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### Nuclear Power in Ukraine in the Late 1990s

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# Nuclear Power in Ukraine in the Late 1990s

David R. Marples<sup>1</sup>

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**Abstract:** A Western authority on the history and consequences of the 1986 disaster at the Chernobyl' nuclear power plant surveys the current debate in Ukraine over the role of nuclear power in the country's energy balance and management of the environmental hazard posed by the destroyed fourth reactor at Chernobyl'. A particular focus is on disputes within the Ukrainian Nuclear Power industry, and between the industry and Western funding and regulatory agencies, as well as the limited scope for action given an acute lack of financial resources. Attention also is devoted to changing public perceptions of nuclear energy in Ukraine. *Journal of Economic Literature*, Classification Numbers: Q42, Q43, Q48. 15 references.

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## INTRODUCTION

The twelfth anniversary of the Chernobyl' disaster on April 26, 1998 has passed quietly in a Western world preoccupied with other issues, not least the recent nuclear tests undertaken by India. In Ukraine, however, the anniversary was marked by continuation of a protracted debate on the future of the station, and on the problems facing the shell that was constructed over the destroyed fourth reactor, generally termed the "sarcophagus," and specifically the covering (in Ukrainian, "Ukryttya") over the exploded core.<sup>2</sup> The paradox is that with each passing year Ukraine has become more reliant on nuclear power for its hard-pressed energy sector. In addition, however, there is a long-running conflict with the West on the amount of aid necessary for Ukraine to resolve its nuclear dilemmas, and whether Western agencies—particularly the European Bank for Reconstruction and Development (EBRD)—have been acting in good faith in their dealings with Ukraine on this issue.

These issues were addressed in a speech by President Leonid Kuchma on the anniversary date this year. The President, speaking in emotive terms, noted that Chernobyl' affected every person and family in Ukraine and had serious consequences in all spheres of life. The expenditures on dealing with the ramifications of the accident to date are estimated at \$120 to \$130 billion, or six times an entire state budget of the late 1990s. A further 2 billion hryvnya (\$1.1 billion) must be taken annually from the state budget for this purpose (Kuchma, 1998, p. 1). In December 1995, at a meeting of the G-7 countries, Ukraine signed a Memorandum, promising to close the Chernobyl' station by the year 2000, in response to international concern about the safety of the plant (it had been declared unsafe by the International Atomic Energy Agency [IAEA] in 1994). The world, however, appears to have ignored the fact that,

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<sup>2</sup> The term "sarcophagus" refers to the entire entombed structure (including the protective covering and destroyed reactor), whereas the Ukryttya refers only to the protective cover constructed after the accident.

left to its own devices, Ukraine cannot carry the burden and costs connected with the closure of the station (*Den*, April 28, 1998, p. 1).

At the time of the Chernobyl' disaster in April 1986, four reactors were operating at the graphite-moderated (RBMK) Chernobyl' plant, and two more were under construction, at 85 percent and 15 percent rates of completion, respectively. At peak size, then, the station would have had a capacity of 6,000 megawatts (Marples, 1986). The two reactors under construction eventually were abandoned, and reactor No. 1 is at the beginning of the decommissioning stage. A first-generation RBMK, it is widely regarded as obsolete. Its twin unit, No. 2, has been shut down since a fire in October 1991 and currently is out of service. It has been estimated by Ukrainian officials that No. 2 would require an investment of 110 million hryvnya and a period of about one year to return to service (Parashyn et al., 1998, p. 8), an option that was strongly supported by the then-director of the Chernobyl' station Serhy Parashyn (see below). Since unit No. 4 has been destroyed, the third unit has been the only one operating in recent times, and this unit has been the subject of considerable controversy. In 1997, a report by the World Association of Nuclear Operators noted a "dangerous operating environment" at the No. 3 unit at Chernobyl', an account that was rejected as invalid by Ukraine's nuclear regulators. The Ukrainian authorities have maintained that the WANO report was an attempt to accelerate the closure of the station (*Uranium Institute News Briefing*, No. 39, 24-30 September 1997, p. 7).

