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**STATE AND BUSINESS PARTNERSHIP AS AN ADAPTATION  
INSTRUMENT**

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*Abstract*

The following article looks how the climate changes influence on dangerous industries. Global warming provokes natural disasters - hurricanes, tsunamis, earthquakes – that have negative influence on ultra dangerous industries. In the article particularly there is an example of Japanese “Fukushima – 1” atomic power plant accident which was caused by the earthquake and tsunami. In economics theory there are two points how to reduce ecological risks. The first one is based on state restrictive measures – financial instruments. The second point is based on business adaptation to constantly changing climate conditions of management. The article suggests economical strategy, which allows to combine resources of state, business, scientific institutes and non-profit organizations to reduce the risk of technogenous disasters. Attention is given to the fact that in actively developing Russian economy with the growth of society needs the lack of possibilities of state financing is perceived, at the same time there are large investment projects which can't be realized only by means of market mechanisms because of their scale and social importance. It is connected with the sphere of national safety, fuel – energy industry, transport infrastructure and community facilities. In this regard, the article discusses the French experience to realize large scale projects in the sphere of power industry.

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**Keywords:** State and business partnership; ultra dangerous industries; global climate changes.



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## 1. Introduction

Global climate changes – one of the largest risks for the whole world society at the beginning of XXI century. 30 years from 1983 to 2012 became the warmest period for the last 1400 years. And the consequences of these planetary scale changes are accelerating. If emissions in the atmosphere remain the same then the world will become warmer for about 4 degrees to 2100, and about 5 degrees in the USA. Sea level rise is also accelerating, dry regions are becoming even drier, wet ones are becoming wetter, as warmer atmosphere holds more moisture. The upper layer of 3 meters permafrost in the northern latitude is constantly melting, that makes one more problem, as it has twice as much carbon as there is in our whole atmosphere today.

Besides, glacier melting creates excessive pressure on the earth's surface. The water weight is about  $1,35 \cdot 10^{16}$  tons. During the process of warming about 4 % of this water mass are transporting into the oceans. It's quite enough to provoke seismic activity in different regions. For example, the eruption of Pavlov's volcano in Alaska takes place from September to December because the water level in the north of the Pacific Ocean is increasing in autumn and winter (less than 20 cm).

Shifts in the earth crust fractures can happen constantly, causing "low" earthquakes. In the east of Taiwan such phenomenon are associated with typhoons. Rapid falling of air pressure, when the centre of storm is going near and breaking in the depth is released, simplifying the movement. It's very important – low earthquakes can be the basis for stronger tremor (Fussel & Klein, 2006).

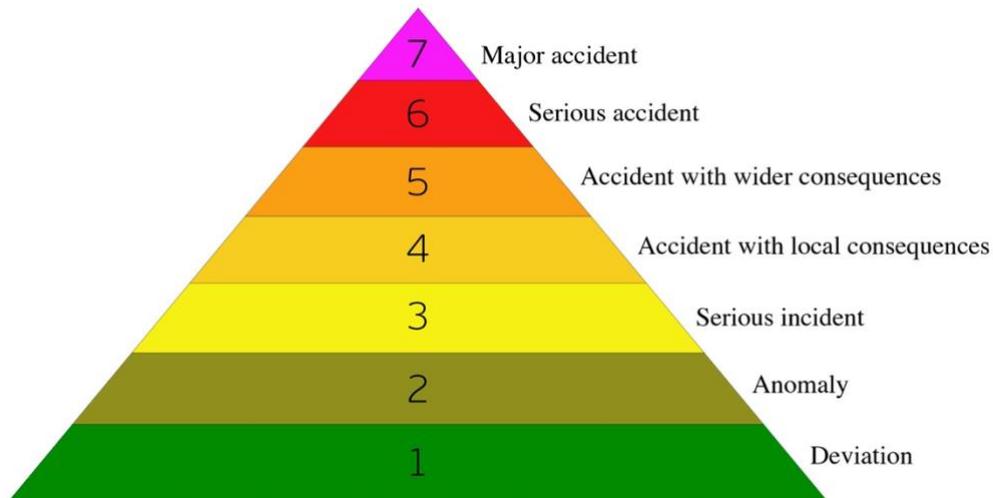
Human activity leads to further temperature increase on the planet, so it's rather possible that there is seismic activity beyond Alaska borders, first of all in the Arctic regions of the planet. Arctic and Antarctic ice melting frees the earth's crust. Greenland is now coming to the surface with 2 cm a year. In one scientific article it was mentioned that this enormous territory keeps low seismic activity due to the weight of ice covering it. But this peace can be disturbed in the nearest decades as glacier melting is accelerating – and the load on fractures lying underneath is decreasing. Seismic activity can increase in all places where active geological fractures are closed by huge ice masses – in Andes, in the South Alps of New Zealand, in Himalayas.

