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ENVIRONMENTAL DIMENSION OF NATIONAL SECURITY: A TRIAL OF SYSTEMS ANALYSIS STUDY

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Sophisticated research of a national security* problem permits to disclose its comprehensive nature. In terms of systems analysis I consider it as system S_3 consisting of various subsystems and elements. From the latter environmental subsystem marked as S_E is going to be studied in detail in this paper. A special analysis of this particular component of the national security problem seems to be very important and timely first of all from theoretical point of view.

As early as in 1956 The Report of the Committee of Three on Non-Military Cooperation of NATO argued that "security is today far more than a military matter. The strengthening of political consultations and economic cooperation, the development of resources, progress in education and public understanding all these can be as important for the protection of the security of nation or an alliance as the building of a battleship of the equipping of an army". (Cited from: The North Atlantic Treaty Organisation, 1989). However in spite of this timely and important observation I dare to say that the progress in transforming it into a systems concept have not been impressive. Judging from the available scientific literature it seems to me that environmental as well as other "nonmilitary" aspects of national security have not been elucidated adequately. Till now the bulk of research in this field as a rule has been confined to analising the impact of combat activities on the environment (scenarios of the "nuclear winter", environmental consequence of the war in Vietnam, etc.) that is really worthy but still not enough.

Secondly a systems study of the environmental dimension of national security is paramount in practical terms. For example nowadays in the USSR costs dealing with ineffective use of natural resources, pollution and its impact on human's health can be assessed as 15-17% of national GNP (Porfiriev, 1990). That means that the volume of resources necessary to compensate fully this negative impact and thus provide long-range environmental stability is comparable or even exceeds the budget allocations for defense needs or in other words for military- political security.

Earlier while discussing the problem of structuring of the S_3 system (see footnote on page 1) I stressed the possibility of dual interpretation of environmental security as a category taking into account its two main aspects. On the one hand considering S_E as an element or subsystem of S_3 and basing on the object of environmental security as a category its aim can be defined as protecting life, health or more

* The systems concept of national security is developed in the article: Porfiriev B.N. (1991). The concept of national security and its environmental dimension: a trial of systems analysis study. (part I). National Security and Strategic Stability Journal. No. 1. (Forthcoming).

correctly the quality of life (QL) and health (QH) of the population, its environmental rights and conditions of living (QE) on the national territory from any destructive impacts. On the other hand analysing S_3 from the viewpoint of origin of the hazards jeorpadising its stability including environmental ones the objective of S_E may be interpreted as defending the society or the system S_3 and its subsystems S_1 (personal security) and S_2 (social groups security) particularly from these destabilising impacts.

Obviously both aspects or interpretations are mutually compatible. One of them clearly delineates the object of environmental security but lacks specification of destabilising factors or hazard's sources and another does it vice versa. Let us consider these aspects one after another using parameters QL, QH and QE to characterise the aim of S_E and marking environmental factors of S_3 destabilising as F_E.

1. <u>The object, criteria and objective of environmental security</u>

As it was already mentioned protecting QL and QH serves as the main objective and same time the main criteria of S_E while conservation or upgrading of QE should be considered as a secondary criterion. At the same time parameters QL and QH are dependable on QE

$$\begin{cases} I_{QL} = f(I_{QH}, I_{QE}) \\ I_{QE} \text{ e } I_{QH} \end{cases} \qquad (1)$$

$$DI^t_{QL} = f(DI^t_{QH},\ DI^t_{QE}) \qquad (2),$$

where I embraces respective integral indexes and DI^t means changes of I in the space time of t.

Stressing the fact that criterion QE is secondary respective to QL and QL is in no way a trial to limit the category of environmental quality to purely medical and ecological aspects and thus to reject its esthetic, cultural and other values especially taking into account that criterion QL is not exhausted by the state of health. But having no intention to discuss the problem of environmental protection but rather considering the issues dealing with environmental security, i.e. minimising risk of hazardous environmental impact on human health, I have to put the mentioned aspects of both of the criteria QE and QL on the first place.