More seriously, perhaps, after the third unit was shut down for routine maintenance on June 20, 1997, a large number of tiny cracks were discovered in the welding around the reactor tubes. Not only was this number alarmingly high—338 in total—but the work to eliminate them entailed high levels of irradiation among plant personnel, amounting to an annual allowable dose among nuclear professionals. In order to "spread the load" of radiation, about 700 people were involved in the repair work, and the problems were eliminated over a period of seven months. Although further maintenance had been scheduled for the end of 1998, the timetable has been delayed as a result of the lengthy shutdown over the past year. The EBRD, in turn, has regarded the change of schedule with some concern, and as a result has declined to finance certain plans for raising the level of nuclear safety at the third reactor unit (Parashyn et al., 1998, p. 8). The unit was restarted following an annual meeting of the EBRD, which was held in Kyiv in May (*Uranium Institute News Briefing*, 13-19 May 1998, p. 20). Reportedly engineers at Chernobyl' have developed a new accident regimen at No. 3 that offers a prompt response to the sort of situation that emerged at the No. 4 reactor in 1986 (Beba, 1998, pp. 4-5).

The Chernobyl' plant is the oldest in Ukraine, but part of an extensive network of nuclear power stations, with some reactors still under construction. In 1996, when Ukraine celebrated the 20th anniversary of the output of nuclear-generated electricity, 14 reactors were in operation, which generated in that year almost 80 billion kilowatt-hours (kWh) of electricity, or 44 percent of the country's overall electricity production (*Uranium Institute News Briefing*, No. 39, 24-30 September 1997, p. 8). More recent figures indicate the proportion is now 44.9 percent, having risen from 33 percent as recently as 1993. Ukraine has two VVER-1000 (pressurized water-cooled) reactors under construction (No. 4 at Rivne and No. 2 at Khmelnytsky)<sup>3</sup> and has suspended construction at three other sites (Uranium

<sup>3</sup>The first two reactors at Rivne were of the VVER-440 design. Reactor 3, completed over the summer of 1986, was the first reactor at the Rivne site with the larger VVER-1000 design, which might be considered the traditional reactor of the former Soviet Union and those East European countries taking part in the CMEA nuclear energy program under Soviet supervision.

Institute, 1998, Nos. 1 and 2). Altogether, five nuclear power stations currently generate electricity in Ukraine—the RBMK at Chernobyl' and stations equipped with VVER-type reactors at Rivne, Khmelnytsky, South Ukraine (Mykolaiv), and Zaporizhzhya.

### THE PARASHYN SAGA

On 4 May 1998, Serhy Parashyn, the outspoken director of the Chernobyl' nuclear power station, who has been working at the station constantly since 1987, was dismissed from his post by Ukraine's new authority for nuclear energy Enerhoatom. He has been replaced by Vitaliy Tovstonohov, an Enerhoatom official. The decision sparked considerable debate throughout Ukraine as to the motives behind Parashyn's removal and its significance for the nuclear energy industry in Ukraine. Parashyn has long been an outspoken proponent of maintaining the Chernobyl' station in service well into the 21st century, and has defended the improvements at the station, comparing the safety record of the Chernobyl' station under his administration favorably with that of the other RBMK stations in the former Soviet Union. It would be fair to say that Parashyn had become the best-known proponent of nuclear energy in Ukraine, and the one who maintained most strongly that the West had renege on its promises to Ukraine to provide sufficient and timely financial aid to permit the closure of Chernobyl' and the commissioning of the two new reactors at the Khmelnytsky and Rivne stations.<sup>4</sup>

At the time of Parashyn's dismissal, Nur Nigmatullin, the president of Enerhoatom, maintained that Parashyn had been guilty of gross insubordination, exceeding his authority by appealing to President Kuchma over the heads of those in the organization (*Monitor Daily Report*, May 5, 1998). There appears to be more to the event than this, however. The main argument is over the future of the Chernobyl' plant and Ukraine's relations with the West, particularly with international financial agencies that have agreed to help finance the closure of the station by the year 2000, as agreed to at the G-7 summit in Ottawa in December 1995. In addition, Parashyn is hardly a team player. Evidence suggests that he had become an embarrassment not only to the officials at Enerhoatom, but paradoxically to the President himself, the person to whom he allegedly was appealing. These two issues are examined briefly below.