But also distant from glaciers regions can occur in risk zone if we consider how fast sea level will increase. Thus, according to the data for the 5th of December 2013, 82 volcanic eruptions were recorded on the earth. The previous record belongs to 2010 when 82 separate volcanic eruptions were recorded. Noteworthy that in 1990 there were only 55 eruptions and since then there were a constant tendency to volcanic eruption increase with evident activity.

August 19, 2013. French newspaper "Le Monde" published the recent results of research, aimed at the estimation of earthquakes risks in the nearest 50 years. Maps show that strong earthquakes are possible in most parts of Rumania. However, the risk is great in Turkey, Italy, Greece and other Balkan countries.

The earthquake of March, 11 2013 and tsunami strike in Japan destroyed nuclear power station "Fukushima – 1" and became the reason for the worst nuclear disaster after Chornobyl. External power supply means and alternative diesel generators were deactivated, that caused disability of all regular and emergency cooling systems and led to dissolution of active parts of reactors on energy blocks 1, 2 and 3 in the first days of the accident (Barysheva, Artcer, Casati, 2015).

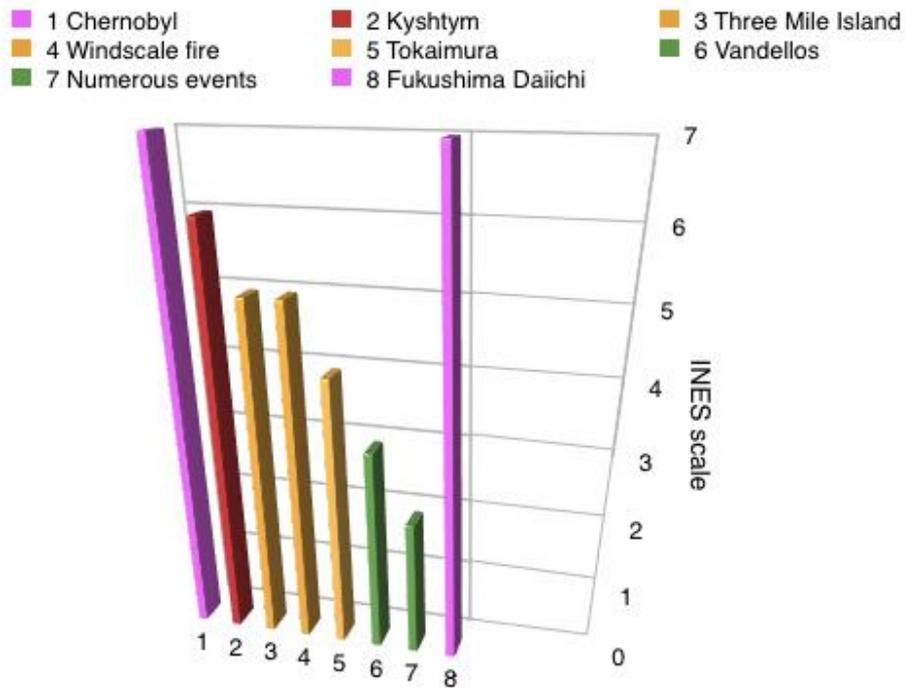
Next conclusions were made by analyzing the process of the accident. It is necessary constantly improve the readiness of NPP's to natural disasters, including the installation of a large number of emergency diesel generators and moving them to higher place or places where there is no danger of damage from a tsunami or other natural disasters specific to the region. Operators of nuclear power plants should check how long the cooling system based on diesel generators is able to work in case of emergency. It is also important constantly conduct rigorous testing of valves for etching pressure of the reactor in terms of the opportunity to operate them in manual mode during a power failure.



