

CHERNOBYL

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PAPER

THE IMPACT OF THE CHERNOBYL' ACCIDENT  
ON THE LONG-TERM DEVELOPMENT OF  
SOVIET NUCLEAR ENERGY

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## INTRODUCTION

Nuclear power interacts with the environment in numerous ways, some positive, some negative. These include the contaminating effect of radiation, the conservation of non-renewable energy resources, the preservation of the landscape, and the avoidance of dangerous pollutants from burning fossil fuels. The Soviets have, especially since the early 1970s, taken an aggressive approach to the development of nuclear power. They have traditionally stressed the positive aspects of nuclear power and downplayed the risk of radiation contamination. At the same time, the Soviet Union has lacked a sufficiently strong voice to argue against the development of nuclear power on the grounds of environmental hazards. This, coupled with the perceived cost-effectiveness of nuclear power plants over fossil fuel plants, has led to the rapid development of the Soviet nuclear power industry. The accident at Chernobyl', however, has painfully reminded everyone of the dangers inherent in today's nuclear power technology. This paper examines the role of nuclear power in the Soviet environment and economy, and the effect that the accident at the Chernobyl' nuclear power station has had, and is likely to have, on the further development of the Soviet nuclear power industry.

## I. ENVIRONMENTAL CONSCIOUSNESS IN THE USSR

### A. The Evolution of Official Soviet Policy.

Traditionally, Soviet policy has treated the environment as a tool to be used to further economic growth. This can be traced back to the days of Lenin, whose efforts to modernize Soviet Russia incorporated the notion of improving or modifying nature to suit the needs of the Bol'sheviks. This philosophy was continued, and perhaps intensified, with the policies of the first five year plan in 1928. At that time, Stalin embarked on an industrial growth plan designed to force the Soviet Union into the twentieth century at virtually any cost. The attitude of this period is summed up in a recent interview with A. L. Yanshin, vice president of the USSR Academy of Sciences, in which he stated: "A saying attributed to I. V. Michurin was generally supported and was justified at the time: 'We cannot wait for favors from nature, our problem is to take them from her'."<sup>1</sup>

The economic system as well as economic goals and priorities of the first five year plan went largely unchanged for the next fifty years. Little attention was given by Soviet officials to resource depletion, pollution, or other environmental concerns. To

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<sup>1</sup>Yuri Danilin, "On Formal Ties with Ecology," Komsomolskaya Pravda (March 22, 1986), p. 2, interview with A. L. Yanshin [emphasis added].

underscore this point, Yanshin also reminded the readers of Komsomolskaya Pravda that, while environmental problems are not new, "...if you leaf through newspapers and magazines from 20 years ago, you won't detect any concern on their account."<sup>2</sup>

To be sure, the Soviet preoccupation with industrial growth, coupled with the vast geographical territory of the country and the uneven dispersion of natural resources, has resulted in mammoth projects that often had powerful environmental impacts. Khrushchev's virgin lands project, the Baikal-Amur Mainline, and the planned diversion of rivers to the arid lands of Soviet Central Asia come quickly to mind. Some would include the rapid development of the Soviet nuclear power industry as another example. In short, throughout the first five decades of their drive to industrialize the country, Soviet officials have shown only sporadic concern about their environment.

There are indications, however, that the exploitative attitudes of Soviet officials are beginning to be replaced by more environmentally sensitive ones. It seems that Soviet officials are now aware that the goals of rapid economic growth and environmental preservation conflict; they are struggling with attempts to resolve that conflict. This development has been led primarily by the academic and specialist communities, and that their efforts appear to have had some impact on policy. The planned diversion of rivers

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<sup>2</sup>Ibid.

has been halted, resource depletion has become a policy issue of great importance, and such issues as water conservation, acid rain, and noise and industrial pollution are also more frequently discussed by officials in the press. The government has also created contests and awards to promote the responsible use of the environment.<sup>3</sup> Taken together, these small steps comprise a perceptible change in official views of the environment.

An authoritative article in Pravda by P. Poletayev, deputy chairman of the commission of the Presidium of the USSR Council of Ministers for Conservation of the Environment and Efficient Use of Natural Resources, outlined the recent history of official environmental policies and the outlook for the future. He was quick to point out that efforts had fallen short of requirements in several areas and that more attention to these problems is required. Poletayev states, for example, that despite the fact that: "The amount of money spent on environmental protection is constantly increasing, ...during the previous two five year plans [1976-1985], 15 percent of the government investment allocations for conservation of the environment was not used."<sup>4</sup> Poletayev notes that, during those years, over 71 billion rubles was budgeted

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<sup>3</sup>For example, an annual contest co-sponsored by a number of official and quasi-official groups in the Ukraine, receives an average of 100 environment preservation suggestions from enterprises, university groups, scientists, and individuals. Winners in such contests receive citations, cash prizes, or the coveted prize for a "Leninist Attitude Toward Nature."

<sup>4</sup>P. Poletayev, "Answerable to the Environment," Pravda (June 5, 1986), p. 3.

for environmental protection. In the Twelfth Five Year Plan (1986-1990), he states that: "...14.5 billion rubles in government investment for environmental conservation" has been budgeted, and argues that: "It is important that these funds be used fully and yield the greatest return...". Poletayev goes on to criticize those in charge of constructing environmental protection facilities, asserting that these facilities are: "...often treated as secondary concerns, their construction is delayed and then finished in a rush, thus resulting in poor quality of operation."<sup>5</sup>

Something about the change in official Soviet perceptions can also be learned by the way environmentalist groups in other countries are portrayed in current Soviet press reports. In an article on the West German Green party that appeared in a major Soviet news weekly after the Chernobyl' accident, the struggle between the traditional Soviet predisposition towards economic growth and the more recent interest in ecological and conservation considerations was clearly evident. The author approached the Greens from both sides. First he criticized the Greens for not having a "...realistic alternative to the 'industrial society' which they denounce." Next, he complimented the Green's environmental policies and activities, and described the support that West Germany's largest labor union (the Metalworkers' Union) gives to the Green's new economic and political platform. The author took pains to note, however, that: "...the union disagrees

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<sup>5</sup>Ibid.

with some of the draft program's provisions, specifically, it does not subscribe to the demand that all atomic power plants be shut down immediately."<sup>6</sup> The author's ambivalence toward environmental initiatives in general seems more or less representative of the attitudes of many Soviet officials. It is also significant that the author singled out the Green's atomic energy policy as the only area of disagreement.