That is why in the following characteristics of environmental security I will use integral index I_{QH}, reflecting the state of somatic, psychiatric and moral health of the society (nation). This index facilitates formalising the main criterion or functional objective of S_E as well as conditions to realise it. The life and health protection from destabilising natural and technological impacts implies:

A) nondeteriorating of parameters inclusive to I_{QH} in those social groups or in those territories where these indicators are recognised by the nation as satisfactory or acceptable. In general it is a stability imperative condition.

B) upgrading of I_{QH} indicators in all other situations that in general means the society or system E_3 development condition.

$$I_{QH}^{t_o} > I_{QH}^{AC} \quad (3) \qquad \text{or} \qquad DI_{QH} > 0 \quad (4),$$

where $I_{QH}^{t_o}$ is an integral index of health quality in a moment t_o (basic year); I_{QH}^{AC} is a standard national index, considered acceptable by the society for a certain number of years previous to t_o.

Equality of the left and right parts in the formulas (3) and (4) corresponds to the situation A whereas situation B is characterised by the nonstrict parts of these formulas.

Using the categories of quality of life and health as well as corresponding integral indexes thus turns to be very fruitful to specify the essence of environmental security. But that does not mean that identifying and calculating of I_{QH} indicators is an easy task both methodologically and practically. It is a sophisticated job envolving elaboration of a cluster of qualitatively different indicators, its calculation and then aggregation in a "nondimensional" indexes. As a rule the necessary statistical base either lacks or is inadequate and a lot of time and big efforts are needed to close somewhat this lacuna. Nevertheless the problem does not seem to have no solution because some concrete approaches already exist and are used in various countries and international organisations.

In particular, such indicator as average life expectancy (D_L) serving one of the main parameters of I_{QH} is well known and widely used. Taking D_L^{AC} as national average life duration calculated for certain Dt (where Dt= 10-20 years) previous to basic year t_o, and $D_L^{t_o}$ as an average life expectancy starting from t_o the first inequality of formulas (3) and (4) may be rewritten as:

$D_L^{t_o} > D_L^{AC}$ (5) or $DD_L > 0$ (6)

In case that these conditions are not fulfilled systems S_3 and its subsystems S_2 and S_1 are unstable and the state of the system E_3 and its subsystems E_2 and E_1 can not be qualified as secure considering environmental criterion.

In the USSR such subsystems include in particular Zaporogye (Ukraine) and the Aral region in the Middle Asia where average life expectancy decreases thanks to negative environmental impact: industrial and agricultural (pesticides) pollution of air and water respectively. In those regions, for example the Aral region,a sharp decrease of I_{QH} is also taking place. Due to heavy pollution of potable water by chemicals (fertilisers, pesticides, etc.) in Karakalpak autonomous republic more than 70% of elder population and 80% of children suffer from one or several diseases, 90% of pregnant women have anemia, 10% of babies die before 1 year and from every five military-service-age persons one is rejected to become a soldier by doctors considering his small weight and height. In Tashauz region of Turkmenia an average family has three ill members, 80% of women and children suffer from anemia, TB morbidity three times exceeds that of the average figure for the USSR.

Another indicator somewhat analogous to D_L and also useful in measuring I_{QH} is a risk of death due to various reasons. Founding on the concept of acceptable risk,marking it as $R^{AC}_{QL,QH}$ and calculating it retrospectively as a possibility of death due to aging formulas (3) and (4) may be presented in the following way:

$$R_{QH}^{t_o} < R_{QH}^{AC} \quad (7) \qquad \text{or} \qquad DR_{QH} < 0 \quad (8)$$

The methodology of R calculations is thoroughly developed by well known analysts including Ch. Starr, B. Fischhoff, S. Lichtenstein, P. Slovic. H. Kunreuther from the USA, K. Vlek, P.-I. Stallen from Netherlands, H. Otway, T. O'Riordan from UK and others. (Fischhoff, Lichtenstein, Slovic, 1979,1980; Slovic, 1987; Kunreuther, 1980; Otway, Pahner, 1976; Otway, Tomas, 1982; Vlek, Stallen, 1981).

