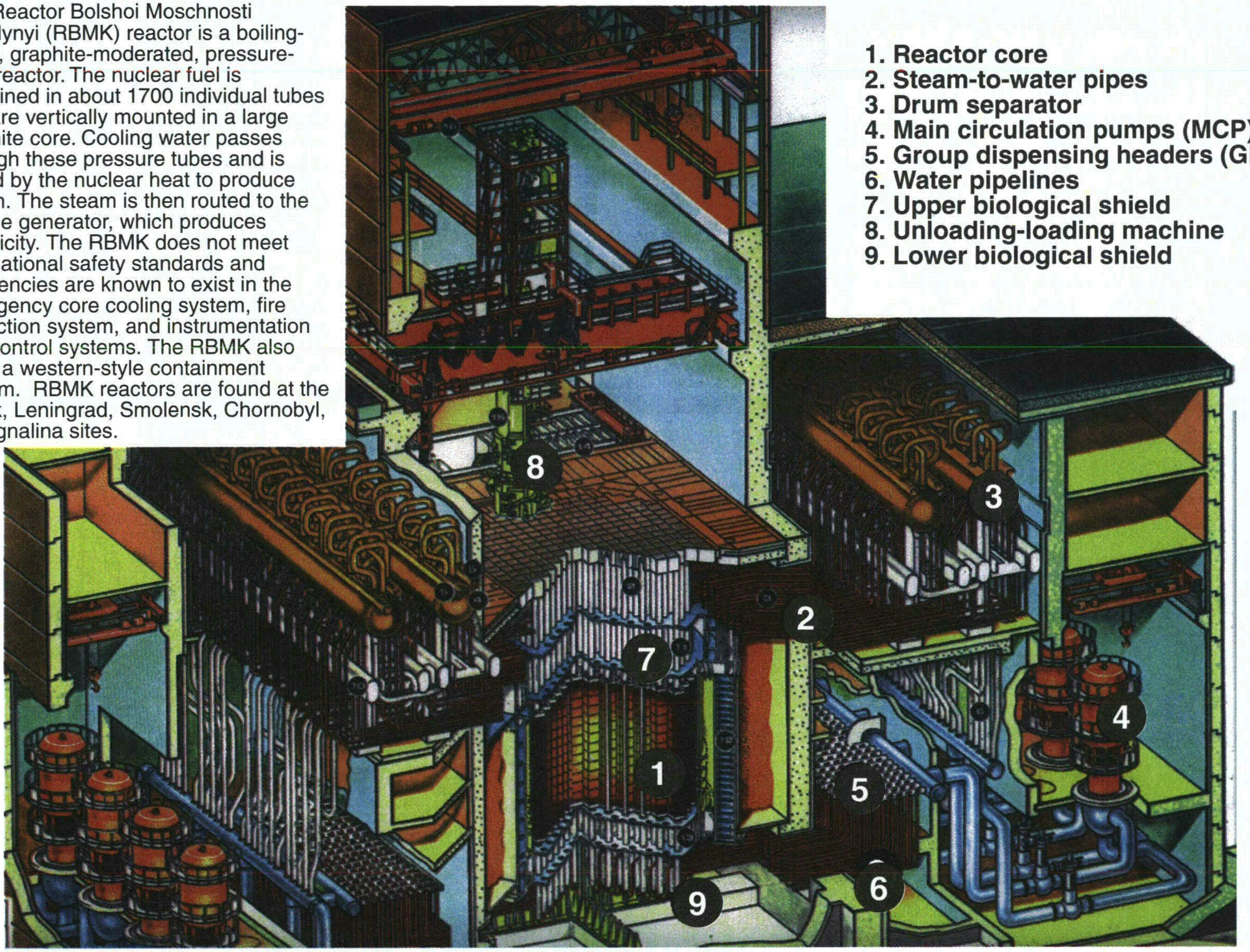
Chairman, Nuclear Regulatory Authority
of the Slovak Republic

APPENDIX A

Illustrations and Descriptions of Soviet-Designed-Reactor Types

RBMK

The Reactor Bolshoi Moschnosti Kanalynyi (RBMK) reactor is a boiling-water, graphite-moderated, pressure-tube reactor. The nuclear fuel is contained in about 1700 individual tubes that are vertically mounted in a large graphite core. Cooling water passes through these pressure tubes and is boiled by the nuclear heat to produce steam. The steam is then routed to the turbine generator, which produces electricity. The RBMK does not meet international safety standards and deficiencies are known to exist in the emergency core cooling system, fire protection system, and instrumentation and control systems. The RBMK also lacks a western-style containment system. RBMK reactors are found at the Kursk, Leningrad, Smolensk, Chornobyl, and Ignalina sites.



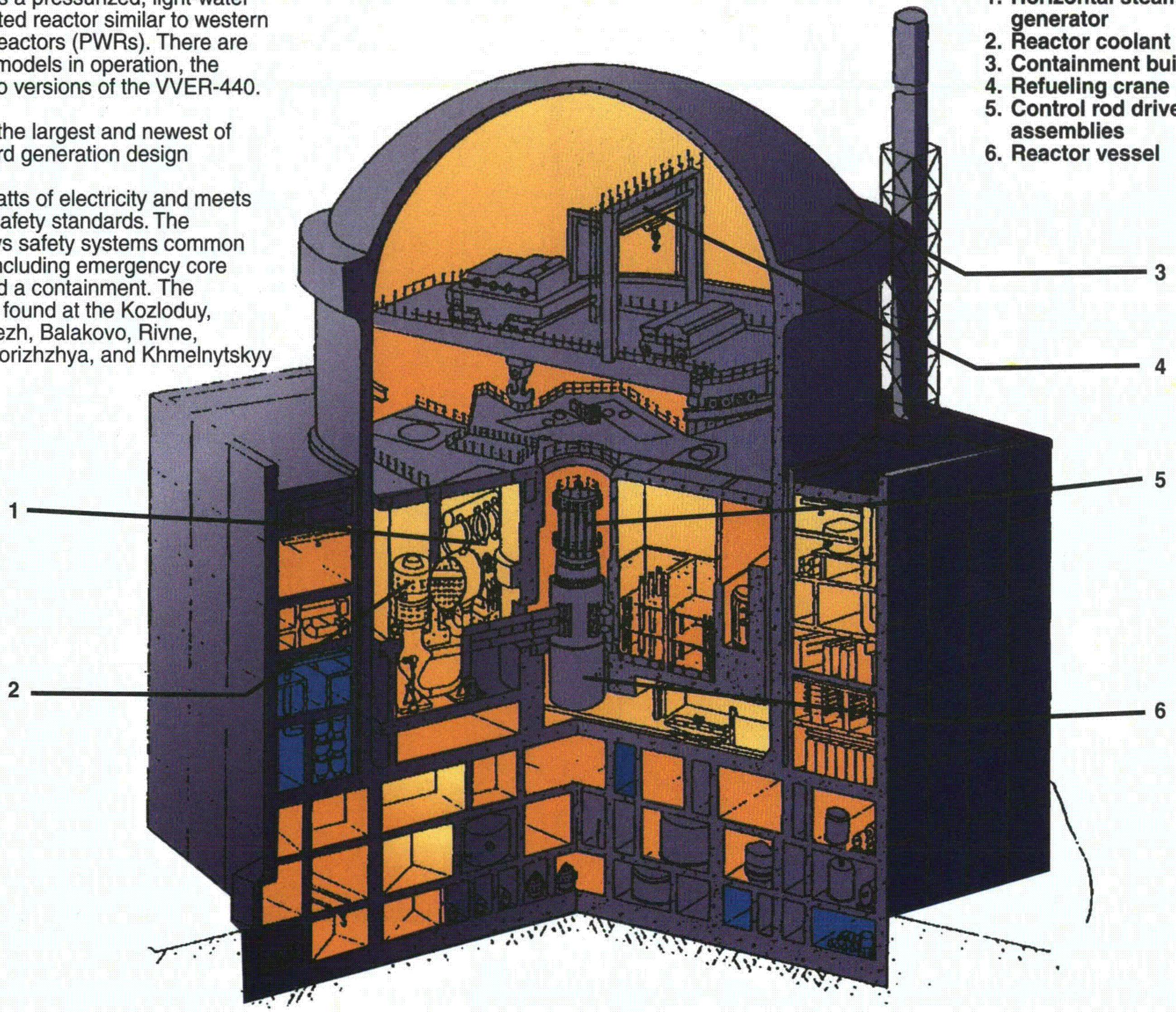
S9508005.2

VVER-1000 Plant Layout

The VVER reactor is a pressurized, light-water cooled and moderated reactor similar to western pressurized water reactors (PWRs). There are three predominant models in operation, the VVER-1000 and two versions of the VVER-440.