Official ambivalence towards the environment is in large part caused by the economic priorities of the Soviet government. This issue is exacerbated by the inability of the traditional Soviet economic system to assign scarcity prices to resources. In fact, Soviet prices tend to undercharge for natural resources and overcharge for equipment such as that used for pollution abatement. This problem was less acute when the Soviets pursued an extensive approach to economic growth. As resources have become more scarce, however, concern is increasing about the pricing and the misuse of resources that results from the use of non-scarcity prices. Discussions of this issue are not common in the Soviet literature, but they do exist.<sup>7</sup> Finally, part of the awakening of Soviet officials has been the result of the overwhelming evidence of

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<sup>6</sup>Alexander Tolpegin, "The Green Tide," New Times (October 13, 1986), pp. 20-23.

<sup>7</sup>Discussions regarding the problems of pricing natural resources are most frequently seen in the specialist literature. In the general press, see, for example, the interview with A.L. Yanshin, in Yuri Danilin, op. cit.; and the article by P. Poletayev in Pravda (June 5, 1986), p. 3.

environmental damage that has been developing in the Soviet Union over the past 60 years. Earlier, such evidence was less staggering. The vast geographical size, and resource abundance of the country, coupled with the relatively low level of industrial activity, meant that ecological problems were relatively inconspicuous. Now, many of the Soviet Union's industrial cities have pollution problems as serious as any in the West. In sum, while maintaining their preferences for economic growth, Soviet officials are finding it increasingly difficult to ignore the environmental aspects of their decisions.

The most impassioned arguments for environmental preservation come of course from environmental specialists. This has always been the case, even during the Stalinist period when their efforts, though muted, were not entirely silenced. More recently, and particularly since the death of Brezhnev, environmentalists have made the ecology debate increasingly public. For example, a recent article in Kommunist, by a well-known and well-respected Soviet academician, discussed environmental issues in very broad, holistic terms and emphasized the importance of protecting the environment:

...those responsible for scientific-technical progress and, even more, for applying its achievements for practical purposes, face the objective requirement to consider the vulnerability of our natural environment, not allow any of its 'safety margins' to be exceeded, more thoroughly study the essence of the complicated and mutually interconnected phenomena peculiar to it and refrain from defying natural laws in order to avoid provoking irreversible processes...We call this requirement the ecological imperative. It must be taken into



consideration not only by those whose activities are of an economic nature but also by political leaders on whose actions the methods of solving international problems depend...The achievements of contemporary science, considering man, mankind, and the environment as a single unified system, provide the starting point in the area of ecological policy.<sup>8</sup>

In an effort to link these opinions to official policy, the author cited the following statements by General Secretary Gorbachev at the 27th Communist Party Congress: "Never before has our home on earth been exposed to such great political and physical stresses. Never before has man exacted so much tribute from nature and never before has he been so vulnerable to the forces he himself has created."<sup>9</sup>

B. Public Concern About the Environment in the Soviet Union.

It is difficult to gauge public perceptions of the environmental issue. Opinion polls regarding environmental issues in the Soviet Union, if taken, have not been published. Also, the Soviet Union has historically lacked environmentalist groups such as those found in the West that serve as a source of information and inspiration to those concerned about the environment. The following impressions of Soviet public opinion regarding the environment are

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<sup>8</sup>N. Moiseyev, "The Ecological Imperative," Kommunist, No. 12, (August 1986) [emphasis in the original].

<sup>9</sup>From a speech delivered at the 27th CPSU Congress, and quoted in N. Moiseyev, op. cit.

taken from two Western studies,<sup>10</sup> an examination of letters to the editor and articles on environmental issues in the popular press,<sup>11</sup> and relevant statements by various people after the Chernobyl<sup>1</sup> accident.

Perhaps the two most consequential factors that have influenced the Soviet public's attitude toward the environment over the years are the lack of objective information regarding environmental issues and the Soviet government's extensive propaganda efforts to convince the public that environmental problems are endemic only to Western capitalist systems. One Soviet bureaucrat estimated that, in the late 1970s, more than 85 percent of the Soviet public was ignorant of how serious Soviet environmental problems were. He went on to explain that: "A Soviet citizen can get a fully detailed, disastrous picture of the state of nature in the United States or the Federal Republic of Germany...the poisoning of Lake Erie, the oil-drenched beaches of England, and the mountains of garbage in New York even flash before him on the television screen to convince him of the advantages of his own, socialist, way of life."<sup>12</sup>

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<sup>10</sup>Sergei Voronitsyn, "How Great is Soviet Citizens' Fear of Nuclear Radiation?," Radio Liberty Research Reports (RL 468/82); and Charles E. Ziegler, "Soviet Images of the Environment," Royal Journal of Political Science (July 1985), pp. 365-380. Both of these articles also provided important bibliographical documentation.

<sup>11</sup>An especially interesting series of letters about the dangers of nuclear power stations appeared in Trud on September 29, 1982.

<sup>12</sup>Boris Komarov, The Destruction of Nature in the Soviet Union, (White Plains, NY: M.E. Sharpe, 1980), p. 17.

However, to the extent that similar information about Soviet environmental problems is collected, it has been kept within a very narrow group of officials and scientists, and not disseminated to the public. This situation has led at least one expert to conclude that: "Perhaps the most accurate description of the Soviet popular image of the environment is indifference or ignorance, or both."<sup>13</sup>

There is reason to believe, however, that public indifference may also be giving way to more interest in the environment. Since the early 1980s, and especially since Gorbachev's glasnost' campaign was initiated, there appear to be more articles in the popular press that deal with conservation and pollution problems. Soviet press reports note well-attended lectures on the environment.<sup>14</sup> They also note the existence and activities of environmental groups at the republic and local levels. As mentioned above, these groups (such as the Ukrainian Environmental Protection Society) sponsor a wide range of activities to promote environmental responsibility. Although it is difficult to ascertain the immediate impact of these groups, their efforts are bound to create at least a more environmentally sensitive attitude among participants. Also, with the availability of better information, and the freer information flows implied by the policy

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<sup>13</sup>Charles E. Ziegler, "Soviet Images of the Environment," op. cit., p. 377.

<sup>14</sup>See, for example: V. Neykov, "World Ecologists in the Fight for a Peaceful Planet," Voprosy Filosofii, No. 4 (April 1986), pp. 152-154; and "The Environment is Everybody's Concern," Pravda Ukrainy (April 27, 1986), p. 3.

of glasnost', Soviet citizens may well begin to play a more assertive role in public debates on environmental issues.