Generally speaking I_{QH} as well as $D_L^{t_o}$ and $R_{QH}^{t_o}$ depend on various factors. But considering the context of environmental security analisis imperatives fixed in the formulas (3) - (8) are referred only to exogenous (in relation to a person or S_1 i.e.the basic element of the systems E_3 and S_3 respectively) impacts jeorpadising one's health and life. This fact is reflected in formulas (1) and (2). It may be only added that all other factors or elements except QE (political, economic ,etc.) constituting the system S_3 taken as constant the latter will be analogous to S_E:

$$\begin{cases} I_N = \text{const} \\ S_3 - S_E \end{cases} \quad (9)$$

where I_N is an integral index of N nonenvironmental parameters.

As far as endogenous (respective to E_1) impacts on parameter QH are concerned, including habits, customs, etc., they refer to the category of individual risk and do not belong to environmental hazards or in other words to environmental factors hampering the national security or S_3

system contrary to the earlier mentioned exogenous impacts.

2. Environmental factors destabilising the national security

These factors marked previously as F_E may be subdivided into two main groups: ecological (natural) and techno- ecological or in other terms producing direct and indirect impacts. The first group ($F_E^/$) incorporates the sources and factors risky for S_3, including S_E, representing a direct hazard both for the objects of these systems and for environment per se. $F_E^/$ usually have purely natural genesis and envelope natural disasters caused by tectonic, oceanic and other natural processes. In rare cases these disasters may stem from artificial sources being induced by economic activities (mining, dam construction, etc) or intentively used methods of geophysical war. With essential reservations some types of infection diseases can be also enlisted in the mentioned group. They have natural etiology but start to represent a serious hazard to social systems stability only becoming pandemic thanks to interactions between people.

Natural disaster's destabilising impact on population and economy of many countries of the world, including the USSR, the USA and UK is substantially impressive. As far as the Soviet Union is concerned direct losses caused by these disasters are soaring to 3,5-4 billion of rubles or approximately 0,4% of GNP annually. If indirect costs are considered as well the figure mentioned increases to no less than 6-8 billion of rubles averagely per year not taking into account the volume of agricultural losses and to 15-20 billion of rubles or about 2% of GNP if the latter are included. These figures do not absorb the compensation for victims losses- I believe their average number constitutes about 150-200 per year - and treatment of several thousands of wounded persons. This kind of costs are relatively small due to poor insurance and medical service support in the country.

The presented figures may seem not so impressive at first glance comparatively to budget military allocations that officially reach about 8% of the Soviet GNP and that according to alternative sources skyrocket to 15-20% of GNP (Sverdlik, 1990). But if these indicators are compared to the respective US ones it can be observed that the gap between the shares of GNP concerning disaster losses is approximately 1:3,5/4 and relating to military expenditures equals to roughly 1:2,5. That means that the $F_E^{//}$ load on economic basis constituting the core of economic security in relative terms should be considered as noticeable.

In particular it is impressive in the regions prone to natural hazards that cover about 70% of the soviet territory, including more than 40% of seimosensitive areas (in the USA the latter embrace about 1/3 of the surface). In 1960 around 13% of the soviet population lived in mountainous regions, in 1990 this share exceeded 20% (about 60 million people). According to some estimates those areas concentrate up to 16% of the USSR national wealth and if all hazard-prone regions are concerned this figure may reach 25% (Baburin, 1990). No doubt Armenia having lost 0,7% of its population and suffered losses equivalent to 150% of its GNP that can be compared to the World War II negative effect for the republic presents one of the most tragic and at the same time vivid example of the regions that recently have confronted large-scale natural disaster.

Another group of destabilising factors called techno-ecological and marked as $F_E^{//}$ envelopes technogenic sources and factors menacing to life and health security of persons and things they value (i.e. to S_E and S_3) indirectly through feedback impact of technologically changed environment on the social system E_3 and its subsystems E_2 and E_1. These negative environmental changes that result in pronounced deterioration of its quality and I_{QE} decrease are caused by human's activities both in war and peace times.

Analysis of combat actions impact on biosphere should be considered as an important area of research that till now have been limited to either elaborating scenarios of environmental consequences of a nuclear war (well known "nuclear winter" models) or studying of analogous impacts of Vietnam war, especially of the agent orange spray on tropical forests and soils. As far as I know analysis of environmental impact of the World War II in the USSR has also been confined to assessment of forest losses though more comprehensive and scrutinized research should facilitate better understanding of destructive potential of conventional armaments for ecosystems and S_E as a whole.