In 1986, after the accident at Chernobyl' and the subsequent evacuation of the town of Prip'yat, with approximately 45,000 residents, a new town was built for station workers and their families called Slavutysh, just over the border from Kyiv Oblast in Chernihiv Oblast. The town was a long-term investment for the Soviet authorities, with an initial population of around 10,000 and a projection for a "21st-century city" of at least 30,000 residents. Slavutysh was to serve as a long-term center for the nuclear station and related activities, such as the production of equipment (Geiger counters) and experimental research related to the consequences of the 1986 accident (Marples, 1988). In April 1994, when the IAEA declared the Chernobyl' plant to be unsafe, the future of Slavutysh and its residents was thrown into question. There were widespread fears in Ukraine that the city would become a site of mass unemployment, and morale in the nuclear industry reached an all-time low. From this time

<sup>4</sup>When Ukraine first entered negotiations with the G-7 countries, two reactors (Nos. 1 and 3) were in operation at Chernobyl'. Parashyn and others thus maintained that the starting of the two new reactors would compensate directly for the loss of power that the shutdown of Chernobyl' would bring. They also argued that Chernobyl' should not be closed without a concomitant completion of these two projects.

onward, Parashyn began to work to secure the livelihood of these workers, preferably by keeping the station in operation beyond the proposed deadline of the year 2000.

Initially, Parashyn conducted this program by diverting attention whenever possible to problems at other RBMK (graphite-moderated) stations across the former Soviet Union. Whereas extensive improvements had been carried out at Chernobyl', it was noted, other RBMKs continued to operate at Kursk, St. Petersburg, Smolensk, and Ignalina in Lithuania that had not received such modifications. The Kursk plant, in particular, was built as a twin to Chernobyl'.<sup>5</sup> This campaign was quite successful in the sense that international nuclear experts began to focus attention on a number of former Soviet nuclear plants, but it has not altered the resolve of the G-7 (now G-8) countries to proceed with the closure of Chernobyl' as scheduled. Parashyn also balked at the official Ukrainian government attitude of compliance with the West's demands, maintaining that Ukraine has been subjected to great pressure from the international community, and that such pressure has not been warranted. Parashyn has long opposed the plans to close Chernobyl' by the year 2000, and has been highly vocal in his opposition. Often his comments have appeared to embarrass the government at times of negotiations of important loans and credits. In short, he may have been a liability.

There also is clearly a conflict at the higher levels of the Ukrainian nuclear industry. According to Enerhoatom president Nigmatullin, Parashyn does not agree with the way the industry has been reorganized, maintaining that safety standards are being imperiled. Enerhoatom, in his view, lacks a license to operate nuclear power stations, whereas those with licenses no longer maintain a legal existence because they have been included in and subordinated to Enerhoatom. Thus, in the case of an accident, there is no organization within Ukraine that would bear responsibility (*Ukraine Today*, No. 6, May 11, 1998). It seems paradoxical that the main supporter of maintaining the highly dangerous Chernobyl' station in service beyond its agreed term would be complaining about threats to safety. More likely, the issue is a straightforward power struggle between the industry's most prominent spokesperson—Parashyn—and the titular head of the industry, Nigmatullin. Parashyn is no stranger to politics: since 1997 he has been involved with the Reforms and Order political party and currently leads its Kyiv branch. Furthermore, there are indications that President Kuchma regards Parashyn as a nuisance and a man who should have been dismissed several months earlier.<sup>6</sup>

### PROBLEMS AT THE UKRYTTYA

Other than the issue of the longevity of the Chernobyl' station, the biggest single issue facing the Ukrainian authorities is that of the roof over the damaged reactor, known as the Ukryttya, or covering. It was constructed hastily over the summer of 1986 in extreme radiation conditions, but the then-Soviet authorities maintained that the problem had been resolved "for eternity." However, it soon became apparent that the structure was far from stable. It was built with holes for ventilation, but these holes could also act as a conduit for the release of radiation. Only five years after the accident, it became apparent that the structure

<sup>5</sup>Russia's Kursk-1 reactor is also a source of concern to international nuclear experts. A first-generation RBMK, it was closed for upgrading in 1994, but is currently operational and undergoing a protracted program of testing over the next 18 months to three years. The United States has maintained that such a protracted testing program is allowing authorities at the station to avoid the major safety tests demanded by the EBRD (*East European Energy Report*, May 1998, p. 25).

<sup>6</sup>The English-language digest of the newspaper *Den'* (No. 14, 1998) cites Interfax, which in turn quotes President Kuchma as stating that Parashyn "became totally engrossed in the parliamentary campaign, forgetting about his work, and should have been fired long ago."

would not last indefinitely and would need to be replaced. In addition, part of the contents of the reactor core remain within the structure, offering the possibility of further dissemination of radiation under certain conditions.