**Figure 01.** International Nuclear Event Scale

Experts say that at the time of the accident at the nuclear power plant Fukushima Daiichi the government failed to use the computer system of forecasting, which is designed to track the direction and degree of concentration of radioactive substances. Nuclear engineers know how that system works. However, the members of the government's commission on nuclear accident wasn't qualified enough to use the system in a proper way. Thereby It is important that staff which is familiar with such systems, has to be included into the team of the commission. In 1990 the International Atomic Energy Agency introduced the International Nuclear Event Scale (INES) in order to classify accidents at nuclear power plant by the radiation released into the atmosphere.

On the picture 2 most famous nuclear power plant accidents are shown. They classified according to the International Nuclear Event Scale, which is schematically represented on the picture 1. The biggest nuclear power plant accidents of 20 century are the Chernobyl and the Kyshtym accident. Those accidents were caused mostly by human mistakes and technical or mechanical failure. After those accidents scientists and engineers conducted a great work to significantly improve nuclear power plant protection from that kind of danger. But, as the Fukushima disaster showed, protection systems against natural hazards were not perfect. And now scientific world faced an important task to develop and improve complex protection systems considering human, mechanical and natural factors (Quetier & Lavorel, 2011).



**Figure 02.** International Nuclear Event Scale

After anthropogenic catastrophe Germany announced that it is going to give up using nuclear power stations to 2022. The second European country that said “no” to nuclear energy was Italy.

In France nuclear energy is the national priority and this country is the world leader according to the whole nuclear energy output (the second place according to the established capacity). Russia is on the fourth place in the rating of nuclear power stations at work.

The following situations determine the necessity of research of global climate change on ultra dangerous industries.

## 2. Problem Statement

### 2.1. Economical policy mechanisms for adaptation of ultra dangerous industries to global climate changes

Market economy can operate only in conditions of manufacture and consumption constant growth what inevitably contradicts planet ecosystem.

Last 50 years world population grew four times and stimulated 18-multiple manufacture growth that led to 4-multiple carbon emission volume increase over this period of time – earth atmosphere began to get warmer progressively.

Two largest and growing economies – China and the USA – champions in carbon dioxide emissions produce 8 billion and 6 billion a year accordingly (both countries give 28% of all world emissions). Greater and greater volume of greenhouse gases is produced by developing countries, in

particular India. Up to 2030 28% increase of emissions is forecasted that will result in the growth of carbon dioxide content, which is more than required (Gallopín, 2006).

Understanding and assessment of previously pointed contradictions regarding the role of economic development and consequences of global warming have fundamental importance for the development of effective mechanisms of economic policy to soften the harm from consequences of pointed changes. From the point of view of economic theory, global warming and its consequences should be regarded as external effects (negative externals) which are not taken into consideration by the market. The methods of restriction and reduction of these external effects are well-known in economic science and practice and include wide range of measures for state influence on economic subjects – external effects sources. These measures include social institutes creation, first of all laws and committees which control how the laws are followed, the establishment of market price for externals, administrative and economic mechanisms to reduce and redistribute (pass) connected risks.

At the same time, from the position of the same economic theory, global warming and its influence on economy should be regarded as part of constantly changing natural conditions of economic activity. As these conditions are considered to be objectively unpowered by humans any attempts to influence on climate formation are thought to be inefficient. Rational economic behavior can be only development and application of various mechanisms of economy and society adaptation to naturally changing climate and other environment conditions.

It is conceived that effective economic strategy and policy, which can take into account global warming and its consequences for the world economy, shouldn't go out of opposition of two mentioned concepts. Effective strategy and policy development and realization should methodologically go out of a system approach, which considers risks of climate changes as part of total and integral risk and in comparison to other economic risks.