I should like to note that practically in all cases mentioned above combat activities were primarily oriented on destroying the enemy's combat potential Environmental deterioration was only a consequence of those actions. Even defoliants in Vietnam were used by the US Air force rather to disclose guerrilla troops hidden in tropical forests than smashing the latter per se though it does not reverse the substantial negative environmental impact of this action.

Nowadays the war in the Persian Gulf perhaps for the first time in world's history presents an example of the new type of combat activities that can be characterised as environmental war. Spilling enormous volumes (about 500 thousand tons)of crude oil from Kuwait stocks into the Gulf waters by Hussein's army has been especially designated to ruin the marine environment and provoke an ecological disaster. The main objective of this new type of war is to destroy all elements of S_E system including QH and QE. That differs it from previous kinds of wars that did not aim predominantly or primarily on environmental destruction. And that is why I consider the detailed and systems study of this phenomenon is becoming an actual and important field of research concerning environmental security issues and the whole problem of the national security.

As far as peacetime $F_E^{//}$ factors are concerned the negative impact on both S_E and S_3 in general is produced while economic activities take place. This impact manifests itself in two main forms including acute or blast-like (disasters, catastrophes) and chronic one that is typical for routine functioning of industries. Correspondingly it is possible to differentiate a sharp or unexpected destabilising of S_E resulting from immediate emission of considerable amount of power or substance into milieu and its gradual destabilising caused through accumulating of hazardous and destructive components in environment and relatively slow ruining of the latter.

The sources of risk in this case are concentrated both in civil and military sectors of national economy.Surely this cross-cutting is more or less conditional because a bulk of industries is of dual purpose producing both civil and military goods. Nevertheless this traditional classification is fruitful for systems analysis of environmental security problem considering that till now soviet studies of its military aspects due to understandable reasons have been restricted to impact of combat activities abroad. In the following using the USSR as a case I shall argue that in peace time destabilising impact of enterprises related to military and industrial complex on environment is rather substantial. Environmental impact produced by many civil industries is in no way less impressive - the fact widely known by the public versus to the previous situation.

I should like to begin the analysis of destabilising forms of S_E mentioned earlier with a sharp one. Today the destructive potential of large scale technological disasters is comparable to that of military activities. Only energy power sector of the world economy now manufactures and stockpiles more than 10 billion of tons of raw materials that can burn or explode. This figure does not differ too much from the volume of nuclear armaments accumulated for the decades. Highly hazardous chemical components like ammonia, phosgen and others have been produced, stockpiled and transported in quantities equivalent to hundreds or even thousands of billions of lethal doses. This is one or two orders more than the volume of accumulated radioactive materials calculated in the same measurement system (Legasov, 1987). The destructive effect of some technological disasters and combat actions is comparable as well. For example, the total number of persons killed and wounded by nuclear bombing in Nagasaki in 1945 was about 140 thousand while the same indicator for Bhopal chemical plant explosion that took place 40 years later equaled to more than 220 thousand.

In the framework of analysing of S_E destabilising problem environmental and ecomedical consequences of technological disasters should be considered as especially important. The latter's scale can be assessed using the case study of the USSR nuclear power complex including both electricity production for civil and plutonium production for military purposes.

As far as the military component of that complex is concerned one should immediately memorise the Kyshtym radiological accident that took place in 1957 in the Southern Urals. It resulted in emitting of about 20 million of curies of ^{239}Pt, forming of radioactive cloud with the scale of 105 x 8 Km, polluting of more than 15 thousand of sq. Km and taking 160 sq. Km of arable lands out of production. More than 10.000 persons were evacuated from 23 villages and cumulative costs of that procedure and compensations reached 2 billion of rubles in current prices (Nikipelov et al, 1989).