The VVER-1000 is the largest and newest of the VVERs. This third generation design produces about 1000 megawatts of electricity and meets most international safety standards. The VVER-1000 employs safety systems common in western plants, including emergency core cooling systems and a containment. The VVER-1000 can be found at the Kozloduy, Kalinin, Novovoronezh, Balakovo, Rivne, South Ukraine, Zaporizhzhya, and Khmelnytskyy

1. **Horizontal steam generator**
2. **Reactor coolant pump**
3. **Containment building**
4. **Refueling crane**
5. **Control rod drive assemblies**
6. **Reactor vessel**



S9508005.4

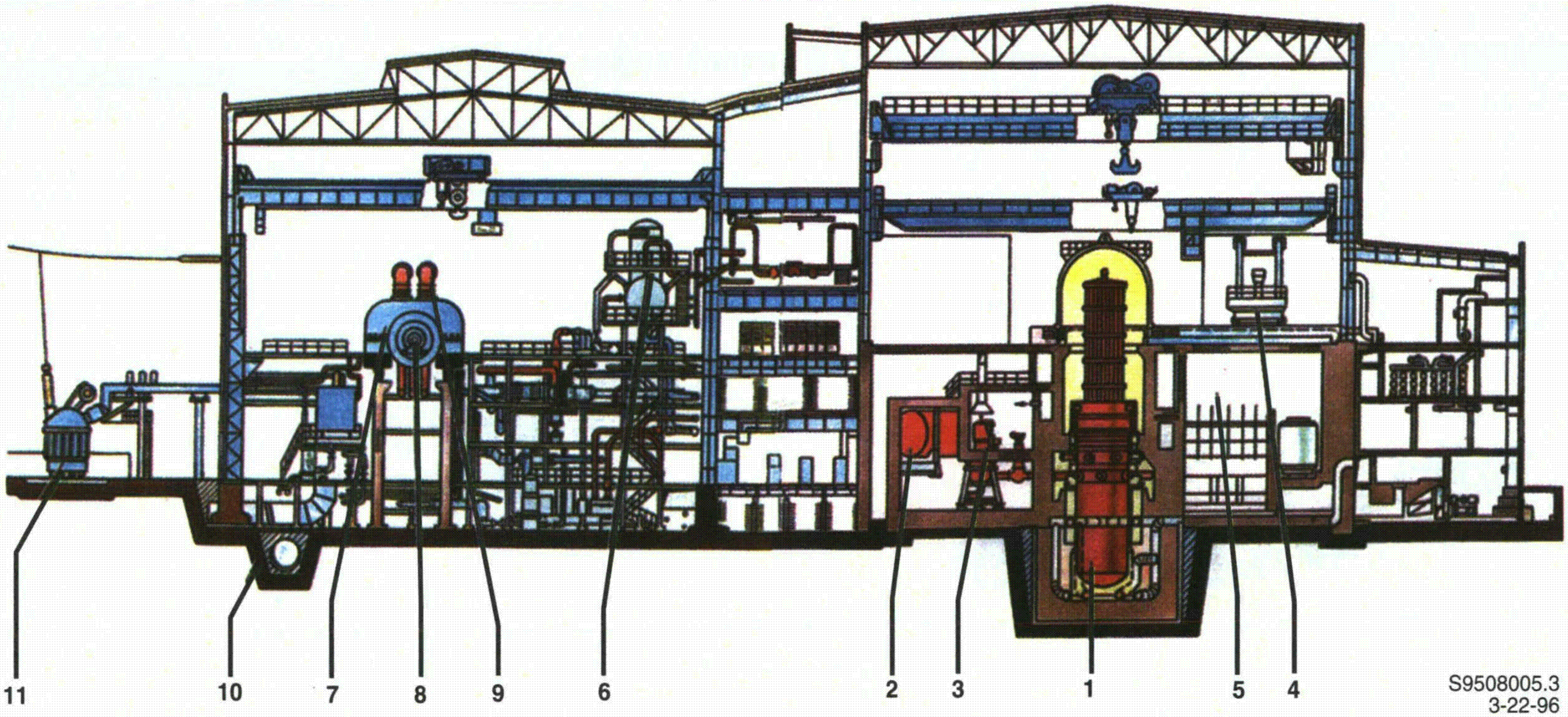
VVER-440 Model 230 Plant Layout

The VVER reactor is a pressurized, light-water cooled and -moderated reactor similar to western pressurized water reactors (PWRs). There are three predominant models in operation, the VVER-1000 and two versions of the VVER-440.

The VVER-440/230 reactor was the initial civilian model of the Soviet PWR. It is similar to Western PWRs in that it uses low-enriched uranium oxide fuel, placed in thin metal-clad rods, to generate heat. The fuel rods are cooled by pressurized light water. The steam to run the turbine generator is produced when pressurized, heated water from the reactor is pumped through steam generators where it transfers its heat to a separate secondary coolant.

The steam is routed to the turbine generator, which produces about 440 megawatts of electricity. The VVER-440/230, although similar to Western PWRs, lacks a number of safety features including fire protection systems, reactor core cooling systems, and a strong containment. The VVER-440/213 reactor is a somewhat enhanced version of the 230 models. It has an emergency cooling system and a "bubble-condenser tower" that acts as a containment to help mitigate off-site releases of radioactive materials in the event of an accident. The 440/230 reactor can be found at the Bohunice, Kozloduy, Kola, and Novovoronezh sites. The 213 can be found at the Bohunice, Dukovany, Loviisa, Paks, Kola, and Rivne sites.

1. **Reactor**
2. **Steam generator**
3. **Main circulation pump**
4. **Refueling machine**
5. **Cooling pond**
6. **Deaerator**
7. **Steam turbine**
8. **Generator**
9. **Steam pipelines**
10. **Cooling water pipelines**
11. **Transformer**



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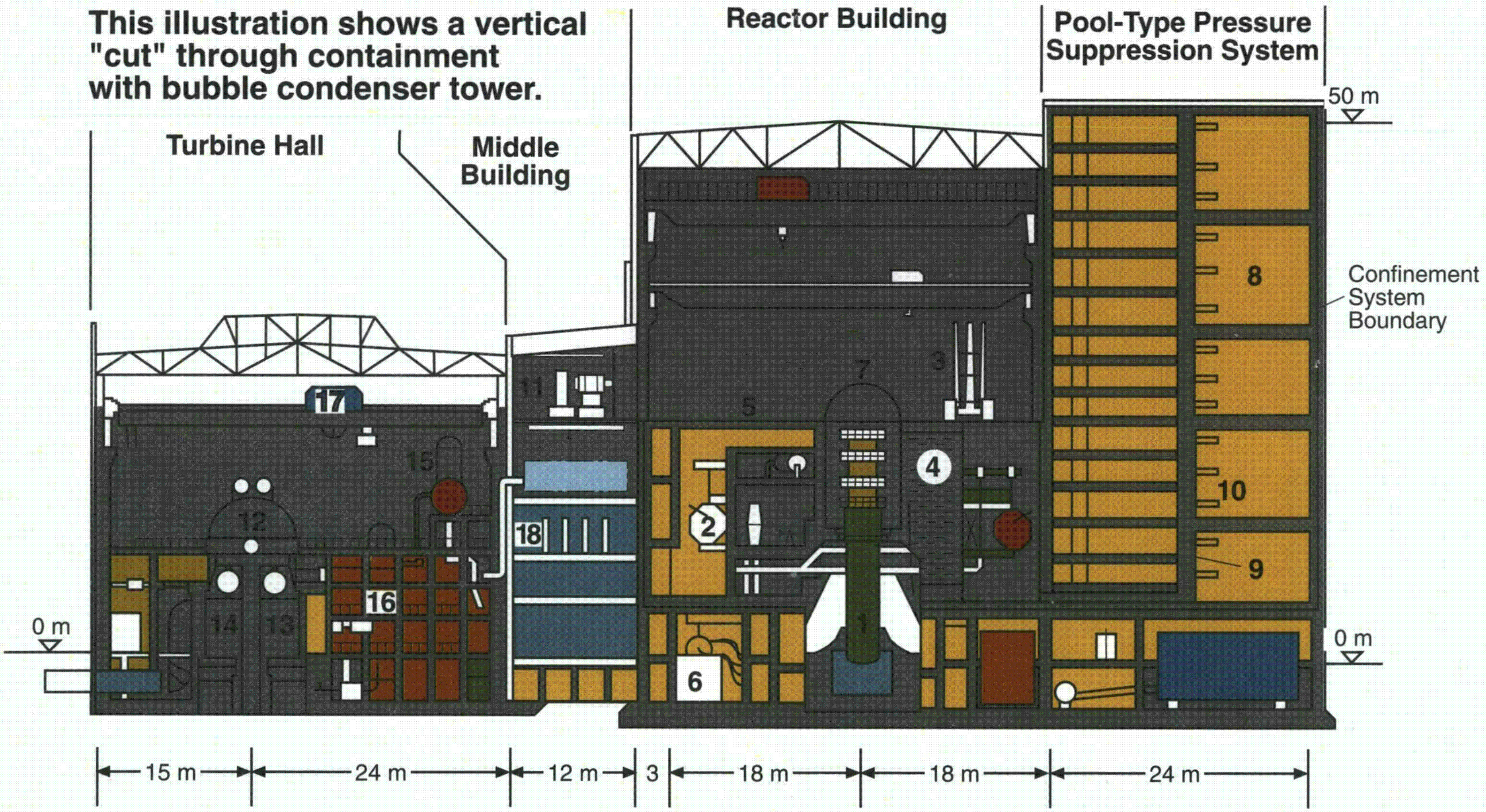
VVER-440/213 Plant Layout

This illustration shows a vertical "cut" through containment with bubble condenser tower.