Scientists have examined parts of the Ukryttya for the past 12 years, although certain areas remain off limits because of the high levels of radiation. The Ukryttya is 160 meters long, 110 meters wide, and 75 feet (~23 m) in height, with the original plant ventilation stack that rises to 150 meters. The latter constitutes the immediate problem, as it was damaged at the time of the 1986 explosion. The U.S. government has funded \$1.8 million of the costs involved in its repair (*Holos Ukrainy*, April 25, 1998, p. 8). Together with Western countries, Ukraine has elaborated a broader project for the entire structure, termed the Shelter Implementation Project (SIP), at an estimated cost of \$758 million; the work will take an estimated eight to nine years.

What are the main problems with Ukryttya? They have been described recently by both Parashyn and Valentyn Kupnyi, general director of the Chernobyl' nuclear plant with responsibility for Ukryttya. Parashyn has noted that in one area there is a deviation in the wall and that an unreliable support structure may lead to the collapse of the roof. He maintains that the lack of information concerning the internal state of the entombed reactor (the sarcophagus) is catastrophic, and that the object can only be stabilized with the complete fulfillment of the SIP plan (Beba, 1998, pp. 4-5, ff.).

Turning to the more detailed analysis, 29 unsafe zones have been revealed within the Ukryttya, 5 of which require immediate measures. The western part of the covering, in particular, contains significant defects and is anticipated to last for no more than five years. The iron-concrete structure in another zone should last roughly seven years. Some "shields" (protective elements) in the southern part could not withstand the force of a tornado (not an unprecedented event in this region) and have an estimated lifespan of only four years. The 150-meter ventilation tower of the V-block presents the most acute problem, which must be resolved within one or two years. In summary, therefore, many parts of the covering require urgent repairs within a one- to seven-year period.

What sort of dangers would emerge if this work is not carried out on schedule? For years, the city of Kyiv has been rife with rumors about the release of radiation from the buried reactor unit, and occasionally staff personnel have fueled such rumors in the hope of speeding up the delivery of promised financial support for remedial action. However, neither Parashyn (while the station director) nor Kupnyi have reason to exaggerate the problems. According to their analyses, the most likely event is the inward collapse of the roof, which would lead to a release of radioactive dust into the surrounding environment. The dissemination of such dust likely would occur within a 10-mile radius of Ukryttya, and would thus encompass the bulk of the evacuated zone, including the 6,000 personnel involved in various tasks at the Chernobyl' station itself, and the several hundred (mainly elderly people) who have chosen to live in the area despite the high levels of radiation in the soil (Rechynsky, 1998, p. 4).<sup>7</sup> The release of dust within a limited area appears to be the most likely consequence if the Ukryttya is not re-covered and stabilized.

Workers at the site have practiced evacuation procedures. On one such exercise last March, 107 personnel who work at the Ukryttya site were evacuated from the area in 19

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<sup>7</sup>An estimated 600 people are living in the zone around the Chernobyl' nuclear power station, and they are aged 48 and over. An estimated 130,000 people were evacuated from the Ukrainian part of the officially designated 30-kilometer evacuation zone around the destroyed reactor immediately or were resettled afterward (Rechynsky, 1998, p. 4).

minutes. Although quite impressive, it is believed that this sort of timetable would not be adequate to ensure that the workers would remain free from contamination (Kuksa, 1998, p. 1).

The structure also is susceptible to an earthquake of magnitude 6 on the old 10-point Soviet scale. According to Soviet seismological studies, Chernobyl' is located in an area where a quake of such magnitude is at least a possibility, and would accelerate the collapse of the structure, and particularly the walls separating the third and fourth reactor units. A third possible dilemma is that of fire. There have been frequent fires in the Chernobyl' region since the 1986 accident. As noted above, a fire caused the shutdown of the second unit in 1991, and another fire in 1993 increased tenfold the concentration of alpha-radiation aerosols in the air around the station (Beba, 1998, pp. 4-5). Kupnyi has also noted that within the sarcophagus itself, fires burn continually. He estimates that there are up to 3,000 tons of burning material, including wood, plastic, cable products, and graphite (see Parashyn et al., 1998, p. 8).

Finally, there is the issue of the fuel that remains in the destroyed reactor after the explosion of April 1986. Experts disagree on the precise amount (between 5 and 80 percent of the original quantity) (Kuksa, 1998, p. 1), but estimates are within the range of 50 to 100 tons. Could this remaining fuel reach a level of criticality sufficient to cause a chain reaction? Kupnyi does not believe so, but nonetheless there remains the possibility of some reaction in the future. A long-term goal of the Ukrainian government is to remove the remaining fuel from the reactor core, but it cannot do so until the Ukrytya has been stabilized. The costs of removing the reactor fuel reportedly are astronomical—in the billions of dollars. Clearly Ukraine does not have the financial resources to resolve this problem and once again must rely on international aid.