C. Public Perceptions of Radiation Contamination Issues.

One area in which there already appears to be a good deal of information and interest on the part of the Soviet public is nuclear radiation problems. In fact, concern about health risks associated with nuclear power plants is probably the most widely discussed environmental issue in the Soviet Union. Especially after the Three Mile Island accident, concern over the effects of "peaceful" radiation contamination spread even into public fora.<sup>15</sup>

Ironically, the Soviet citizens' increased apprehension about nuclear radiation was inadvertently due, at least in part, to the effect of Soviet propaganda about the Three Mile Island accident and the environmental effects of nuclear war. After the Three Mile Island accident, the Soviets mounted a campaign designed partly to draw attention to the fallibility of U.S. technology. The fact that such an accident could also occur in the Soviet Union was not entirely lost on the Soviets, however. An article in Kommunist, for instance, directly addressed the environmental concerns associated with nuclear power, but balanced these concerns by

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<sup>15</sup>See Sergei Voronitsyn, "How Great is Soviet Citizens' Fear of Nuclear Radiation?," op. cit.

noting the important role of atomic power in the Soviet Union's energy balance.<sup>16</sup>

Another way in which official Soviet propaganda on nuclear issues has worked against the official Soviet policy that nuclear power stations are relatively safe is through the obvious link to nuclear weapons. Every day one can find articles in the Soviet press that warn of the dangers of nuclear war. Practically every Soviet citizen has repeatedly read and heard about the effects of radiation sickness and the perils of nuclear winter. Press reports complimenting anti-nuclear demonstrations by peace and environmentalist groups in the West are also frequently published and tend indirectly to support this campaign. Through these frequent reports about the dangers of nuclear weapons, Soviet citizens are exposed to a great amount of general information about the effects of nuclear contamination. This must impact negatively on their attitude towards nuclear energy.

After the Chernobyl' accident, public discussions about nuclear radiation naturally became even more frequent. Soviet officials redoubled their efforts to assure Soviet citizens that nuclear power was safe for the environment: "We believe that in the foreseeable future nuclear power will be able to meet mankind's growing needs and, provided normal operational requirements are

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<sup>16</sup>N. Dollezhal' and Iu. Koriakin, "Nuclear Energy: Achievements and Problems," Kommunist, No. 14 (1979), pp. 19-28.

observed, will inflict only minimal damage on the environment."<sup>17</sup> Another authoritative figure, this time an ecologist, concurred, stating that:

The rapid growth of nuclear power engineering is an impressive example of a program well-thought economically and ecologically. Today, after the accident at the Chernobyl' atomic power station, it is even more important--even though hard--to say so publicly...In short, nuclear power engineering is an outstanding achievement of human reason and the highest accomplishment so far of ecological thinking.<sup>18</sup>

Soviet authorities also tried to calm the public by providing widespread testing of the population in the area surrounding Chernobyl' (nearly 400,000 citizens were tested). They published several official reports indicating that this testing had found no one afflicted by unacceptably high levels of contamination.

This campaign seems to have had only marginal effects. In July and August 1986, Pravda published two series of letters from readers with questions regarding Chernobyl'.<sup>19</sup> The first article noted that: "...many readers have asked a number of specific questions concerning the future fate of nuclear power stations." Questions from readers were then referred to Alexandr Petrosyants, Chairman

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<sup>17</sup>Alexandr Petrosyants, "Nuclear Power Development After Chernobyl'," New Times, No. 36 (September 15, 1986), pp. 17-18.

<sup>18</sup>Alexei Antipov, (Assistant Editor-in-Chief, Priroda), "Is Man Really the Master of Nature?," New Times (November 3, 1986), p. 28.

<sup>19</sup>"The Fate of Nuclear Power Stations," Pravda (July 31, 1986), p. 6; and "Zone of Special Concern: Chernobyl' AES," Pravda (August 18, 1986), p. 3.

of the USSR State Committee for the Utilization of Atomic Energy. In particular, it referred to receiving a "...large batch of questions...[on] the location and construction of nuclear power stations." One reader advised: "Build nuclear power stations in uninhabited locations, in the tundra or in the desert." Petrosyants responded by noting that several factors must be considered in the location of nuclear power plants, but concluded his answer by saying that: "...firm and diverse conclusions have been drawn in our country from the events at Chernobyl'. They also apply to the consideration of questions concerning the location of future nuclear power stations. New normative requirements are being elaborated on this score."<sup>20</sup>

The second article (August 18, 1986) reported that Pravda, as well as newspapers in Kiev and Gomel oblasts received letters on Chernobyl' on a daily basis. The themes of the letters ranged from offers of assistance, to praise for heroic efforts by plant personnel and rescue teams, to sympathy for those affected by the accident. Letters also complained that people near the affected zone were nervous and stressful, largely due to the threat of radiation contamination. They also complained that these fears were exacerbated by a lack of objective information about the effects of radiation and the authorities' future measures to take care of those who were displaced or otherwise affected by the accident. Pravda agreed, noting that many of the articles in the press

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<sup>20</sup>Pravda (July 31, 1986), p. 6.

took the form of pep talks and lacked serious, useful information: "...there are not enough lectures and articles about radiobiology, nuclear physics, and measures to ensure safety in the parts of the Ukraine and Belorussia affected by the accident."<sup>21</sup>

The public's awareness of the dangers associated with nuclear radiation has had some direct consequences for the Soviet nuclear power industry. For instance, a distinct shortage of labor willing to work in nuclear power plants apparently developed after the Soviet press reports about the accident.<sup>22</sup> It seems that many Soviet citizens may have developed a deep concern and perhaps fear regarding the potential health effects of radiation contamination from nuclear power facilities. So far, official attempts to quell this fear appear to have had limited success, and there seems to be little evidence of grassroots support for the rapid development of the Soviet nuclear power industry.

## II. NUCLEAR POWER IN THE USSR.

### A. The Development of Soviet Nuclear Energy.

The Soviet Union installed the world's first commercial nuclear power plant at Obninsk in 1954. Throughout the 1950s and 1960s, when fossil fuels were relatively abundant, the Soviet nuclear

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<sup>21</sup>Ibid.