1. Reactor pressure vessel
2. Steam generator
3. Refueling machine
4. Spent fuel pit
5. Confinement system
6. Make-up feedwater system
7. Protective cover
8. Confinement system
9. Sparging system
10. Check valves
11. Intake air unit
12. Turbine
13. Condenser
14. Turbine block
15. Feedwater tank with degasifier
16. Preheater
17. Turbine hall crane
18. Electrical instrumentation and control compartments

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APPENDIX B

Soviet-Designed Nuclear Power Plants in Russia, Ukraine, and Central and Eastern European Countries

Key:

ADE: Light-water-cooled, graphite-moderated, plutonium production reactor

BN: Breeder reactor

G-n: Generation of design, i.e., *first- or second-generation*

LWGR: Light-water-cooled, graphite-moderated reactor

RBMK: Light-water-cooled, graphite-moderated reactor

VVER: Pressurized water reactor

Country/Plant Name	Reactor Type	Startup Date
Armenia		
Metsamor-1	VVER-440 Model 230	1976 (Shut Down 1989)
Metsamor-2	VVER-440 Model 230	1981, 1995 (Shut Down 1989-1994)
Bulgaria		
Kozloduy-1*	VVER-440 Model 230	1974
Kozloduy-2*	VVER-440 Model 230	1975
Kozloduy-3*	VVER-440 Model 230	1980
Kozloduy-4*	VVER-440 Model 230	1982
Kozloduy-5*	VVER-1000	1987
Kozloduy-6*	VVER-1000	1991
Czech Republic		
Dukovany-1*	VVER-440 Model 213	1985
Dukovany-2*	VVER-440 Model 213	1986
Dukovany-3*	VVER-440 Model 213	1987
Dukovany-4*	VVER-440 Model 213	1988
Hungary		
Paks-1*	VVER-440 Model 213	1982
Paks-2*	VVER-440 Model 213	1984
Paks-3*	VVER-440 Model 213	1986
Paks-4*	VVER-440 Model 213	1987
Kazakhstan		
Shevchenko	BN-350	1973
Lithuania		
Ignalina-1*	RBMK-1500 (G-2)	1985
Ignalina-2*	RBMK-1500 (G-2)	1987
Slovakia		
Bohunice-1*	VVER-440 Model 230	1978
Bohunice-2*	VVER-440 Model 230	1980
Bohunice-3*	VVER-440 Model 213	1984
Bohunice-4*	VVER-440 Model 213	1985
Russia		
Balakovo-1*	VVER-1000	1986
Balakovo-2*	VVER-1000	1988
Balakovo-3*	VVER-1000	1989
Balakovo-4*	VVER-1000	1993
Balakovo-5	VVER-1000	Construction Suspended

* Participates in the Soviet-Designed-Reactor Safety Program.

Country/Plant Name	Reactor Type	Startup Date
Russia (cont'd)		
Beloyarsk-1	LWGR-1000	1964 (Shut Down)
Beloyarsk-2	LWGR-1000	1969 (Shut Down)
Beloyarsk-3	BN-600	1980
Bilibino-1	LWGR-12	1974
Bilibino-2	LWGR-12	1975
Bilibino-3	LWGR-12	1976
Bilibino-4	LWGR-12	1977
Kalinin-1*	VVER-1000	1985
Kalinin-2*	VVER-1000	1987
Kalinin-3	VVER-1000	Under Construction
Kola-1*	VVER-440 Model 230	1973
Kola-2*	VVER-440 Model 230	1975
Kola-3*	VVER-440 Model 213	1982
Kola-4*	VVER-440 Model 213	1984
Kursk-1*	RBMK-1000 (G-1)	1977
Kursk-2*	RBMK-1000 (G-1)	1979
Kursk-3*	RBMK-1000 (G-2)	1984
Kursk-4*	RBMK-1000 (G-2)	1986
Kursk-5	RBMK-1000	Construction Suspended
Novovoronezh-1	VVER-210	1964 (Shut Down 1988)
Novovoronezh-2	VVER-365	1969 (Shut Down 1990)
Novovoronezh-3*	VVER-440 Model 230	1972
Novovoronezh-4*	VVER-440 Model 230	1973
Novovoronezh-5*	VVER-1000	1981
Smolensk-1*	RBMK-1000 (G-2)	1983
Smolensk-2*	RBMK-1000 (G-2)	1985
Smolensk-3*	RBMK-1000 (G-3)	1990
(Leningrad) Sosnovyy Bor-1*	RBMK-1000 (G-1)	1973
(Leningrad) Sosnovyy Bor-2*	RBMK-1000 (G-1)	1975
(Leningrad) Sosnovyy Bor-3*	RBMK-1000 (G-2)	1979
(Leningrad) Sosnovyy Bor-4*	RBMK-1000 (G-2)	1980
Russian Production Reactors		
Krasnoyarsk-2	ADE	1964
Tomsk-4	ADE	1964
Tomsk-5	ADE	1965

* Participates in the Soviet-Designed-Reactor Safety Program.

Appendix B: Soviet-Designed Nuclear Power Plants in Russia, Ukraine, and Central and Eastern European Countries

Country/Plant Name	Reactor Type	Startup Date
Ukraine		
Chornobyl-1*	RBMK-1000 (G-1)	1978
Chornobyl-2	RBMK-1000 (G-1)	1978 (Shut Down 1991)
Chornobyl-3*	RBMK-1000 (G-2)	1982
Chornobyl-4	RBMK-1000 (G-2)	1983 (Destroyed 1986)
Khmelnytskyy-1*	VVER-1000	1988
Khmelnytskyy-2	VVER-1000	Under Construction
Rivne-1*	VVER-440 Model 213	1981
Rivne-2*	VVER-440 Model 213	1982
Rivne-3*	VVER-1000	1987
Rivne-4	VVER-1000	Under Construction
South Ukraine-1*	VVER-1000	1983
South Ukraine-2*	VVER-1000	1985
South Ukraine-3*	VVER-1000	1989
Zaporizhzhya-1*	VVER-1000	1985
Zaporizhzhya-2*	VVER-1000	1985
Zaporizhzhya-3*	VVER-1000	1987
Zaporizhzhya-4*	VVER-1000	1988
Zaporizhzhya-5*	VVER-1000	1989
Zaporizhzhya-6*	VVER-1000	1995

* Participates in the Soviet-Designed-Reactor Safety Program.