Climate changes, regardless of reasons, have common for the whole world character. It initially determines mentioned changes and climate itself as common global benefit (or harm, depending on consequences) and limited effectiveness of separate country's efforts to decrease risks of mentioned changes and/or adaptation to the changed climate conditions of economy.

Therefore there is a necessity for the international cooperation of these efforts and mechanism, binding states to take appropriate measures in the frames of such cooperation so that to soften the risks of "no ticket" effect.

One of the most important roles belongs to International Atomic Energy Agency (IAEA), which deals with problems of protections of nuclear power plants from natural disasters. They organize special event such as International Experts Meetings to work and discuss on the problem. On such meeting in September 2012 the problems of protection of nuclear power plants from extreme earthquakes and tsunamis in light of the accident at Fukushima were discussed.

In result of mentioned discussion, experts produced a special document, which contains peculiar algorithm of organization of safety at nuclear power plants. The name of the document is Action Plan on Nuclear Safety, it consists of 12 paragraphs:

1. Safety assessments in the light of the accident at TEPCO's Fukushima Daiichi Nuclear Power Station

2. IAEA peer reviews
3. Emergency preparedness and response
4. National regulatory bodies
5. Operating organizations
6. IAEA Safety Standards
7. International legal framework
8. Member States planning to embark on a nuclear power programme
9. Capacity Building
10. Protection of people and the environment from ionizing radiation
11. Communication and information dissemination
12. Research and development (Foxon, Reed, Stringer, 2009).

The accelerating of climate change paces (first of all temperature regime, but not only), regardless of reasons, in last decades caused considerable changes in economy conditions of different countries and regions of the world and can be followed by even greater changes in the future. It suggests importance and necessity of development and usage of measures package, providing the adaptation of economy to changing climate conditions that in its turn requires qualitative change of institutions and production and technological basis of economy.

Climate changes have from time to time abnormally strong character, having disastrous consequences for the economy and society in the whole. Considering previously mentioned accelerating of climate change paces it means the risk of more frequent hydrometeorological disasters and economic damage connected with them that is confirmed empirically. Therefore there is a necessity to develop defense system and insurance from climate risks and disasters; besides global character of climate changes and their consequences determine international status of mentioned systems.

Risks of climate changes increase because modern forms of economic activity and placement of production factors led and are leading to economic vulnerability strengthening, first of all in urban zones, to natural conditions change (especially extreme character). At the same time the growth and degree of mentioned vulnerability are not the same in different countries and regions of the world and depend on concrete social and cultural conditions of previous way and current track of economic development. This circumstance determines diversity (specificity) of models to reduce climate changes risks and adaptation of national economies to them.

It's important to have theoretical base comprising economic growth, technological transition and reduction of mentioned risks in single strategy in relation to global warming. This strategy should be long-term considering climate changes lag and huge difficulty of the problem. However, such theory is only due to be created but even now it's possible to determine its outlines in the frames of institute and evolution approach. The policy based on it must promote shaping of institute environment and conditions in which technological progress is favorable to the softening of global warming consequences. In evolution approach context it means transition from modern "risk society" to qualitatively another society and knowledge economy which are based on universal values coming out of economical frames and giving the answer to the questions – why do we need economical growth and who needs it. Science and education development must become the integral part of this process, first of all sciences about earth,

progress of which is a necessary condition to reduce uncertainty about some reasons and correlation of global warming factors and correspondingly the process of development and realization of measures reducing climate changes risks including innovation, organization and engineering technologies.

National innovation policy formation is the process of agreement of contradictory interests of various administrative departments that's why the increase of its effectiveness, correct arrangement of procedures of determination and agreement of goals and aims, development of activity plan adequate to aims acquire its own meaning. Requirements on conducting of revision of nuclear power plants operators are presented in the Action Plan on Nuclear Safety in paragraph National Regulatory Bodies. For example, it is necessary to check the effectiveness of department of management, adequacy of human and financial resources, necessity of appropriate technical and scientific support (Bendor, 2009).