<sup>22</sup>Voronitsyn, op. cit.



power industry grew slowly. In the early 1970s, the Soviets began to develop their nuclear power capacity in earnest. This was essentially a response to the increasing world market price of oil and other fossil fuels; and also because their mined coal began to deteriorate markedly in quality and to increase in cost. This meant that nuclear power, as a substitute for fossil fuels, became increasingly cost-competitive, especially in the European part of the USSR, where fossil fuels are relatively expensive.

The current energy tightness in the Soviet Union has been well documented.<sup>23</sup> In general, growth in energy production has been falling over the past ten to 15 years, from approximately 3.8 percent per year during the Tenth Five Year Plan (1976-1980), to approximately 2.7 percent per year during the Eleventh Five Year Plan (1981-1985). Even though the growth of the Soviet economy also slowed over this period, a number of factors have contributed to increased demand for energy. First, the Soviet economy is energy-intensive. This means, for example, that there are more BTUs per unit of national product in the Soviet economy than in Western economies.

Second, the Soviets have yet to make substantial progress in their efforts to conserve energy. Though they have had some

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<sup>23</sup>For example: Ed A. Hewett, Energy Economics and Foreign Policy in the Soviet Union (Washington, D.C.: Brookings Institution, 1984); Robert Campbell, Soviet Energy Balances, (Santa Monica, CA: Rand Corporation, 1978); and Robert Campbell, "Energy," in Bergson and Levine, eds., The Soviet Economy to the Year 2000 (London: George Allen and Unwin, 1983).

success in energy conservation, Soviet economists and officials note the need to expand these efforts. Finally, the situation has become more constrained as the Soviet Union's increased dependence on oil exports has effectively raised its demand for oil. By the mid-1980s, oil came to account for more than two-thirds of total Soviet hard currency revenues, which they use to purchase badly needed Western technology. As the Soviet economy develops and its technological requirements increase, oil exports will continue to divert energy resources away from the domestic economy.

Most analysts, in the West and in the USSR, expect this tightness to continue indefinitely. The prospects for growth in oil and coal production in the future are not promising, and the continued need for hard currency will be a major constraint on the domestic allocation of crude oil resources. Natural gas apparently has unconstrained production potential in the foreseeable future. At the margin, though, rising costs interfere with its attractiveness as a substitute for oil. In light of these constraints, the Soviets have planned to give nuclear power an important role as a supplement to fossil fuels wherever possible in the short- and medium-term, and then to shift from nuclear fission to thermonuclear fusion by the year 2000.

The area in where nuclear power is best suited to supplement fossil fuels is in the European part of the country. As Alexandr Petrosyants points out: "The USSR is one of the few countries with substantial reserves of organic fuels...However, the USSR's natural

resources are unevenly distributed...Therefore, it is economically expedient to build atomic power plants in the European part."<sup>24</sup> In fact, it is estimated that, due mostly to transportation costs, the cost of fuel produced in the eastern part of the USSR and consumed in the European part is as much as 2.5 times more costly than fuel both produced and consumed in the European part.

It is this perceived savings in fuel that makes nuclear power cost-effective with respect to electricity from thermal plants fired with fossil fuel. According to Soviet calculations, the capital investment costs of a 2000 MW nuclear plant are 35 percent higher than those for a thermal plant of equivalent capacity, due largely to the higher technological requirements of the nuclear plants.<sup>25</sup> This is particularly significant now, when capital investment resources are stretched tightly. Over the past decade, the energy sector has been a voracious consumer of capital investment resources. Although investment allocations to the energy sector will continue to grow, under the new Gorbachev strategy more emphasis is now being given to other sectors, especially machine building. Within the energy sector, the advantages of capital-intensive nuclear plants have thus become considerably more tenuous. According to Soviet estimates, the total annual costs (charges for interest on capital and operating

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<sup>24</sup>A. Petrosyants, "Nuclear Power Development After Chernobyl'," New Times, op. cit.

<sup>25</sup>Judith Thornton, "Chernobyl' and Soviet Energy," Problems of Communism (November-December 1986), p. 7.

costs) of a 2000 MW nuclear plant are 120.7 million rubles, while the total annual costs of the equivalent thermal station are 144.6 million rubles (see Table 1), an annual savings of 25.9 million rubles.

Table 1 tells an important story that deserves some explanation. The estimated costs in column 1 are based on prices set by the central pricing administration of the USSR. An important part of these costs is the assumption of a 20 ruble per ton cost of fossil fuel included in the annual operating costs of the thermal power plant. Actually, 20 rubles per ton is far below the true marginal cost of fossil fuels in the Soviet Union. Nevertheless, the estimated costs in column 1 are of the type typically used in investment decisions, such as the cost-effectiveness of one project over another. Column 2 shows the costs of the power stations based on actual 1976-1980 investment costs and a fossil fuel price of 45 rubles per ton, as opposed to the 20 rubles per ton that the Soviets use for planning purposes. The 45 ruble per ton figure is one that the Soviets themselves calculate; it represents the shadow price of a linear programming model; in essence it is the marginal cost of fossil fuel. Some officials in the various fossil fuel ministries argue that even these costs are rigged in favor of the nuclear plants. They assert that these costs do not include the extra training involved for nuclear plant personnel and extra safety measures required by nuclear facilities, and that they grossly underestimate the true cost of enriched uranium.

TABLE 1

COMPARISON OF COSTS OF ELECTRIC POWER

(In Millions of Rubles)

	Estimated (Planning) Costs	Actual 1976-80 Costs*	+20% Invest- ment (Nuclear)	+40% Invest- ment (Nuclear)
<u>COSTS OF 2,000-MW NUCLEAR PLANT</u>				
Total Fixed and Working Capital	484.4	1265.3	1518.4	1771.4
Annual Capital Charge at 12%	58.1	151.8	182.2	212.6
Annual Operating Costs	62.6	62.6	62.6	62.6
Total Annual Costs	120.7	214.4	244.8	275.2
<u>COSTS OF 1,950-MW THERMAL PLANT</u>				
Total Fixed and Working Capital	251.4	403.7	403.7	403.7
Annual Capital Charge at 12%	30.2	48.4	48.4	48.4
Annual Operating Costs	114.4	223.7	223.7	223.7
Total Annual Costs	144.6	272.1	272.1	272.1
ANNUAL SAVINGS FROM NUCLEAR PLANT	25.9	57.7	27.3	-3.1

\*Actual investment costs and actual fossil fuel costs at 45 rubles per ton of of standard fuel.

Source: Judith Thornton, "Chernobyl' and Soviet Energy," Problems of Communism (November-December 1986), p. 8.