In spite of substantial time passed after that accident its consequences are still should be considered as noticeable though not all soviet specialists share this view. For example, B.V. Nikipelov et al argue that the medical surveys of population of the suffered area do not manifest any case of acute, subacute or chronic radiation sickness. At the same time according to professor V.A. Shevchenko data no less than 1000 persons suffered chronic radiation sickness. Significant changes in cardiovascular pathologies rates as well as endocrine, blood creating systems dysfunctions and neuropcychogenic stresses can be easily traced. The leukemia incidence rate has doubled (Shevchenko, 1990). A considerable fraction of radionucleids has been absorbed with food, milk in particular, from the households left on polluted territory (Manucharova, 1991). Many indicators displaying the morbidity spectrum of the suffered population in the Southern Urals region are similar to that of Chernobyl areas where I performed my field studies so reasonings of professor V.A. Shevchenko and some other prominent specialists like professor H.B. Burlakova I consider as more sound.

As to Chernobyl accident per se it should be taken as the most tragic and known evidence of the large scale civil technological disaster with environmental consequences comparable to those of some contemporary combat operations. Moreover from the viewpoint of its long-term results it represents the worst accident in the modern society's history (Verchovny Soviet, 1989). Not saying a word about 30 dead bodies, more than 200 of hospitalised and 116 thousands of evacuated persons during the first weeks of the accident about 1,5 million hectars of agricultural lands where ^{137}Cs density exceeded 5 Ci/sq Km. were put out of production. More or less intensive radioactive pollution spread over the territory with a radius of more than 2000 Km enveloping about 20 countries,including 131 thousand of sq. Km in the USSR only. 14 regions of Russia, Ukraine and Byelorussia suffered most and at least 6 more suffered less incorporating the largest USSR resort, Sochi with its 900 radioactively polluted small areas (Dergachev, 1991).

The most heavily polluted zone where ^{239}Pt and ^{240}Pt density exceeds 0,1 Ci/sq Km lies mainly within the radius of 10 Km from the nuclear power plant and is excluded from economic life for centuries. The whole number of people living on the radioactively polluted territory where $^{137}Cs >$ 1 Ci/sq Km now is approaching to 4 million including 140 thousand of persons who should leave these areas in 1991-1992. The material costs linked with the Chernobyl accident according to some estimates would exceed 200 billion of rubles by the year 2000 (Koryakin, 1990).

The so called gradual destabilisation is no less menacing to S_E and respectively S_3 systems and it takes place as a result of step-by-step environmental deterioration by highly toxic or hazardous substances. The negative effects of this process though not so vividly and vastly pronounced as in the previous case but still well observed display themselves already in a global scale (i.e. green-house effect, ozone layer depletion, etc.) thus hampering the perspectives of the world's environmental security and of the S_5 (global security) system in general. But at the national level (E_3) this hazard has already been felt most vividly well, in particular in the Soviet Union where ecomedical consequences of environmental pollution are noticeably more serious than say in the USA or UK. For example according to some estimates these factors are responsible for 1/3- 1/2 of cancer morbidity in the USSR versus 2-5% in the USA (Whelan, 1985).

Like the case of accidents and disasters the environmental pollution is caused by highly toxic and hazardous substances released by the industries of both civil and military sectors of the national economy but while their normal functioning. Analysing the environmental impact of the latter (i.e. of military enterprises) I should like to take again the nuclear industrial complex in the Southern Urals as a case.

For decades in Chelyabinsk region the "Mayak" enterprise that was the cradle of the first soviet nuclear bomb and has been producing plutonium till recent times released highly radioactive wastes directly into the adjacent Techa river and lake Karachay and only later buried it into the ground though without any treatment. As a result the vast territory around this powerful complex has accumulated radioactivity over 1 billion of curies (according to some calculations more than 1,2 billion), including 120 million of curies in lake Karachay only that is respectively more than 20 and 2 times surpasses the Chernobyl's accident emission volume. Radioactive intensiveness at the river Techa banks now is 26 times higher than in Chernobyl areas (Manucharova, 1991).

All that leads to increase of the region's population morbidity rates. Professor V.A Shevchenko argues that about 500 thousand of persons have been exposed to high radiation levels nearly 1% of those have chronic radiation sickness.

Considering that a great bulk of radioactive wastes are concentrated in the surface waters connected with river Ob basin one may observe an increase of the territory with intensive radioactive pollution extremely hazardous to human's health and expect this situation transforming to environmental disaster in the nearest decades (Manucharova, 1991).