APPENDIX C

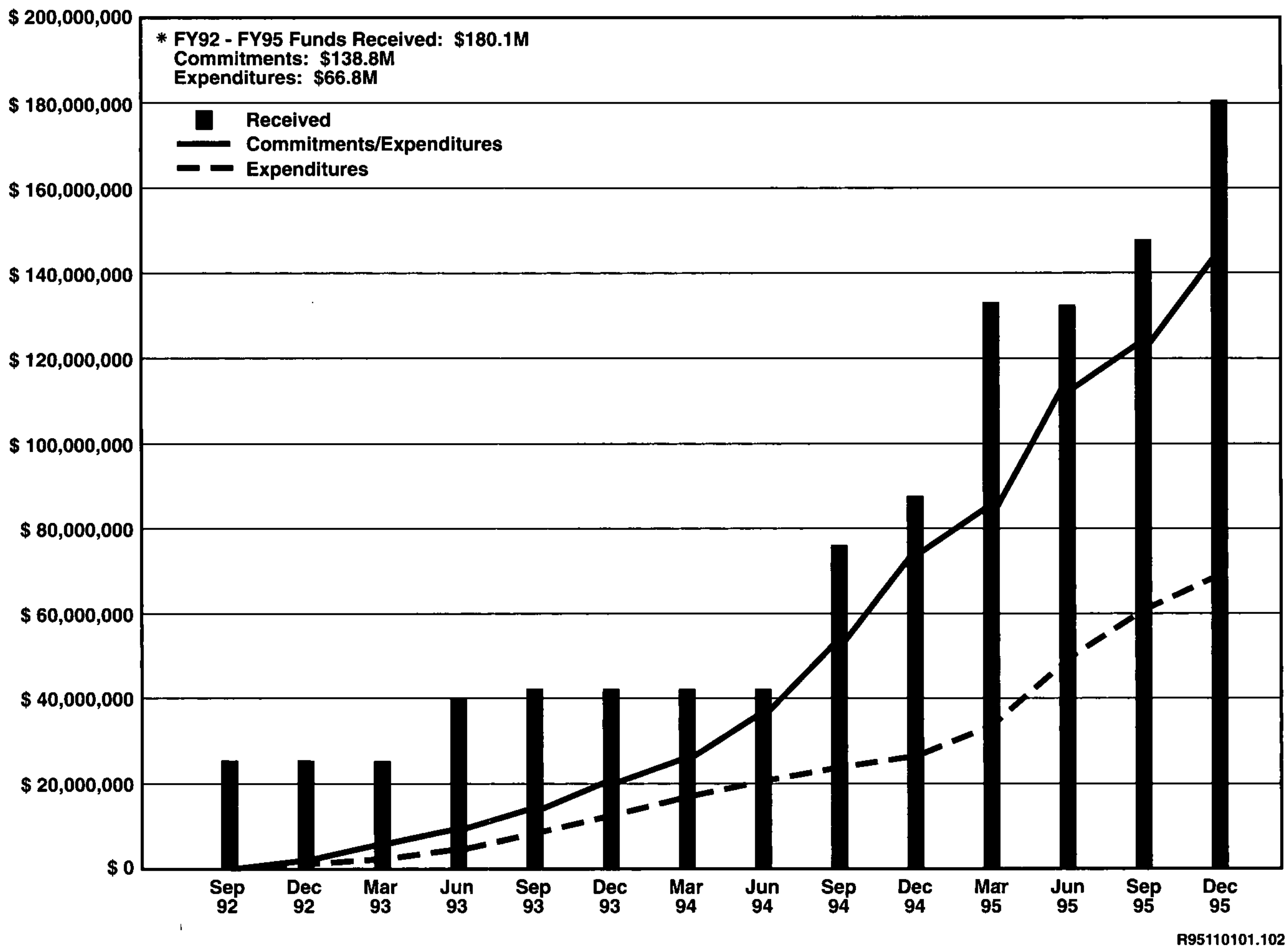
Financial and Schedule Summary

Figure C.1 displays a financial summary of the U.S. Department of Energy's Soviet-Designed-Reactor Safety Program as of December 31, 1995, including funds received, expenditures, and commitments.

The chart summarizes the expenditure and commitment status of FY 1992 - FY 1996 funds received through December 31, 1995, by DOE for the purpose of improving the safety of Soviet-designed reactors in Russia, Ukraine, and the following Central and Eastern European countries: Bulgaria, Czech Republic, Hungary, Lithuania, and Slovakia.

Funds received are all funds that have been made available to DOE from FY 1992,1993, 1994, 1995, and 1996 appropriations through December 31, 1995, as listed in Table C.1. Note that funding was often received at or near the end of the fiscal year and, in some cases, in the fiscal year following the year of appropriation.

Expenditures are actual costs incurred for the period from program inception through December 31, 1995, based on the accounting records of the organization responsible for performing the work. Actual



* All funds are assigned to specific projects per agreement with foreign government representatives. Committed funds are projects for which contracts have been executed or which have entered the contracting cycle.

Figure C.1. Financial Summary for the Soviet-Designed Reactor Safety Program, Russia/Ulkraine/Central and Eastern European Countries, as of November 30, 1995

Table C.1. Summary of Program Appropriations (dollars in thousands)

Funding Source	Beneficiary	Fiscal Year	Amount Expected	Amount Received	Date Received	Funds Available - FY92-94	Funds Available - FY95/96
AID[a]	CEEC[c]	1992	2,850	2,850	7/2/92	2,850	
AID	NIS[d]	1992	21,900	21,900	9/30/92	21,900	
AID	NIS	1993	14,000	14,000	6/30/93	14,000	
AID	CEEC	1993	3,600	3,600	7/12/93	3,600	
AID	NIS	1994	30,000	30,000	9/30/94		30,000
AID	CEEC	1994	3,600	3,600	9/30/94		3,600
DOD[b]	NIS	1993	11,000	11,000	11/7/94		11,000
AID	NIS	1994	45,000	45,000	2/21/95		45,000
AID	NIS	1995	6,900	6,900	7/28/95		6,900
AID	NIS	1995	8,500	8,500	9/29/95		8,500
AID	CEEC	1995	2,700	2,700	10/26/95		2,700
DOE	NIS/CEEC	1996	30,000	30,000	11/13/95		30,000
AID	NIS	1996	11,400				
Total			191,450	180,050		42,350	137,700

(a) AID = U.S. Agency for International Development.
(b) DOD = U.S. Department of Defense.
(c) CEEC = Central and Eastern European countries.
(d) NIS = New Independent States (Russia and Ukraine).

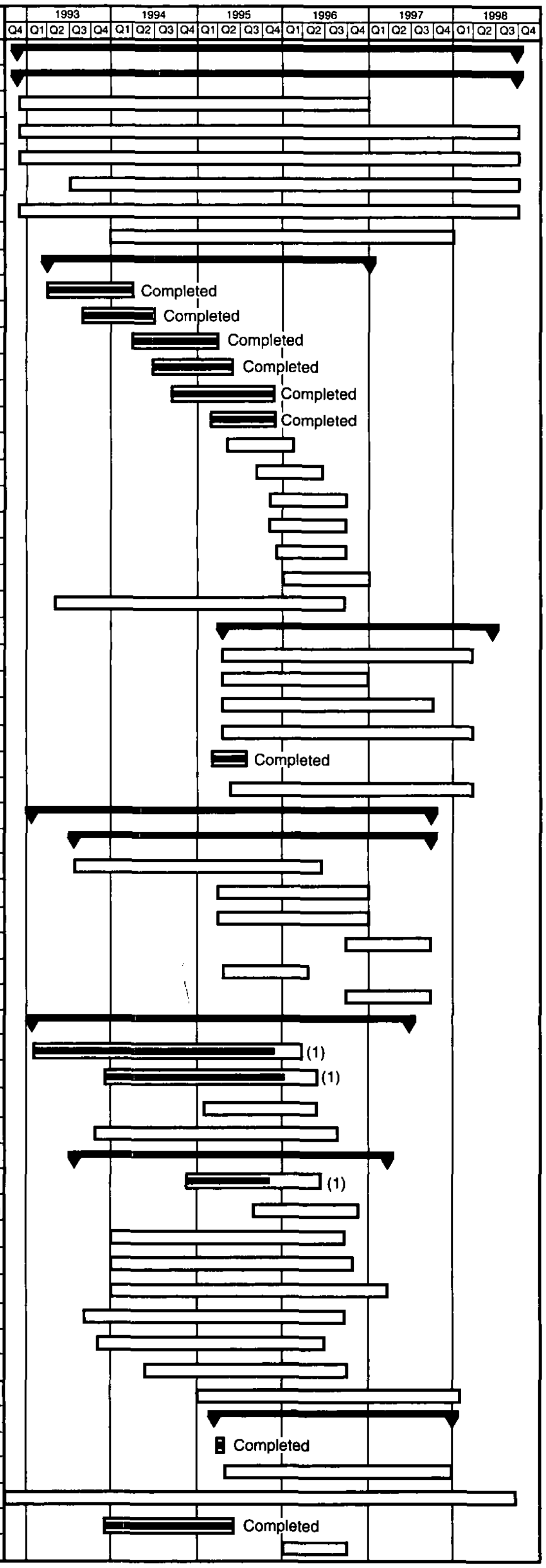
costs include all cash outlays incurred to date plus accruals made in accordance with generally accepted accounting principles. The amount of expenditures reflected here may be greater than the amount currently reflected in DOE-Headquarters records based on reporting time lags between performing organizations, field offices, and Headquarters.

Commitments are all funds assigned to specific projects per agreement with foreign government representatives. Committed funds are assigned to projects for which contracts have been executed or which have been assigned to responsible organizations.

Tables C.2 and C.3 show schedules of activities for Russia and Ukraine, respectively.