Unfortunately, there is no way of estimating these costs with a reasonable level of reliability.

Column 3 adds 20 percent to the capital investment figure for the nuclear station in column 2. This is an arbitrary example of the way costs could change if, say, the Soviets modify their nuclear power stations to correct for some problems brought to light by the Chernobyl' accident. Under these three assumptions, the nuclear power station appears to be a cost-effective decision. Finally, column 4 presents cost estimates based on a 40 percent increase in investment costs to the nuclear power station. Under this assumption, the nuclear station is not cost-effective.

There are two issues related to the cost-effectiveness question not brought out in Table 1. First, the annual operating costs are highly dependent on the location of both the nuclear and the thermal plant. Generally, the annual operating costs of a nuclear plant located in Kazakhstan, West Siberia, or East Siberia are uneconomical compared with the equivalent thermal station. This is because electricity transmission distances are longer and less efficient, and the transportation costs of fossil fuel of thermal stations in these areas are relatively low. Nuclear plants become more cost-effective in those areas which are farthest away from fossil fuel deposits, in particular the Northwest and areas west of the Urals.<sup>26</sup> Thermal plants, on the other hand, are less cost-

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<sup>26</sup>D.G. Zhimerin, Sovremennye problemy energetiki [Contemporary Problems of Energy] (Moscow: Energoatomizdat, 1984), p. 152.

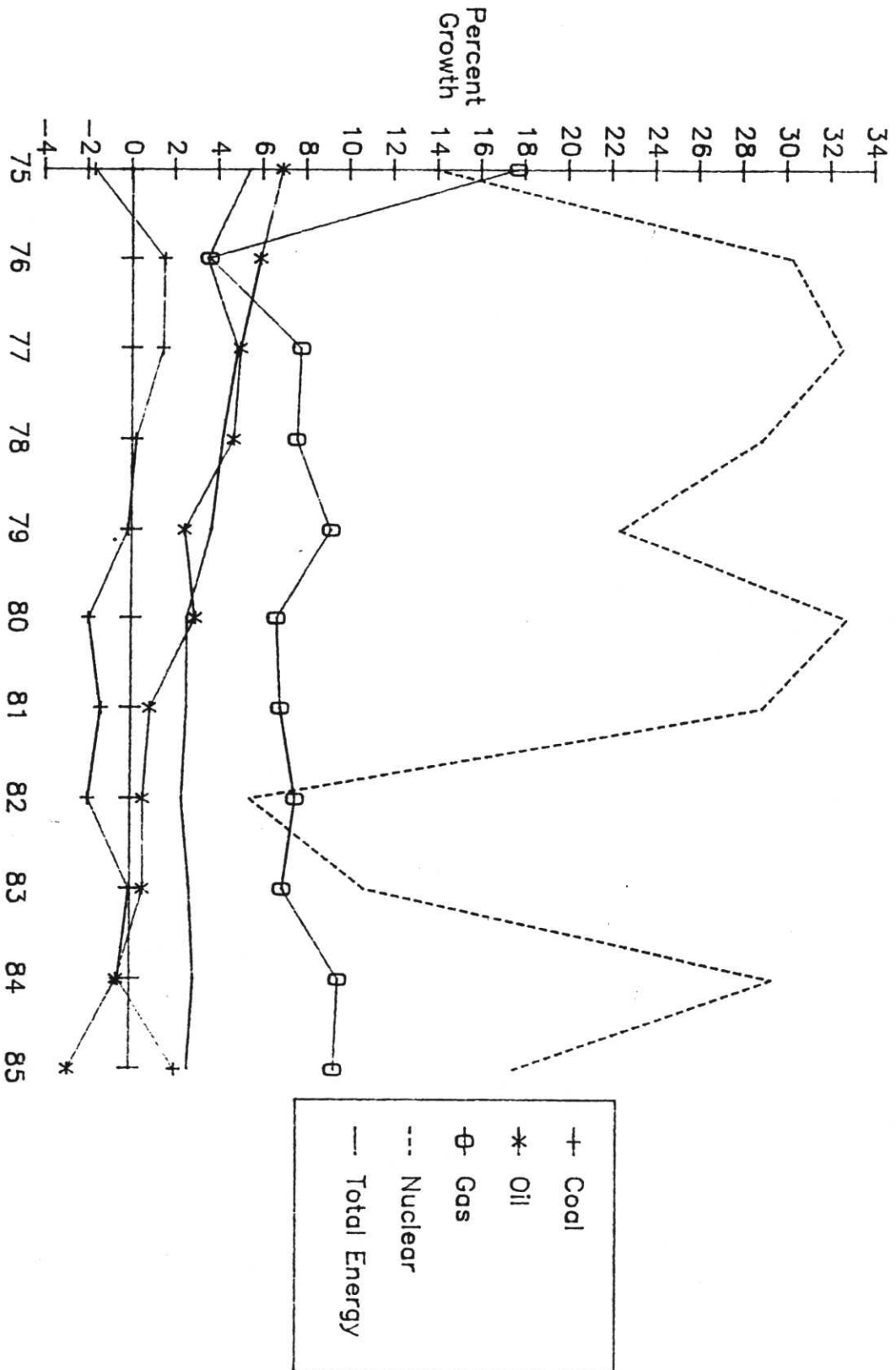
effective, the greater the distance from fossil fuel deposits. Consequently, it is not surprising that the Soviets have concentrated the construction of their nuclear power stations in the European part of the country.

It is also worth noting that even a 40 percent increase in investment costs might underestimate the future cost of the 2000 MW nuclear power station discussed above. This large an increase is not likely to result from design changes and enhanced training programs alone. However, if new siting criteria are indeed developed, and power plants are not located as close to urban areas as they have been, this would mean substantial losses in power transmission efficiency and increased capital investments for the development of the necessary infrastructure. These costs could easily have a negative impact on the further development of nuclear energy in the Soviet Union. Finally, one of the ways in which the Soviets have planned to expand the role of nuclear energy in the future is by building small units near population centers, primarily to supply heat to the municipal services and housing sectors. New policies regarding the siting of nuclear plants could jeopardize any future applications of this sort.