### THE EBRD AND G-7 MEETINGS OF MAY 1998

Ukraine's civilian nuclear power program has been under international scrutiny since the Chernobyl' accident, but particularly after 1994. A significant international meeting with a bearing on Chernobyl' was that of the G-7 (*Group of Seven major industrialized nations*), convened in Ottawa, Canada in December 1995. The delegates formulated a Memorandum of Understanding with the government of Ukraine concerning the closure of the Chernobyl' station, a final version of which was published on August 2, 1996. In the Memorandum, Ukraine made it clear that the closure of Chernobyl' by 2000 was contingent upon the completion of the two new reactors—Rivne-4 and Khmelnytsky-2, and the G-7 countries concluded that the amount of time needed for construction of these two new reactors was 30 months. However, inefficiencies in the production and utilization of electrical power and other forms of energy in Ukraine soon became a contentious issue. A Panel of Experts appointed under the terms of the Memorandum noted that the costs of producing energy in Ukraine are approximately 10 times higher than in other industrialized countries, and that approximately one-third of monthly earnings are spent on household energy bills (in developed countries, the average is less than 3 percent) (Ukraine, 1996, p. 6).

In May 1998, the annual meeting of the EBRD was held in Kyiv. Ukraine had agreed to postpone the restarting of the No. 3 reactor at Chernobyl' until after this meeting, and the Ukrainian authorities had high hopes that the meeting would see the resolution of the questions remaining over the closure of Chernobyl' and the commissioning of the new reactors at Rivne and Khmelnytsky. The EBRD is one of the largest investors in Ukraine, having invested \$600 million in 26 projects (20 private, 6 state-run), with a special focus on the

energy sector (*Uryadovyi kur'yer*, May 12, 1998, p. 4). Despite some complaints over the EBRD's reluctance to embrace more projects, the Ukrainian leadership hosted the meeting with enthusiasm, but the results were very disappointing.

In particular, the EBRD refused to advance the funds for the completion of the new reactors at the Rivne and Khmelnytsky plants (*The Day*, No. 15, 1998), which would cost an estimated \$1.2 billion. The EBRD members appeared to echo the skepticism of other Western financial agencies regarding the condition of the Ukrainian economy, the slow pace of reforms, and inefficiencies in energy conservation. The EBRD committed itself only to offering \$130 million toward the costs of repairs to the sarcophagus, an amount just over one-sixth of the likely total costs (*Monitor Daily Report*, May 13, 1998). Prior to the meeting, Ukraine's Minister of the Environment and Nuclear Safety, Yuri Kostenko, had warned that unless promised financial assistance (he had in mind the G-7 specifically) was forthcoming, Ukraine could not commit itself to the closure of the Chernobyl' plant by the year 2000 (*Monitor Daily Report*, May 8, 1998). Shortly after the meeting concluded, the No. 3 reactor at Chernobyl' was returned to the national grid, and remains the only functioning reactor at the station (*Uranium Institute News Briefing*, No. 20, 13-19 May 1998, p. 20).

On May 15, 1998, a G-7 summit was held in Birmingham, England, and once again the question of Chernobyl' was placed on the agenda. According to an account in the Ukrainian parliamentary newspaper *Holos Ukrainy*, although many questions raised at the conference received firm decisions, those of interest to Ukraine, including the closure of the troublesome nuclear plant, never got beyond the discussion stage (*Holos Ukrainy*, May 19, 1998, p. 1). The G-7 countries issued what was tantamount to a reprimand to Ukraine, urging the republic to fulfill its obligations to close the plant by 2000. The official response, from Ukrainian Foreign Minister Boris Tarasyuk and presidential spokesperson Oleksandr Maydannik, was that the Western countries have failed to live up to their obligations of the 1995 Ottawa Memorandum, which anticipated the granting of around \$3 billion of aid to Ukraine to assist in the closure of the plant (*Monitor Daily Report*, May 21, 1998). A more optimistic view of the situation was offered by Ukraine's First Deputy Minister of the Environment and Nuclear Safety, Oleksandr Smyshliayev, who maintains that the costs for bringing the two new reactors on line are receiving more attention and that funds should be forthcoming within this calendar year (*Den*, May 19, 1998, p. 1).