The situation in the Southern Urals in nowhere unique besides its perhaps really tremendous scale. The same processes of gradual S_E system destabilising take place at other enterprises and organisations of different profile located in other regions. One may cite an example of Czecho-Slovakia where according to press agency CTK from 227 places left by soviet troops only 12 did not suffer environmental degradation. The whole area occupied by these troops covers 13 thousand hectares of agricultural lands and 6,5 thousand hectares of forests. Czechs assess the sum of losses as 243 million Kr but the soviet side agrees only to 74,7 million or 28% (Argumenty y facty, 1991).

The situation in Donbass may serve as another example. The burial of wastes from the special factory in Gorlovka unknown to the public and neighboring enterprises officials was punched while mining. That have leaded to poisoning of both soil and underground waters and several of hundreds of the miners including three of them who died (Glotov, 1990; Reshetnikov, 1991).

Industries in the civil sector of the national economy also produce a significant impact on S_E system due to ineffective technology and management of natural recourses exploitation resulting both in its depletion and air, water and soil pollution. Each year the rivers and seas of the Soviet Union receive more than 150 billion m^3 of waste and drainage waters containing 30 million of tons of toxic materials. Poor quality of oil and gas mining technologies provoked the emerging of great hazard to the environment of the Lower Volga and Northern Kaspian regions. The waters of Syr-Darya and Amu-Darya rivers in Central Asia have been nearly depleted through irrigation and heavily polluted by mineral fertilisers and pesticides. That resulted in loss of the Aral sea considering it recreational and fish-resource potential as well as in earlier mentioned environmental crisis in the Aral region as a whole. The Draft of the State programme for environmental protection and rational use of natural resources in the USSR in 1991-1995 and by the year 2005 argues that ecologically safe threshold in the basins of Kuban, Don, Ural and other rivers is over passed thanks to overexploitation of water resources (Gosudarstvennaya Programma, 1990).

More than 100 million of tons of pollutants including hazardous substances are emitted yearly in the air of the USSR. Since recently there can be observed the trend of increasing the rate of extremely high pollution levels surpassing 50 PCT (permittable concentrations threshold) in 16 cities and towns and 10 PCT in more than 100 of them incorporating Volgograd, Donyetsk, Sverdlovsk, Tashkent megapolicies. In 15 cities including Nizhniy Novgorod and Leningrad agglomerations high pollution levels has resulted in morbidity increase (Gosudarstvennaya Programma, 1990).

In general there are about 15-20 of regions of the USSR that can be characterised as environmental disaster or crisis areas where more than half of the national population lives in. A respective soviet ecologist professor A.V.Yablokov states that "as a result a rapid increase of morbidity induced by environmental quality deterioration takes place. Every third man in those regions has a cancer and the number of such persons is increasing from year to year and the average life expectancy is 4-8 years shorter than in the developed countries of the world" (Yablokov, 1989). As has been already mentioned the gross costs linked with intensifying of environmental destabilising process in the USSR can be assessed at least as 15-17% of the GNP.

Thus even the brief and obviously not exhaustive analysis of environmental situation in the USSR displays the heterogeneity of F_E factors that hazardously impact human's health and environment per se and destabilises S_3 and E_3 as a whole. The latter experiences the pressure not only from F_E. Increase in morbidity rates and shortening of average life expectancy caused by environmental quality degradation lead to worsening of labor force characteristics. At the same time intensive depletion and deterioration of natural resources undermine the primary sector's potential and consequently hurt the economic security subsystem (S_{EC}) of the society or E_3 system. Besides the sharp and negative change in the environment for many nationalities in particular the small ones results in destruction of their habits, customs, traditions, break of community linkages, i.e. disturbance of the holisticity of sociocultural security subsystem (S_C).

The fate of the Northern peoples of the USSR may serve as a vivid example of this situation.

Considering close connections between S_{EC} and S_C subsystems on the one hand and political security subsystem (S_P) on the other as well as the growing importance of environmental issues in international relations, i.e. in S_3, S_4 (regional security) and S_5 links, the mentioned processes lead also to destabilising of the whole system of national security S_3 and E_3 system incorporating it. This confirms once more the necessity and utility of a systems approach to research and development of the national security problem. It can be solved only through protection of all human commons including environmental ones and a Person as the main value.