Thus far, the Soviets have estimated that their nuclear power plants generate enough savings over fossil fuel plants to warrant rapid development. From 1975 to 1985, nuclear power was the fastest growing energy source in the USSR (Figures 1 and 2). Its contribution to the total electric energy supply jumped from 1.9

FIGURE 1

ANNUAL GROWTH OF ENERGY SOURCES: USSR

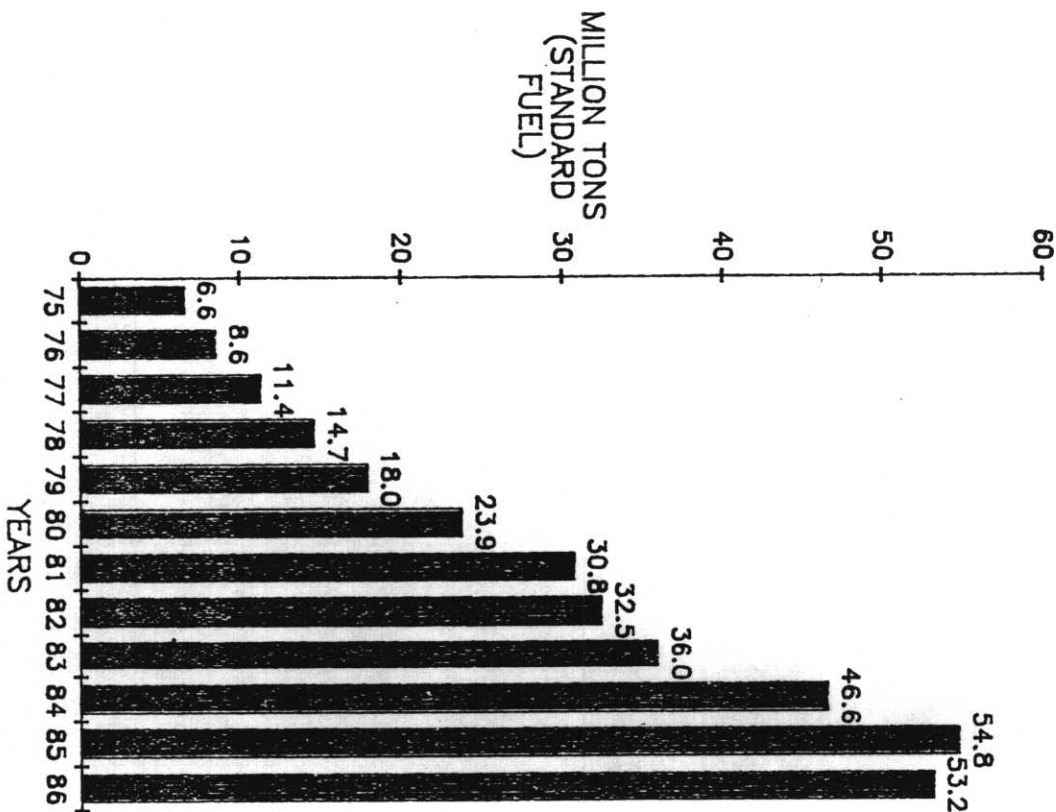


Source: Hudson Institute.

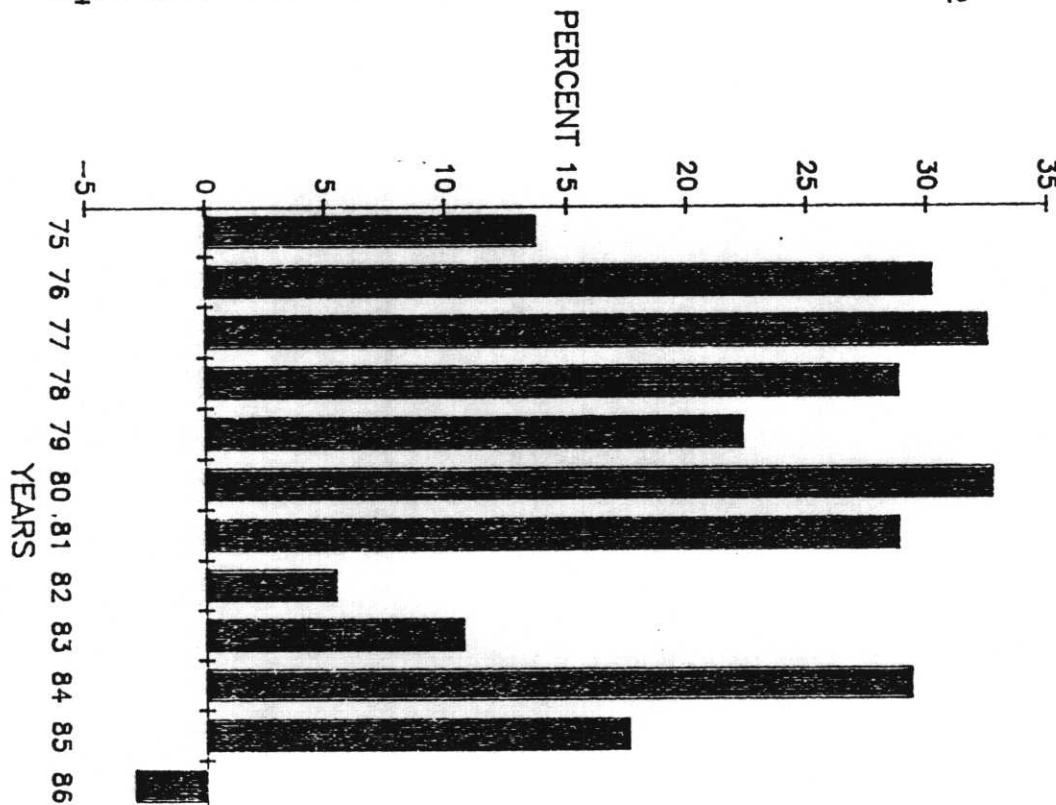


FIGURE 2

SOVIET NUCLEAR POWER  
PRODUCTION



ANNUAL PERCENTAGE  
CHANGE



percent in 1975 to 10.8 per cent in 1985 (Table 2). In the Twelfth Five Year Plan, nuclear power is scheduled to increase its capacity 144 percent, from 28,358 MW in 1985 to 69,300 MW by 1990. This would represent approximately 21 percent of the total electricity supply in the USSR. The planned growth rate is significantly higher than the Soviets have achieved in the past, and it seems unlikely to me that the required construction capacity exists within the Ministry of Atomic Power. Indeed, Minatomenergo has had a relatively poor record of fulfilling its capital construction plans. During the Eleventh Five Year Plan (1981-1985), for example, Minatomenergo achieved only 74 percent of the planned increases in capacity.<sup>27</sup>

#### B. Soviet Reactor Technology.

Currently, the Soviets rely on two different types of nuclear reactors, the RBMK and the VVER, to produce nearly all their nuclear power. By the year 2000, they hope to switch to fast breeder neutron reactors, which represent a significant increase in investment costs over the conventional fission reactors. The RBMK reactor is the type that exploded at Chernobyl'. These reactors contribute slightly less than 60 percent of total nuclear energy in the Soviet Union. The RBMK reactor is a graphite-moderated, pressure-tube reactor that does not have a widely used analog in

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<sup>27</sup>The Ninth and Tenth Five Year Plans for nuclear power capacity were also unfulfilled; by 46 percent and 43 percent respectively.