The situation regarding financial aid for the repair of the sarcophagus is somewhat clearer. The G-7 countries have committed themselves to funding \$300 million of the total costs of \$754 million for the SIP project. In addition, the European Union has agreed to provide \$110 million. A further \$2.5 million to stabilize the ventilation stack was offered last fall jointly by the United States and Canada (*Uranium Institute News Briefing*, No. 41, 8-14 October 1997). The more immediate need to effect repairs on the sarcophagus may explain why funding from the West has been made available more quickly, although it seems unlikely that Ukraine will be able to come up with the remaining funds. Of more concern to Ukraine is the apparent duplicity of the G-7 countries on the question of funding for the closure of Chernobyl' and financial commitment to the two new reactors.

Where does the truth lie? From Ukraine's point of view, the issue is very simple. The West continues to exert pressure on Ukraine to close Chernobyl' at a time of critical energy shortages, but without fulfilling its part of the bargain to provide substantial funds to do so. Ukraine has always stressed that it lacks funding to act independently. Therefore the question arises of how Ukraine will act if funding is not forthcoming. Evidence suggests that the Chernobyl' plant will continue to operate well into the 21st century, and that the nuclear

power program will also be developed by Enerhoatom, but without the requisite attention to safety. Enerhoatom already has declared that modernization of Ukraine's nuclear power stations should be delayed until these plants start to show a profit. This statement applied particularly to the VVER-1000 stations at Rivne and Khmelnytsky (Smyshliayev, 1998).<sup>8</sup> Ukraine also is anxious to relieve some of its dependence on Russia for energy and to reduce its foreign debt by about \$10.2 billion through cutbacks in budget spending (Kniazhansky and Moseyenkova, 1998). The Chernobyl' question thus is intricately involved with the economy and Ukraine's need to extricate itself from a financial crisis.

Although Ukraine has strongly criticized the G-7 and the EBRD for their apparent failure to follow through with promised assistance, it has praised the U.S. Government for aid in the nuclear energy sector. In March 1998, following a visit to Kyiv by U.S. Secretary of State Madeleine Albright, the United States and Ukraine announced a 30-year agreement on nuclear cooperation, through which a number of U.S. firms would help Ukraine complete the Khmelnytsky-2 and Rivne-4 reactors (Marple, 1998). On May 6, the two countries signed an agreement whereby Ukraine would receive \$30 million in aid to promote national production of fuel for nuclear reactors; in the past Ukraine has been dependent almost totally on Russia for such fuel (*Monitor Daily Report*, May 7, 1998). The Albright visit also led to Ukraine's withdrawal from an agreement to produce turbines for the Bushehr nuclear power plant in Iran, which is being built by Russia.

### POLITICS AND NUCLEAR ENERGY

Ukraine's attitude toward nuclear power has changed visibly from that prevailing in the immediate aftermath of Chernobyl'. Surveys indicate that the public reaction to the development of the nuclear industry is now quite positive.<sup>9</sup> Nuclear power has become the critical factor in Ukrainian energy development, and is the only sector that conceivably could be expanded in the immediate future.<sup>10</sup>

Currently, the Ukrainian government—partly as a result of international vigilance—wishes to do no more than complete a program initiated in the 1970s and developed during the 11th and 12th Soviet five-year plans (1981-1985 and 1986-1990).<sup>11</sup> The environmental protests of the late 1980s are virtually nonexistent today. As in other former Soviet republics, such as Lithuania (e.g., see Dawson, 1996), opposition to nuclear power proved to be of short duration once it was realized that the nuclear power stations were a mainstay of the economy. The Lithuanian case is an extreme example, but the Ukrainian nuclear authorities also undoubtedly are aware that even FSU countries lacking a nuclear power program in the

<sup>8</sup>Smyshliayev's concern is that currently the Rivne and Khmelnytsky stations are being financed through taxes on the local population. The amount of money received from this source is, in his view, insufficient to render these new units acceptable from the perspective of safety requirements (Smyshliayev, 1998, p. 5).

<sup>9</sup>In late April 1998, a survey of 1,200 people conducted by the firm SOTsIS-Gellap indicated that over 50 percent of the respondents felt that the nuclear power industry should be expanded or remain at the existing level. The share of those who thought that the number of nuclear plants should be reduced was 25 percent, a figure that has remained consistent over the past two years (see *Den'*, April 15, 1998, p. 1).