Table C.2. Schedule of Activities for the Soviet-Designed-Reactor Safety Program, Russia

ID	Task Name	Notes
1	**Management & Operations Safety**	
2	Emergency Operating Instructions	
3	VVER-440/230 - Novovoronezh	
4	VVER-440/213 - Kola	
5	VVER-1000 - Balakovo	
6	RBMK - Smolensk	
7	Enhanced Operational Controls	
8	Operator Exchange Visits	
9	Training	
10	I&C Maintenance	Completed
11	Reactor Field Operator	Completed
12	Turbine Field Operator	Completed
13	Mechnical Maintenance	Completed
14	Refueling Operator	Completed
15	Shift Supervisor (Control Room)	Completed
16	Electrical Maintenance	
17	Electrical: Operations	
18	Water Chemistry	
19	Systems Course-Engrs.	
20	Automatic Controls: Operations	
21	Reactor Building Shift Supervisor	
22	Special Courses	
23	Simulators	
24	Kola	
25	Balakovo	
26	Novovoronezh	
27	Kalinin	
28	Emergency Response Workshops	Completed
29	Equipment Maintenance Tech Transfer	
30	**Engineering & Technology**	
31	Fire Safety Upgrades	
32	Smolensk RBMK Fire Safety Upgrades	
33	Fire Hazards Analysis Training	
34	Plant Specific Fire Hazard Analysis	
35	Plant Specific Fire Safety Upgrades	
36	Leningrad Fire Detection System	
37	Kursk Fire Safety Upgrades	
38	Confinement Safety System Upgrades	
39	Kola Confinement Leak Tightness	(1)
40	Kola Confinement Isolation Valves	(1)
41	Kursk Confinement Leak Tightness	
42	Kola Post Accident Radiation Monitors	
43	Engineered Safety System Upgrades	
44	Kola Reliable DC Power Supply	(1)
45	Novovoronezh Safety Panel Display System	
46	Novovoronezh Emergency Water Supply	
47	Kursk Reliable DC Power Supply	
48	RBMK Safety Panel Display System	
49	Kursk Ultrasonic Test Equipment	
50	Kursk High Temperature Clothing	
51	Kursk Emergency Water Supply	
52	**Plant Safety Evaluations**	
53	**Nuclear Safety Legislative & Regulatory**	
54	Workshop on International Liability	Completed
55	Regulatory Capability Enhancement	
56	**Program Management**	
57	Alternative Energy Study	Completed
58	Site Specific Decommissioning Study	



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Summary — Task — (1) U.S. portion of work completed

Table C.3. Schedule of Activities for the Soviet-Designed-Reactor Safety Program, Ukraine

ID	Task Name	1993–1998 (Q4 1993 – Q4 1998)
1	**Management & Operations Safety**	
2	Emergency Operating Instructions	
3	VVER-440/213 - Rivne	
4	VVER-1000 - Zaporizhzhya	
5	Enhanced Ops Controls - Zaporizhzhya	
6	Operator Exchange Visits	
7	Training	
8	Mechanical Maintenance	Completed
9	Control Room Operator (1)	Completed
10	Turbine Operator	Completed
11	Refueling Operator	
12	Reactor Vessel Technician	
13	Reactor Field Operator	
14	Control Room Operator	
15	Chemical Operator	
16	Special Courses	
17	Simulators	
18	Khmelnytskyy	
19	South Ukraine Unit 3	
20	South Ukraine Unit 1	
21	Rivne	
22	**Engineering & Technology**	
23	Fire Safety Upgrades	
24	Zaporizhzhya VVER Fire Safety Upgrades	(1)
25	Fire Hazards Analysis Training	
26	Plant Specific Fire Hazard Analysis	
27	Plant Specific Fire Hazard Upgrades	
28	**Plant Safety Evaluations**	
29	**Dry Cask Storage for Zaporizhzhya**	
30	**Program Management**	
31	Alternative Energy Study	Completed
32	**Chornobyl Projects**	
33	Emergency Operating Instructions	
34	Quality Assurance	
35	Training	
36	Fire Safety Upgrades	
37	Safety Panel Display System	
38	Slavutych Center	

R95110101.104 — Summary — Task — (1) U.S. portion of work completed

APPENDIX D

Activities by Program Element and Country

Management and Operational Safety

Activities are directed at increasing the safety of day-to-day operations at Soviet-designed nuclear power plants. This is accomplished by establishing practices and procedures for conduct of operations, improving training programs, transferring modern maintenance methods and technology, and developing and implementing symptom-based emergency operating instructions to improve response to emergency events.

Activities	Russia	Ukraine	CEEC
Conduct of Operations. The objective of this activity is to support the improvement of management and operational safety practices at Soviet-designed nuclear power plants. A working group composed of representatives from the Soviet-designed nuclear power plants, U.S. industry, the Institute of Nuclear Power Operations, and the U.S. Department of Energy (DOE) is developing improved operating procedures for Soviet-designed plants.	√ 3.1.1	√ 4.1.1	√ 5.0
Operator Exchange. The operator exchange task enables host nuclear power plant operators to visit U.S. nuclear power plants and observe U.S. approaches to operational safety, especially in the areas of conduct of operations and emergency operating instructions. These visits are part of the DOE-sponsored portion of the World Association of Nuclear Operators operator exchange program.	√ 3.1.2	√ 4.1.2	√ 5.0
Simulators. The objective of this activity is to improve the overall understanding of nuclear power plant operating characteristics on the part of operators, technical support staff, and management; to improve reactor operator training; to improve analytical availabilities of technical support staff; and to establish host country capabilities to design and manufacture simulators and plant analyzers.	√ 3.1.3	√ 4.1.3	B,L,S 5.1, 5.4, 5.5
Training. The objective of this activity is to assist the host countries in establishing the capability for developing and implementing a systematic approach to training nuclear power plant personnel and to provide technical assistance and equipment for establishing two nuclear training centers.	√ 3.1.3	√ 4.1.3	B,L,S 5.1, 5.4, 5.5
Emergency Operating Instructions. The activity is directed toward the transfer of U.S. methods for developing emergency operating instructions for the VVER-440/230, VVER-440/213, VVER-1000, and RBMK nuclear power plants. Owners' groups are preparing the operating instructions for each type of plant; DOE and U.S. utility experts are providing support in this effort. Once the instructions for these plants have been completed, the owners' groups will extend them to other nuclear power plants in Russia.	√ 3.1.4	√ 4.1.4	√ 5.0
Emergency Management and Planning. This objective is directed at improving the emergency management and planning capabilities in host countries.	√ 3.1.5		√ 5.0
Maintenance Technology Transfer and Training. This activity is directed at transferring maintenance technology and associated training to host countries to help improve the safety of Soviet-designed nuclear power plants.	√ 3.1.6		

Key:
√ = Activity takes place in country
x.x, x.x.x = Section number in this report that discusses country-specific activities
CEEC = Central and Eastern European Countries (see below)
B = Bulgaria, C = Czech Republic, H = Hungary, L = Lithuania, S = Slovakia

Engineering and Technology

Activities are directed at improving the performance of safety systems in Soviet-designed nuclear power plants by transferring the tools, equipment, and procedures necessary to upgrade the safety of these plants. Activities are focused on upgrades to fire safety systems, confinement safety systems, and engineered safety systems.

Activities	Russia	Ukraine	CEEC
Fire Safety System Upgrades. The objective of this activity is to provide vital fire safety equipment, establish demonstration plants, and implement an effective fire prevention program.	√ 3.2	√ 4.2	B 5.1
Confinement System Upgrades. The objective of this activity is to improve the confinement capabilities of VVER and RBMK nuclear power plants.	√ 3.2		H,S 5.3, 5.5
Engineered Safety System Upgrades. The objective of this activity is to reduce the risk associated with the operation of the older Soviet-designed reactors, specifically the RBMKs and the VVER-440/230s, through upgrades in vital safety-related systems, without encouraging their continued operation.	√ 3.2		

Plant Safety Evaluations

Activities are directed at improving indigenous capability of designers, operators, and regulators of Soviet-designed reactors to evaluate the safety of their plants using internationally accepted codes, standards, and methods. Activities include the transfer of technology and assistance to perform safety evaluations used in determining safe operating limits, quantify safety margins, and assess plant system and operator actions that impact safety.

Activities	Russia	Ukraine	CEEC
Safety Analysis for Operating Plants. The objective of this activity is to support plant owners and regulators in performance of plant-specific safety analyses and probabilistic risk assessments to establish the safety margin of plants, and to assist in prioritization of future plant modifications.	√ 3.3	√*	√ 5.0
Improvement of Safety Evaluation Infrastructure. The objective of this activity is to provide, or jointly develop, methodologies, techniques, and analytical expertise that will allow designers, owners, and regulators to perform safety analyses consistent with international standards.	√ 3.3	√*	L 5.4

* No activities are reported for this element for Ukraine during September through December 1995.

Key:
√ = Activity takes place in country
x.x, x.x.x = Section number in this report that discusses country-specific activities
CEEC = Central and Eastern European Countries (see below)
B = Bulgaria, C = Czech Republic, H = Hungary, L = Lithuania, S = Slovakia

Fuel Cycle Safety

Activities are directed at ensuring safe storage of spent nuclear fuel in Ukraine by transferring the technology and equipment to design, manufacture, regulate, and operate safely dry storage systems for spent nuclear fuel. In Russia, activities are focused on enhancing the safety of Russian nuclear fuel cycle facilities and research reactors.