TABLE 2

	Structure of Soviet Energy Production, Million tons standard fuel																					
	COAL	%total	OIL	%total	GAS	%total	PEAT	%total	SHALE	%total	FIRE WOOD	%total	HYDRO-POWER	%total	NUCLEAR POWER	%total	TOTAL ENERGY	%total	NET EXPORTS	%total	APPARENT CONSUM.	%total
1975	490.4	29.5	701.8	42.2	367.2	22.1	16.9	1.0	11.7	0.7	23.8	1.4	42.8	2.6	6.6	0.4	1661.2	100.0	198.9	12.0	1462.3	88.0
1976	479.0	28.1	743.1	43.7	380.3	22.3	11.3	0.7	11.0	0.6	24.6	1.4	44.5	2.6	8.6	0.5	1702.4	100.0	321.0	18.9	1381.4	81.1
1977	486.0	27.2	780.5	43.7	410.0	23.0	14.0	0.8	11.4	0.6	24.6	1.4	48.2	2.7	11.4	0.6	1786.1	100.0	329.0	18.4	1457.1	81.6
1978	487.0	26.2	817.3	43.9	441.1	23.7	9.2	0.5	11.6	0.6	24.1	1.3	55.7	3.0	14.7	0.8	1860.7	100.0	278.5	15.0	1582.2	85.0
1979	486.2	25.2	837.4	43.4	481.8	25.0	13.6	0.7	11.8	0.6	24.2	1.3	56.5	2.9	18.0	0.9	1929.5	100.0	295.0	15.3	1634.5	84.7
1980	476.9	24.1	862.6	43.6	514.2	26.0	7.3	0.4	11.8	0.6	22.8	1.2	60.4	3.0	23.9	1.2	1979.9	100.0	316.1	16.0	1663.8	84.0
1981	470.5	23.2	876.6	42.9	549.9	27.1	12.6	0.6	11.7	0.6	22.9	1.1	61.4	3.0	30.8	1.5	2030.4	100.0	319.6	15.7	1710.8	84.3
1982	479.5	23.1	876.0	42.1	591.9	28.5	8.3	0.4	11.2	0.5	23.3	1.1	57.4	2.8	32.5	1.6	2080.1	100.0	327.1	15.7	1753.0	84.3
1983	479.4	22.4	881.4	41.2	633.2	29.6	8.6	0.4	10.5	0.5	23.1	1.1	66.6	3.1	36.0	1.7	2138.8	100.0	339.8	15.9	1799.0	84.1
1984	476.8	21.6	876.2	39.8	694.3	31.5	6.0	0.3	10.5	0.5	22.6	1.0	79.2	3.2	46.6	2.1	2203.2	100.0	350.1	15.9	1853.1	84.1
1985	486.9	21.5	851.3	37.6	759.9	33.6	5.5	0.2	10.2	0.5	23.5	1.0	70.2	3.1	54.8	2.4	2262.3	100.0	326.2	14.4	1936.1	85.6

the West. It has several advantages, including its pre-fabricated, modular design. This means that the reactors can be manufactured off-site in existing facilities, transported to the construction site, and assembled. The VVER, on the other hand, must be manufactured and tested on-site. The RBMK is a relatively flexible reactor. It can be expanded relatively simply, by either increasing the flow of coolant or by adding more fuel elements and control rods.<sup>28</sup> It can be fueled while in operation, operate at a wide range of power levels, and produce more plutonium-239 than other reactors. This last point is important to the Soviets, because they plan to use this plutonium to fuel the breeder reactors they plan to build in the transition phase between the fission and fusion reactors.

The disaster at Chernobyl' has apparently jeopardized the future of the RBMK. Although it was determined that the accident at Chernobyl' was caused by human error and not by design flaws, the RBMK has come under extremely close scrutiny. On a general level, officials in the Soviet Union have stressed the continuation of current plans, with an emphasis on improving operating procedures and labor performance at the plants. Also a number of statements by officials indicate some minor modifications or enhancements of fail-safe mechanisms in existing and future RBMK plants. One report quotes Nikolai Lukonin, the Minister of the new Ministry of

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<sup>28</sup>William J. Kelly, Hugh L. Shaffer, and J. Kenneth Thompson, Energy Research and Development in the USSR (Durham, NC: Duke University Press, 1986), Chapter 3.

Atomic Power, as saying that two more RBMK reactors would be built at Chernobyl' (as planned), but that the rest of the Soviet nuclear power program would be based on the VVER reactor design, of which six more are planned to be built by 1990.<sup>29</sup> Actually, this does not represent a large departure from earlier plans. Of the 54 nuclear reactors currently under construction or in site preparation, only nine were RBMKs, while 40 were VVERs.

### C. Construction Problems.

The construction of Soviet nuclear power plants has been a cause for concern for quite some time.<sup>30</sup> One source notes that: "In 1980, Radio Moscow broadcast a report from the site of the Smolensk nuclear power station. It referred to the persistently poor quality of the work carried out and to countless deviations from design specifications, construction standards, and engineering rules."<sup>31</sup> Another report noted the shortage of skilled personnel and the substitution of untrained labor at the construction site. Construction workers at nuclear power plants complain about all the

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<sup>29</sup>Christopher Walker, "Russians To Alter Nuclear Reactors," The London Times (December 18, 1986), p. 1.

<sup>30</sup>Many articles and letters from nuclear plant construction workers are summarized in Allan Kroncher, "Soviet Nuclear Power Station Construction Poses Constant Hazards," Radio Liberty Research Report, RL 194/86 (May 15, 1986); and Wayne Brown, "Nuclear Safety in the USSR," Radio Liberty Research Report, RL 195/86 (May 16, 1986). This discussion draws largely from these articles and other reports in the Soviet press.