1 ARGUMENTY Y FACTY (1991). No.7. S.3.

2 BABURIN V.L. (1990). Socialno-economicheskaya otzenka opasnych prirodnich yavleniy. Opasniye prirodniye yavleniya. Ed. C.M. Myagkov. Moskva: Moskovsky Gosudarstvenniy Universitet.

3 DERGACHEV A. (1991). Sledi Cherobilya v centre Sochi. Izvestiya. No. 35. 9 Fevralya.

4 GLOTOV B. (1990). Otkuda "golubaya" voda?. Pravda. 11 Maya.

5 GOSUDARSTVENNAYA PROGRAMMA PO OCHRANYE OKRUZHAYUSCHEY SREDI I RATZIONALNOMU ISPOLZOVANIYU PRIRODNICH RESURSOV SSSR NA 1991-1995 GODI Y NA PERSPEKTIVU DO 2005 GODA. PROEKT. Pravitelstvenniy Vestnik. No. 40. Octyabr. S. 5-6.

6 KORYAKIN Yu.I. (1990). Socialniye aspecti yadernoi energe-

tiki. Energeticheskoye Stroitelstvo. No. 8. S.9.

7 LEGASOV V.A. (1987). Iz segodnya- v zavtra. Pravda. 5 Octyabrya.

8 NIKIPELOV B.V., ROMANOV G.N., BULDAKOV L.A., BABAEV N.S., KHOLINA Yu.B. (1989). Radiatzionnaya avariya na Yuzhnom Urale. Atomnaya Energetika. T.67. No.2. S. 22-30.

9 THE NORTH ATLANTIC TREATY ORGANISATION (1989). Facts and figures. Brussels: NATO Information Service. P. 386.

10 OTWAY H., PAHNER P. (1976). Risk assessment. Futures. No.8. P. 122-134.

11 OTWAY H, TOMAS K. (1982). Reflection on risk perception and policy. Risk Analysis. Vol. 2. No. 2. P. 69-82.

12 PORFIRIEV B.N. (1990). Economicheskiye i organizatzionno-upravlecheskiye problemi ekologicheskoi politiki v SSSR. Izvestiya Akademii nauk SSSR. Ser. economicheskaya. No. 3. S. 22-30.

13 RESHETNIKOV V. (1991). Neuzheli obyazatelno nuzhni katastrofi? Izvestiya. No. 23. 26 Yanvarya.

14 SHEVCHENKO V.A. (1990). The genetic consequences of the impact of ionising radiation on natural population after Kyshtym and Chernobyl. /Proc. of the Seminar on consequences assessment of the environmental impact of radionucleids released through the major nuclear accidents: Kyshtym, Windscale and Chernobyl. Luxembourgh, October 1-5, 1990./International Radioilogical Union. (Forthcoming).

15 SLOVIC P.,FISCHHOFF B.,LICHTENSTEIN S. (1979). Rating the risks. Environment. No.4. P. 14-17, 36-39.

16 SLOVIC P.,FISCHHOFF B.,LICHTENSTEIN S. (1980). Facts and fears: understanding perceived risk. Societal risk assess-

ment: how safe is safe enough? / Eds. R. Shwing, R. Albers. N.Y. P. 181-216.

17 SLOVIC P. (1987). Perception of risk. Science. No. 4799. P. 280-285.

18 STARR Ch. (1969). Social benefit versus technological risk. Science. No. 165. P. 1232-1238.

19 SVERDLIK Sh.B. (1990). Volny ekonomist protiv vsey korolevskoi rati. ECO. No. 12. S. 111-118.

20 VERCHOVNIY SOVIET SSSR (1990). Postanovleniye "O edinoy programme po likvidatzii posledstviy avarii na Chernobylskoi AES i situatzii, svyazannoi s etoi avariyei". 25 Aprelya 1990. Pravda. April 28.

21 VLEK C., STALLEN P.-I. (1981). Judging risks and benefits in the small and large. Organisational Behavior and Human Performance. No. 2. P. 235-271.

22 WHELAN E. (1985). The toxic terror: the truth about the score of cancer. Ottawa (Illinois).

23 YABLOKOV A.V. (1989). Vistuplenie na I Syiezde narodnich deputatov SSSR. Pravda. 10 Aprelya.