Activities	Russia	Ukraine	CEEC
Fuel Storage Safety. The objective of this activity is to augment the spent fuel storage activities being undertaken by the Zaporizhzhya nuclear power plant by providing dry cask storage equipment and supporting analyses.		√ 4.3	
Regulatory Support. The objective of this activity is to provide training, equipment, and codes to allow Ukrainian regulators to license the dry storage facility.		√ 4.3	
Fuel Cycle Facilities and Research Reactors. This involves cooperative agreement with the Federal Nuclear and Radiation Safety authority in Russia to enhance safety of fuel cycle facilities and research reactors.			

Nuclear Safety Legislative and Regulatory Framework

Activities are directed at supporting development of a legal framework in host countries that promotes adherence to international nuclear safety and liability conventions or treaties and domestic indemnification for nuclear liability.

Activities	Russia	Ukraine	CEEC
Legislative and Regulatory Framework Implementation. The objective of this activity is to implement the safety legislative and regulatory strategic plans.	√ 3.4		

Chornobyl Initiatives

DOE, in cooperation with Ukraine, has initiated two major efforts associated with the Chornobyl nuclear power plant. One of these efforts is the establishment of an International Research Center on Nuclear Safety, Radioactive Waste and Radioecology at Slavutych; the other is to enhance the near-term safety of the reactors that continue to operate at the Chornobyl nuclear power plant.

Activities	Russia	Ukraine	CEEC
Ukraine International Research Center on Nuclear Safety, Radioactive Waste and Radioecology. The United States is planning with Ukraine the establishment of an International Research Center on Nuclear Safety, Radioactive Waste and Radioecology. The Center, to be located at Slavutych near Chornobyl, will enable Ukraine to develop an indigenous capability for solving nuclear safety and nuclear contamination problems at Chornobyl and at other nuclear power plants throughout Ukraine.		√ 4.4	
Near-Term Safety Enhancement at Chornobyl Nuclear Power Plant. To date, two tasks have been defined for enhancing near-term safety at the Chornobyl nuclear power plant—Unit 3 Fire Safety Upgrades and Operational Safety.		√ 4.4	

Key:
√ = Activity takes place in country
x.x, x.x.x = Section number in this report that discusses country-specific activities
CEEC = Central and Eastern European Countries (see below)
B = Bulgaria, C = Czech Republic, H = Hungary, L = Lithuania, S = Slovakia

APPENDIX E

Tables for Activities in Russia

Table E.1. Status of Guidelines and Plant-Specific Procedures—Russia

Document	Date	Responsibility	Status
1. Preparing/Writing Normal Operating Procedures			
Prepare draft guide[a]	7/93	VNIIAES	complete
Review[b]	10/93	VNIIAES	complete
Implement at base plant[c]	5/95	Balakovo	complete
Issue final guide[d]	12/95	Rosenergoatom	
2. Review, Approval, and Maintenance of Operational Procedures			
Prepare draft guide	6/94	VNIIAES	complete
Review	7/94	VNIIAES	complete
Implement at base plant	5/95	Balakovo	complete
Issue final guide	12/95	Rosenergoatom	
3. Procedure User's Guide			
Prepare draft guide	1/95	Zaporizhzhya	complete
Review	8/95	Zaporizhzhya	complete
Implement at base plant	10/96	Balakovo	
Issue final guide	TBD	Rosenergoatom	
4. Control of Temporary Modifications			
Prepare draft guide	5/95	Balakovo	complete
Review	8/95	Balakovo	complete
Implement at base plant	6/96	Balakovo	
Issue final guide	TBD	Rosenergoatom	
5. Development of Abnormal Operating/Annunciator Response Procedures			
Prepare draft guide	4/94	VNIIAES	complete
Review	7/94	VNIIAES	complete
Implement at base plant	5/95	Balakovo	complete
Issue final guide	12/95	Rosenergoatom	
6. Development of Surveillance/Testing Procedures			
Prepare draft guide	4/95	Bohunice/VNIIAES	complete
Review	5/95	Bohunice/VNIIAES	complete
Implement at base plant	9/96	Balakovo	
Issue final guide	TBD	Rosenergoatom	
7. Operator Log Keeping			
Prepare draft guide	7/93	VNIIAES	complete
Review	10/93	VNIIAES	complete
Implement at base plant	9/94	Balakovo	complete
Issue final guide	8/95	Rosenergoatom	complete

Table E.1. (contd)

Document	Date	Responsibility	Status
8. Shift Turnover			
Prepare draft guide	9/93	VNIIAES	complete
Review	1/94	VNIIAES	complete
Implement at base plant	9/94	Balakovo	complete
Issue final guide	8/95	Rosenergoatom	complete
9. Removal and Restoration of Equipment (tagout procedure)			
Prepare draft guide	10/94	Zaporizhzhya	complete
Review	2/95	Zaporizhzhya	complete
Implement at base plant	3/96	Balakovo	
Issue final guide	5/96	Rosenergoatom	
10. Conduct of Operator (equipment) Rounds			
Prepare draft guide	3/94	VNIIAES	complete
Review	4/94	VNIIAES	complete
Implement at base plant	5/95	Balakovo	complete
Issue final guide	11/95	Rosenergoatom	complete
11. Verbal Communications			
Prepare draft guide	7/94	Zaporizhzhya	complete
Review	10/94	Zaporizhzhya	complete
Implement at base plant	3/95	Balakovo	complete
Issue final guide	12/95	Rosenergoatom	
12. Independent Verification			
Prepare draft guide	2/95	Kozloduy	complete
Review	11/95	Kozloduy	complete
Implement at base plant	10/96	Balakovo	
Issue final guide	TBD	Rosenergoatom	
13. Equipment Labeling			
Prepare draft guide	7/94	Paks	complete
Review	10/94	Paks	complete
Implement at base plant	1/95	Balakovo	complete
Issue final guide	TBD	Rosenergoatom	
14. Control of System Status			
Prepare draft guide	10/94	Ignalina/VNIIAES	complete
Review	8/95	Ignalina/VNIIAES	complete
Implement at base plant	12/96	Balakovo	
Issue final guide	TBD	Rosenergoatom	

Table E.1. (contd)

Document	Date	Responsibility	Status
15. Maintenance of Operating Documents			
Prepare draft guide	4/95	Kola	complete
Review	2/96	Kola	
Implement at base plant	TBD	Balakovo	
Issue final guide	TBD	Rosenergoatom	
16. Organization and Conduct of Operations			
Prepare draft guide	2/95	VNIIAES	complete
Review	8/95	VNIIAES	complete
Implement at base plant	TBD	Balakovo	
Issue final guide	TBD	Rosenergoatom	

(a) "Prepare draft guide" indicates the draft document was prepared by the responsible organization.

(b) "Review" indicates the guide has been reviewed by group members and discussed at a group meeting.

(c) "Implement at base plant" indicates the nuclear power plant (base plant) has developed the site-specific procedure/guide for the activity, and the procedure is in use at the station or the site-specific guide is approved and ready for use.

(d) "Issue final guide" indicates the generic guide was updated to reflect lessons learned following implementation of the site-specific procedure at the base plant. The guide is then sent to the other Russian and Ukrainian nuclear power plants by Rosenergoatom or Goscomatom for development and implementation of their site-specific instructions.

Table E.2. Operator Exchange Program, 1995 - Russia

Visitor	U.S. Host Plant and/or Location	Participants	Date	Status
Kursk, Smolensk	Duane Arnold, Iowa	6	1/14/95 - 1/27/95	complete
Smolensk, Leningrad	Hatch, Georgia	2	5/20/95 - 6/10/95	complete
Leningrad	Commonwealth Edison (Zion, Braidwood), Illinois	10	6/2/95 - 6/17/95	complete
Leningrad	Zion, Illinois	10	7/17/95 - 7/29/95	complete
Kola	Point Beach, Wisconsin	4	9/11/95 - 9/15/95	complete
Smolensk, Kursk, Leningrad, RDIPE	Duane Arnold, Iowa	6	9/16/95 - 9/23/95	complete
Kalinin	Shearon Harris, North Carolina	6	10/7/95 - 10/21/95	complete
Kola	North Anna, Virginia	4	10/28/95 - 11/4/95	complete

Table E.3. Russian Training Program Development

General Courses	Initiation Date	Completion Date
1. General Maintenance (Soldering)	4/93	completed—3/94
2. Reactor Field Operator (Non-Control Room)	9/93	completed—9/94
3. Turbine Field Operator (Non-Control Room)	4/94	completed—3/95
4. Mechanical Maintenance	7/94	completed—5/95
5. Refueling Operator	9/94	completed—11/95
6. Shift Supervisor (Control Room)	2/95	completed—11/95
7. Electrical Maintenance	9/95	6/96
8. Electrical Operations	9/95	11/96
9. Water Chemistry	1/96	9/96
10. Automatic Controls: Operations	2/96	1/97
11. Radiation Protection Technician	4/96	1/97
12. Planned (Reactor Building Shift Supervisor)	5/96	3/97
Specialized Courses		
Introductory Systematic Approach to Training	5/93	completed—5/93
Safety Culture Training	9/93	completed—2/94
General Employee Safety Training	6/94	completed—9/95
Instructor Training	8/95	6/96
Procedure Development Training	8/95	6/96
Supervisory Skills Training	10/95	8/96