<sup>10</sup>The share of nuclear-generated electricity in Ukraine in 1997 (44.9 percent), for example, is roughly the same as in such countries as Bulgaria (46.0 percent) and Slovakia (44.5 percent in 1996) but considerably below that of Lithuania (81.0 percent) (Uranium Institute, 1998).

<sup>11</sup>In addition to completion of the reactors at Rivne and Khmelnytsky, the plans called for the construction of two new reactors at the South Ukraine station, two reactors at the Crimea station (Shchelkino), a new station at Chyhyryn, and an atomic heat and power station (ATETs) outside of Kharkiv (e.g., see Sagers, 1988, pp. 450-454)—*Ed.*, *PSGE*.

Soviet period have begun to consider and even to accept the nuclear option.<sup>12</sup> The past few years have seen a growing emphasis on nuclear energy in Ukraine that appears even more dramatic when compared to the situation in the other countries of Eastern Europe and the former Soviet Union that were original members of the CMEA nuclear power program.

Worldwide the nuclear industry appears to have recovered fully from the negative publicity surrounding the disaster at Chernobyl<sup>1</sup> and is in the process of further expansion. IAEA statistics, for example, show that in 1997, the number of nuclear power stations operating rose from 432 to 437, while 36 nuclear reactors were under construction in 14 countries. In 17 countries, nuclear power provided at least one-quarter of all energy needs, and nuclear power accounted for 17 percent of world electricity output in 1997 (Reuters, May 8, 1998). In Ukraine, the reliance on nuclear energy has risen as dramatically and consistently as in any country in the world, with nuclear-generated electricity rising from one-third to almost 45 percent of the country's total production over the five-year period 1993-1997. One should not discount the fact that other sources of energy production in Ukraine have been in acute decline and that the percentages do not necessarily reflect a similar increase in overall reactor capacity. Nonetheless, Ukraine could conceivably bring several more reactors into service in the early 21st century. It is instructive in this context to compare nuclear generating capacity (in MW) in 1998 with that existing at the time of the Chernobyl accident in 1986 (Marples, 1986):

<u>Station</u>	<u>Capacity 1986</u>	<u>Capacity 1998</u>
Chernobyl <sup>1</sup>	4000	3000 <sup>13</sup>
Rivne	880	1880
Zaporizhzhya	4000	5000
South Ukraine	1000	2000
Khmelnysky	0	1000
Total	9880	12880.

In 1986, a portion of nuclear-generated electricity in Ukraine (approximately 15 percent) was exported to East European countries. Two stations—the Kerch nuclear plant on the Crimean Peninsula and the Chyhyryn station on the Dnipro River—were decommissioned permanently. However, as noted earlier, government initiatives to increase further the reliance on nuclear energy, even if this signified the construction of new capacity, would likely receive the support of the Ukrainian population. In this respect, the psychological impact of nuclear energy development on public opinion has been significantly less than the effects and

<sup>12</sup>The most obvious example is Belarus, where plans are well under way to commence construction of a nuclear power station, reportedly to reduce the costs of importing energy resources from Russia. The plant is to be built in the Vitebsk region, the only part of Belarus not affected by radiation fallout from the Chernobyl<sup>1</sup> accident. At peak size the station is anticipated to be 2,400 MW and to provide for about 35 percent of the republic's energy needs. Completion of the first unit is expected by 2005. In response to queries regarding the wisdom of constructing a plant in the republic most affected by the world's worst nuclear accident, the authorities have responded that Belarus is "surrounded" by 12 atomic stations within 12 to 60 km from its borders and no additional risk therefore will be derived from having a domestic plant (see *Belorusskaya delovaya gazeta*, April 2, 1998, p. 18).

<sup>13</sup>The capacity figure for Chernobyl<sup>1</sup> includes that for all reactors that have not been decommissioned (i.e., Nos. 2 and 3), and for the No. 1, which has yet to be fully decommissioned.

influence of radiation fallout. It is thus possible for high-level officials, including President Kuchma, to separate completely these two issues in public speeches.<sup>14</sup> In this respect, the impact of the Chernobyl' accident on the development of nuclear power in Ukraine has been largely overcome.