<sup>31</sup>Kroncher, op. cit.

typical problems traditionally associated with construction and industrial projects in the Soviet Union. These include poor quality materials, delivery delays, lack of complete documentation and building plans, and unrealistic production schedules that demand fulfillment of such quantitative targets as tons of concrete poured.

Sotsialisticheskaya Industriya, in April 1985, described the faulty construction of a nuclear power plant in some detail. The paper noted that only one-fourth of the construction work on the plant presented for inspection was accepted without further improvements. The paper stated that this was typical of work on nuclear power plants. Kroncher further reports that: "In 1984, a total of 136 serious technological violations and unauthorized deviations from design specifications were recorded."<sup>32</sup>

Efforts to remedy these problems have not been very successful. In August 1985, a new regime for carrying out nuclear power plant construction was established at the Rostovskaya AES plant. Noting that construction was running ahead of schedule, a proud foreman declared: "After all we are now working entirely under contract. We are even planning differently, not in tons, as before, but in cubic meters."<sup>33</sup> By way of explanation, the foreman stated that,

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<sup>32</sup>Ibid.

<sup>33</sup>L. Shamardina, "The Contract Brought Change," Sotsialisticheskaya Industriya (October 18, 1985), p. 1.

in the past, different work brigades competed with each other as an incentive to meet plan targets and that:

...until recently all of the work of the assembly brigades was measured in tons of metal structures, which were installed with no particular consideration for the interests of the subcontractor...There was no coordination as long as the partners had two separate plans and there were two means of payment--some by the ton, and some by the cubic meter...There was competition for one thing and payment for another...In short, such competition did not mean much to the competitors and the work suffered. The reactor grew slowly.

While the new contract arrangement may mitigate the confusing and unorganized interactions between construction brigades, it does not solve many of the more fundamental problems inherent in Soviet construction projects. One obvious problem is that the contractors are still working to achieve quantitative indicators. For example, at the Kursk nuclear power plant, inspectors had rejected concrete panels because they were defective. The construction chief ordered that they be installed despite the defects, claiming: "...our business is cubic meters."<sup>34</sup> At best, such construction deficiencies can be corrected, with additional expenses and schedule delays. At worst, they go uncorrected and jeopardize the safe operation of the nuclear power plant.

Also, the new contract arrangement does not address production schedules that are apparently too demanding, causing workers to cut corners in order to achieve the plan. Finally, within the nuclear

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<sup>34</sup>Quoted in Kroncher, op. cit.

power community, there appears to be an aversion to incorporating all but absolutely necessary technology into the reactors, because this raises their capital costs and makes them less competitive with thermal power plants.

Despite these problems, the Twelfth Five Year Plan calls for a significant acceleration of the construction of nuclear power plants, particularly in the European part of the country. The lead article in an important trade journal reiterated the importance of faster production of nuclear power stations and outlined some of the specific production targets:

The collectives of construction and installation workers must also...increase labor productivity by at least 4.2 percent...The amount of construction and installation work performed by the brigade contract method must be increased by 53 percent.<sup>35</sup>

Such an acceleration has serious implications for quality control. Even if past levels of production are maintained and not increased, there is no reason to believe that the extensive quality control problems associated with Soviet nuclear power plant construction will be remedied by the limited changes already instituted. If, as planned, production of nuclear power plants is accelerated, and workers attempt to meet even more ambitious schedules, it is reasonable to expect that these problems will be exacerbated. I expect, however, that because of all the problems--

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<sup>35</sup>"The XXVII Party Congress--Meet It Worthily", Energetik, No. 10 (October, 1985).



economic, production, environmental, and public safety--brought to light by the Chernobyl' accident, the Soviets will not even attempt to achieve the 53 percent increase in construction and installation during the current five year plan.

### III. CONCLUSIONS

This paper has examined the current and future positions of the Soviet nuclear energy industry from both environmental and economic perspectives. To be sure, issues within both of these areas impact on the development of Soviet nuclear power. However, in contrast to the situation in the U.S., economic considerations are predominant in the debate over nuclear energy in the USSR. Environmental concerns are as yet not as widely discussed as economic issues, and environmental concerns do not seem to share the immediacy of economic ones in the USSR. Evidence presented in this paper suggests, however, that environmental issues are indeed becoming increasingly important in many Soviet economic debates. It is my conclusion that environmental concerns can now "color" economic debates in the Soviet Union. Further, as environmental issues become better understood by a wider constituency, they will have a stronger impact on policy. Currently, in regard to the development of nuclear energy, environmental concerns cast a shadow over the debate, but are not decisive factors.

Economic issues, on the other hand, do play decisive roles. Historically, the Soviets have seen nuclear energy as a cost-effective way of supplying their country with electricity and of freeing up oil and natural gas for use as hard currency exports. Based on these assumptions and motivations, the Soviets rapidly developed their nuclear power industry.

There are ample indications, however, that nuclear reactors may not be as cost-effective as the Soviets once thought. The Twelfth Five Year Plan and the Plan to the Year 2000 both imply very tight investment resources that do not bode well for capital-intensive nuclear power facilities. Moreover, it is not unreasonable to expect that investment requirements in nuclear power plants will increase significantly as the Soviets introduce more sophisticated technology designed to reduce the chance of worker error. If the Soviets modify their siting policies and build nuclear plants farther away from population centers, the additional investment costs could also be significant. As they begin to shift to breeder reactors, which are even more capital-intensive than their traditional fission reactors, this problem will become even more acute. In the long-run, as the Soviets try to adapt to the environmental and safety concerns of nuclear energy, costs will rise, nuclear power's comparative advantage will diminish, and this will create pressure to reduce nuclear power's role in the Soviet energy balance.

The bottom line is that the Chernobyl' accident has brought to light a wide range of problems that until now occupied only a secondary level of importance for Soviet planners. My conclusion based on this finding is that the Soviet nuclear power industry will grow less quickly than would have been expected before Chernobyl'. This includes a much slower pace for the introduction of the small fission reactors that were to be built near population centers to provide municipal heat as well as electricity. It also includes a slower pace for the introduction of breeder reactors than previously envisioned. If the Soviets were to achieve their historical level of plan fulfillment for the period to 2000, nuclear energy would account for about 30 percent of total electricity for the country by that time. Now, due to the problems that the Chernobyl' accident either created or exacerbated, I would expect Soviet nuclear energy to account for something less than 30 percent of total electricity produced by the year 2000.