Table E.4. Fire Safety, Confinement Systems, and Engineered System Upgrades for Russian Nuclear Power Plants

Project Description	Status	Start	Complete
Fire Safety Upgrades			
1. Smolensk Nuclear Power Plant	Sample equipment delivered to Russia for testing. Sanding machine and compressors for breathing apparatus delivered to plant. Bechtel returned to plant in December 1995 to identify additional equipment not requiring testing. A number of procurements are in process.	10/92	11/96
2. Leningrad Nuclear Power Plant	Fire detection equipment from Honeywell Corporation delivered to the plant.	5/95	7/96
3. Fire Hazards Evaluation Guidelines Development	Draft B of the guidelines was completed and translated into Russian. A peer review meeting was held in Washington, D.C. with Russian, Ukrainian, and American fire protection experts.	3/95	7/96
4. Fire Hazards Evaluation Training	First training session was held in Charlotte, North Carolina, November 13-17, 1995. No Russians participated because of other commitments. An additional session will be provided in July 1996.	3/95	9/96
Confinement System Upgrades			
1. Kola Confinement Leak Tightness	Kola staff continue to apply materials provided for sealing leak paths. A proposal has been submitted by the plant for more sealant materials.	4/93	12/96
2. Kola Confinement Isolation Valves	The 11 isolation valves and operators have been received at Kola. A compressed air system for the pneumatic valves is being held in the United States awaiting Customs clearance.	7/93	5/96
3. Kola Post-Accident Radiation Monitors	Manufacture of the monitors has been completed and they have been packaged for shipping.	7/93	8/96
4. Novovoronezh Post-Accident Confinement Venting	This project is under review.	6/95*	TBD
5. Kursk Confinement Leak Tightness	This project was cancelled at the DOE/Minatom meeting in December 1995 because of the development effort that would be required.	2/95	12/95
Engineered System Upgrades			
1. Kola Reliable Direct-Current Power Supply	The first set of direct-current batteries and racks for Kola Unit 2 passed through Customs and are at the plant. The remaining two batteries for Kola Unit 1, racks, and the switchboards are being held at the plant awaiting Customs clearance.	7/93	11/96
2. Novovoronezh Safety Parameter Display System	A Requirements Specifications document was completed and is being used as input to a bid specification.	1/95*	3/97
3. Novovoronezh Emergency Water Supply	Gilbert/Commonwealth and Pacific Northwest National Laboratory staff met with nuclear power plant, Rosenergoatom, Atomenergoproject, and Gidropress staff to discuss preliminary specifications and contractual arrangements.	5/95*	7/97

Table E.4. (contd)

Project Description	Status	Start	Complete
4. Kursk Reliable Direct Current Power	Two non-safety-grade batteries have been purchased from Yuasa Exide and are in transit to the plant. Technical requirements have been developed for the Class 1E (safety-grade) batteries and switchboards. These are being manufactured.	3/95*	12/96
5. RBMK Safety Parameter Display System	The conformed equipment specification has been developed and agreed upon with Russian participants. The Westinghouse contract has been renegotiated accordingly.	1/94	3/97
6. Kursk Ultrasonic Test Equipment	Manual ultrasonic test equipment has been received at the Kursk plant. Specifications were provided to vendors for remotely operated ultrasonic test equipment to obtain budgetary estimates. ABB-CE will provide this equipment.	3/94	10/96
7. Kursk High-Temperature Clothing	Modification 1 suit is awaiting Customs clearance. Modification 2 suit has been received at the Kursk plant.	3/94	10/96
8. Kursk Emergency Water Supply	Equipment specifications have been approved. Burns & Roe has received authorization to purchase equipment.	3/95*	10/96
9. RBMK Valve Manufacture Technology Transfer	Burns & Roe selected as contractor. Scope of assistance to be discussed at upcoming meeting at Kursk.	5/95*	TBD

* Date of Task Restart.

APPENDIX F

Tables for Activities in Ukraine

Table F.l. Status of the Guidelines and Plant-Specific Procedures—Ukraine

Document	Date	Responsibility	Status
1. Preparing/Writing Normal Operating Procedures			
Prepare draft guide[a]	7/93	VNIIAES	complete
Review[b]	10/93	VNIIAES	complete
Implement at base plant[c]	5/95	Zaporizhzhya	complete
Issue final guide[d]	12/95	Goscomatom	
2. Review, Approval, and Maintenance of Operational Procedures			
Prepare draft guide	6/94	VNIIAES	complete
Review	7/94	VNIIAES	complete
Implement at base plant	5/95	Zaporizhzhya	complete
Issue final guide	12/95	Goscomatom	
3. Procedure User's Guide			
Prepare draft guide	1/95	Zaporizhzhya	complete
Review	8/95	Zaporizhzhya	complete
Implement at base plant	10/96	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	
4. Control of Temporary Modifications			
Prepare draft guide	5/95	Balakovo	complete
Review	8/95	Balakovo	complete
Implement at base plant	6/96	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	
5. Development of Abnormal Operating/Annunciator Response Procedures			
Prepare draft guide	4/94	VNIIAES	complete
Review	7/94	VNIIAES	complete
Implement at base plant	1/95	Zaporizhzhya	complete
Issue final guide	12/95	Goscomatom	
6. Development of Surveillance/Testing Procedures			
Prepare draft guide	4/95	Bohunice/VNIIAES	complete
Review	5/95	Bohunice/VNIIAES	complete
Implement at base plant	9/96	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	
7. Operator Log Keeping			
Prepare draft guide	7/93	VNIIAES	complete
Review	10/93	VNIIAES	complete
Implement at base plant	9/94	Zaporizhzhya	complete
Issue final guide	12/95	Goscomatom	

Table F.I. (contd)

Document	Date	Responsibility	Status
8. Shift Turnover			
Prepare draft guide	9/93	VNIIAES	complete
Review	1/94	VNIIAES	complete
Implement at base plant	4/94	Zaporizhzhya	complete
Issue final guide	12/95	Goscomatom	
9. Removal and Restoration of Equipment (tagout procedure)			
Prepare draft guide	10/94	Zaporizhzhya	complete
Review	2/95	Zaporizhzhya	complete
Implement at base plant	12/95	Zaporizhzhya	
Issue final guide	5/96	Goscomatom	
10. Conduct of Operator (equipment) Rounds			
Prepare draft guide	3/94	VNIIAES	complete
Review	4/94	VNIIAES	complete
Implement at base plant	5/95	Zaporizhzhya	complete
Issue final guide	11/95	Zaporizhzhya	complete
11. Verbal Communications			
Prepare draft guide	7/94	Zaporizhzhya	complete
Review	10/94	Zaporizhzhya	complete
Implement at base plant	3/95	Zaporizhzhya	complete
Issue final guide	12/95	Goscomatom	
12. Independent Verification			
Prepare draft guide	2/95	Kozloduy	complete
Review	11/95	Kozloduy	complete
Implement at base plant	10/96	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	
13. Equipment Labeling			
Prepare draft guide	7/94	Paks	complete
Review	10/94	Paks	complete
Implement at base plant	1/95	Zaporizhzhya	complete
Issue final guide	TBD	Goscomatom	
14. Control of System Status			
Prepare draft guide	10/94	Ignalina/VNIIAES	complete
Review	8/95	Ignalina/VNIIAES	complete
Implement at base plant	12/96	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	

Table F.I. (contd)

Document	Date	Responsibility	Status
15. Maintenance of Operating Documents			
Prepare draft guide	4/95	Kola	complete
Review	2/96	Kola	
Implement at base plant	TBD	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	
16. Organization and Conduct of Operations			
Prepare draft guide	2/95	VNIIAES	complete
Review	8/95	VNIIAES	complete
Implement at base plant	TBD	Zaporizhzhya	
Issue final guide	TBD	Goscomatom	

(a) "Prepare draft guide" indicates the draft document was prepared by the responsible organization.

(b) "Review" indicates the guide has been reviewed by group members and discussed at a group meeting.

(c) "Implement at base plant" indicates the nuclear power plant (base plant) has developed the site-specific procedure/guide for the activity, and the procedure is in use at the station or the site-specific guide is approved and ready for use.