### CONCLUSIONS

The Chernobyl' issue continues to be a major factor in the economic and political life of Ukraine. However, Ukraine's options are limited by its economic needs and by an acute shortage of ready cash. Recently Ukraine has promised the IMF that it will reduce its budget deficit to 1.5 percent of GDP (Kniazhansky and Moiseyenko, 1998) in the hopes that the latter organization will recommence tranches of credit that were suspended in 1996. On the other hand, if promised aid for the closure of Chernobyl' and repairs to the sarcophagus are not forthcoming, Russia has indicated its willingness to step in. This would not be the first occasion that assistance was extended from the east rather than the west. In February 1998, when the EBRD turned down contracts on 8 of 13 projects advanced by Ukraine for its nuclear energy sector, Russia at once offered a technical loan of \$200 million (Marple, 1998).

There are further indications that the Kuchma-Pustovoitenko government could move toward Russia rather than the West. The results of the March 29, 1998 elections in Ukraine, which saw the emergence of the Communist Party of Ukraine as the largest party in the new parliament,<sup>15</sup> and the protracted contest for the post of the new Speaker in the Ukrainian parliament,<sup>16</sup> both indicate that the forces of the Left are gaining strength. In the past, a leftward orientation in Ukrainian politics has signified warmer relations with Russia and a distancing of Ukraine from the West. On the other hand, Ukraine has maintained friendly relations with the United States, a country that continues to provide substantial aid to Ukraine's nuclear energy sector, in contrast to the delayed offerings from the EBRD and G-7 (in which the United States plays a leading role).

Two key points should be noted. First, there remains a wide gap between Ukraine and the G-7 and Ukraine and the EBRD concerning financial payments for the closure of Chernobyl' by the year 2000 and the completion of new reactors. Second, there also is a growing rift within the Ukrainian energy hierarchy between Enerhoatom and the Ministry for the Environment and Nuclear Safety. According to officials of the latter ministry, Enerhoatom has acted irresponsibly on questions of nuclear safety and is pushing ahead with nuclear power development before the necessary funding has been provided. One might add to these points the Parashyn affair, which is an indication that Enerhoatom has emerged victorious

<sup>14</sup>There are some isolated exceptions, such as the head of the National Commission for Radiation Protection of the Ukrainian Population, Academician Dmytro Hrodzins'kiy. Responding to the question of whether Ukraine should continue to develop nuclear energy, he remarked (April 1998) that one should first calculate the energy needs of Ukraine. Then one should ask whether Ukraine wishes to preserve its position as a country with one of the largest recreational areas in Europe. "Who would wish to visit the Carpathian Mountains or the Crimea once nuclear power stations are built there?" he asked. Hrodzins'kiy (1998, p. 19) concluded that Ukraine must work toward the development of new, alternative energy technologies.

<sup>15</sup>The Communist Party of Ukraine received 24.68 percent of the popular vote, heading the list of all parties. Second was the Popular Movement of Ukraine (Rukh) with 9.4 percent (*Den*, April 4, 1998, p. 4).

<sup>16</sup>On July 8, 1998, Oleksandr Mykolayovych Tkachenko was appointed Chairman of the Ukrainian parliament. Born in 1939 in the Cherkasy region, he was Ukrainian Minister of Agriculture under the Soviet regime from 1985 to May 1991, and also chairman of the State Agroindustrial Association of the Ukrainian SSR. He is known for his conservative views on agrarian reform and can be considered a candidate who would likely side with the Leftist bloc in the parliament (*Holos Ukrainy*, July 9, 1998, p. 1).

from a power struggle that has taken place within the Ukrainian nuclear energy industry. Enerhoatom, in turn, is responding to the economic needs of the government for greater supplies of energy. In this sense, nuclear energy, as before the Chernobyl' accident, is perceived as the short-term solution to Ukraine's energy needs.

Finally, the situation is reminiscent of 1986 in that, except for the environmental ministry, there is little public opposition to nuclear power development. In 1986, the lack of opposition was a result of a totalitarian political system in which all decisions on nuclear-energy questions were made in Moscow by the relevant ministries. In 1998, politicians have expressed the view that Ukraine has been made a scapegoat for the results of a disaster over which it had no control, and that the West has not fulfilled its part of the agreement signed in Ottawa in 1995. The tardiness of aid from the West lends weight to this perspective. Ukrainians, in the final analysis, have learned to accept the dangers of nuclear power alongside the evident benefits of heating in winter and maintenance of industries with high levels of electricity consumption. These developments hardly augur well for the future. They reflect rising optimism with respect to nuclear power worldwide, but particularly within Eastern Europe, where several countries, and Ukraine in particular, have continued to develop the industry.

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