(d) "Issue final guide" indicates the generic guide was updated to reflect lessons learned following implementation of the site-specific procedure at the base plant. The guide is then sent to the other Russian and Ukrainian nuclear power plants by Rosenergoatom or Goscomatom for development and implementation of their site-specific instructions.

Table F.2. Operator Exchange Program, 1995 —Ukraine

Visiting Plant	U.S. Host Plant and/or Location	Participants	Date	Status
Chornobyl	Hatch, Georgia	1	5/20/95 - 6/10/95	complete
Rivne	Byron, Illinois	4	6/3/95 - 6/9/95	complete
Rivne	Point Beach, Wisconsin	5	9/11/95 - 9/15/95	complete
Chornobyl	Duane Arnold, Iowa	2	9/16/95 - 9/25/95	complete
Chornobyl	Brunswick, North Carolina	7	10/28/95 - 11/4/95	complete
Chornobyl	Brunswick, North Carolina	7	12/2/95 - 12/9/95	complete

Table F.3. Ukraine Training Program Development

General Courses	Initiation Date	Completion Date
1. Mechanical Maintenance	5/93	completed—4/94
2. Control Room Operator	10/93	completed—5/94
3. Turbine Operator	6/94	completed—3/95
4. Refueling Operator	9/94	3/96
5. Control Room Operator (2)	12/94	6/96
6. Reactor Vessel Repair Technician	2/95	1/96
7. Control Room Operator (3)	9/95	11/96
8. Chemical Operator	9/95	8/96
Specialized Courses		
Introductory Systematic Approach to Training	5/93	completed—7/93
Safety Culture Training	9/93	completed—2/94
General Employee Safety Training	6/94	completed—2/95

Table F.4. Fire Safety Upgrades—Ukraine

Project Description	Status	Start	Complete
1. Zaporizhzhya Nuclear Power Plant	Fire detection and suppression equipment and sealant material were shipped to the plant. Asken has initiated manufacture of fire doors.	7/93	10/96
2. Fire Hazards Evaluation Procedures Development	Draft B of the guidelines was completed and translated into Russian. A peer review meeting was held in Washington, D.C. with Russian, Ukrainian, and American fire protection experts. Guidelines will be issued in July 1996.	3/95	7/96
3. Fire Hazards Evaluation Training	First training session was held in Charlotte, North Carolina, November 13-17. Two nuclear power plants were toured. Additional session planned for July 1996.	3/95	7/96

APPENDIX G

U.S. Commercial Organizations Providing Services and Materials

Appendix G: U.S. Commercial Organizations Providing Services and Materials

Company	Services/Materials
ABB-CE	Ultrasonic test equipment
American Technologies, Inc.	Configuration management support
Ameridata	Computer equipment
Babcock & Wilcox	Technical support services
Bechtel Power Corporation	Fire protection equipment and special studies
Bradford Corporation	Fire hazards evaluation support
Burns & Roe	Technical support services
Duke Engineering & Services	Dry cask storage system for Zaporizhzhya spent fuel
General Physics Corporation	Training support
Gilbert/Commonwealth Corporation (Parsons Power Group, Inc.)	Seismic upgrades, safety parameter display system vendor selection
Haliburton NUS Corporation	Technical/software support, including translation of computer programs into Cyrillic, and training
Honeywell	Computer equipment
International Management Development Corporation	Logistics management and transportation coordination
Mariner Engineering, Inc.	Engineering services
Matrix International Logistics Inc.	Logistics management and international transportation services
Orion/Atlantic	Satellite system for international communication
Path Training Corporation	Training support
Promatec, Inc.	Sealant materials

Appendix G: U.S. Commercial Organizations Providing Services and Materials

Company	Services/Materials
Raytheon Engineers & Constructors, Inc.	DC power supply, architect-engineering support
S3 Technologies	Simulator design and provision
Science Applications International Corporation	Fire safety support, training support, simulator equipment, and probabilistic risk assessment
Scientech	Training support, other technical support services
Sierra Nuclear Corporation	Dry cask storage system for Zaporizhzhya spent fuel
Stone & Webster, Inc.	Configuration management support
Sonalysts, Inc.	Training support
Taurus	Simulator technology support
Westinghouse Electric Corporation	Safety parameter display system

APPENDIX H

Acronyms and Abbreviations

DC	direct current
DOE	U.S. Department of Energy
GAN	Gosatomnadzor (Russian organization responsible for regulating the safety of nuclear reactors and fuel cycle enterprises)
Goscomatom	Ukrainian State Committee on Nuclear Power Utilization
GUPO	National Fire Department of Ukraine
IBRAE	Russian Academy of Sciences - Nuclear Safety Institute
kW	kilowatt
MEPNS	Ministry for Environmental Protection and Nuclear Safety (Ukraine)
Minatom	Ministry of Atomic Energy of the Russian Federation
MOHT	consortium of Gidropress, Kurchatov Institute, and VNIIAES for emergency operating instruction work
NVLAP	National Voluntary Laboratory Accreditation Program
RBMK	Soviet-designed, graphite-moderated, boiling water-cooled, channel reactor
REA	Rosenergoatom
RDIPE	Research and Development Institute of Power Engineering (Russia)
SCNRS	State Committee for Nuclear and Radiation Safety (Ukraine; now known as MEPNS)
UJD	Slovakian Nuclear Regulatory Authority
VNIIAES	Russian Institute for Nuclear Power Plant Operations
VUJE	Slovakian research institute
VVER	Soviet-designed pressurized water reactor

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For more information about the Soviet-Designed-Reactor Safety Program, contact:

Kristen Suokko
International Nuclear Safety Program
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

E-mail: kristen.suokko@hq.doe.gov
Phone: (202) 586-5559
Fax: (202) 586-8353
Internet: http://insp.pnl.gov:2080

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

***

AFFIRMATION SESSION

***

PUBLIC MEETING

***

Nuclear Regulatory Commission
Commissioners Conference Room
One White Flint North
11555 Rockville Pike
Rockville, Maryland

Friday, November 22, 1996

The Commission met in open session, pursuant to notice, at 1:30 p.m., Shirley A. Jackson, Chairman, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission

KENNETH C. ROGERS, Member of the Commission

NILS J. DIAZ, Member of the Commission

EDWARD MCGAFFIGAN, JR., Member of the Commission

STAFF SEATED AT THE COMMISSION TABLE:

JOHN C. HOYLE, Secretary of the Commission

MARTIN G. MALSCH, Deputy General Counsel

DISCLAIMER

This is an unofficial transcript of a meeting of the United States Nuclear Regulatory Commission held on November 22, 1996 in the Commission's office at One White Flint North, Rockville, Maryland. The meeting was open to public attendance and observation. This transcript has not been reviewed, corrected or edited, and it may contain inaccuracies.

The transcript is intended solely for general informational purposes. As provided by 10 CFR 9.103, it is not part of the formal or informal record of decision of the matters discussed. Expressions of opinion in this transcript do not necessarily reflect final determination or beliefs. No pleading or other paper may be filed with the Commission in any proceeding as the result of, or addressed to, any statement or argument contained herein, except as the Commission may authorize.

P R O C E E D I N G S

[1:30 p.m.]

CHAIRMAN JACKSON: Good afternoon ladies and gentlemen. This is an affirmation session. We have one item to come before us this afternoon.

Before I ask the Secretary to lead us through the item for affirmation, do any of my fellow commissioners have any opening comments they would like to make?

[No response.]

CHAIRMAN JACKSON: If not, then Mr. Secretary, please proceed.

MR. HOYLE: Thank you, Chairman. The paper is Secy-96-235. In this paper, the Commission is being asked to act on petitions requesting Commission review of the Decision recently issued by the Director of the Office of Nuclear Materials Safety and Safeguards on the certification of gaseous diffusion plants. The Director's Decision was issued on September 19th and it dealt with continued operation by the U.S. Enrichment Corporation of the Diffusion Plants at Paducah, Kentucky and Piketon, Ohio. The Chairman and Commissioners Rogers, Diaz and McGaffigan have approved the Memorandum and Order which rejects one late filed petition, denies the two requests for reconsideration of two previously rejected petitions, and addresses the remaining contentions raised in the valid petitions. The Memorandum and

Order denies all remaining contentions in the petitions. I note that Commissioner Dicus does not participate in this matter. I ask you to affirm your votes.

CHAIRMAN JACKSON: Aye.

COMMISSIONER DIAZ: Aye.

COMMISSIONER ROGERS: Aye.

COMMISSIONER DICUS: Aye.

COMMISSIONER McGAFFIGAN: Aye.

MR. HOYLE: Thank you.

CHAIRMAN JACKSON: Is there anything else to come before us this afternoon?

MR. HOYLE: No, there isn't.

CHAIRMAN JACKSON: If not, we're adjourned.

[Whereupon, at 1:35 p.m., the affirmation was adjourned.]

CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: AFFIRMATION SESSION

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Friday, November 22, 1996

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Darlene K. Wright