Thus, the preferable form of support must be co-financing of those or other projects or stimulation of different activities promoting modernization in the frames of state – private partnership (SPP).

“State – private partnership” – it is public structure aimed at agreement of common activities of different parts in development and realization of socially important pacts on definite period. The basis for suggested structure will be economical factors.

Modern world practice of using SPP shows that French companies are in the group of leaders among foreign companies using in their activity mechanisms of state – private partnership.

According to legal regulation in the frames of EU in France there are “contract” and “institute” forms of SPP. Contract SPP is a concession given to an individual investor (concession for project implementation, facilitation, leasing and other kinds). Institute SPP is a joint venture with participation of some state authority or company, on one hand, and individual investors, on the other hand.

Contract forms of SPP, such as affermages (government property rent), *régieintéressée* (management of government property by private entrepreneur, rewarded depending on results of his or her activity), *bail emphytéotique administratif* (BAE) (long term rent of municipal property), *autorisation d'occupation temporaire* (AOT) and others, regulated by special items in legislation.

Concession forms of agreements have special place in state – private partnership practice in France. Concession agreements underwent considerable changes during the last 20 years, first of all, state financial commitment increased. Because of that concession mechanisms are now more often used in large – scale infrastructural projects, especially in transport sector and in power industry (Galieger Barysheva, Artser, 2013).

Power engineering sector in France was and remains one of the biggest private investments recipients, in the frames of partnership between state and private sectors, and also projects financed by donors. Investment volumes necessary for creation of large generating capacity are too high for most of private companies even for the largest and stable private companies of power engineering sector. As a result, with the growth of national treasury expenses and debt level increase the building of such projects is becoming too expensive even for state sector. Project financing suggests a good way of means mobilization to create infrastructure for energy output and transmission, which doesn't burden budgets of private companies and state.

The strongest positions in French economy SPP has in the sphere of auto-road, public health, community facilities, power engineering.

SPP projects turned out to be especially successful in the sphere of new generating capacity creation. Projects for electricity output are large and very expensive and that's why it's good that they are in project financing structure. Usually such projects are linked with creation of totally new assets, which must be separate, isolated projects suitable for credit supply and giving independent income flow.

In France SPP linked with passing and distributing projects in power engineering sector are met rarely. Electricity passing and distributing is harder to insert into SPP model unlike generating capacity creation. One exception in this case is building long electricity lines or internet units.

Mechanism of state – private partnership is widely used by companies AREVA and EDF for building nuclear power stations on the territory of France and abroad. The peculiarity of nuclear power station projects is possibility to organize changeable financing structure at different stages. It gives financial flexibility, possibility to refinance the debt taken and transition on more effective financing in long-term perspective. On the basis of international experience we can single out several model types of mixed financing: the model of big energy recipient, the model of “tied investor”, the model of power companies union, the model of regional union.

The example of successful realization of big energy recipient model is the project of French energy company EDF on building the third block of nuclear power station “Flamanville”. This project was carried out with state direct support using technologies of AREVA company and joint-stock participation of large energy recipients' consortium Exeltium. This consortium was comprised of the following companies: Air Liquide, Alcan, Arcelor, Arkema, Rhodia and Solvay. EDF made with these companies long-term agreements on electricity selling. The building of nuclear power station with the cost of 6 billion Euros began in 2007 and launching is planned in 2014.

There is another example of SPP realization by French company AREVA – building block № 3 of nuclear power station “Olkiluoto” in Finland. AREVA Group got a contract on building this block in December 2003. It was the first contract on building power block for created in 2001 group and also the first contract on building block with reactor EPR-1600. This project also belongs to the model of big energy recipient and a variety of mixed financing, where supplier or group of suppliers acting in a form of consortium has to build nuclear power station for a fixed price. Members of consortium return their expenses with the profit in the process of station building but investor – owner of nuclear power station covers his expenses in the process of power block operation. As a result of constant changing of the date of delivery in operation of “Olkiluoto” and payment of forfeit by AREVA the cost of project increased in different assessments from 6,6 to 10 billion dollars (Gallopín, 2006).

In the frames of this project a number of large energy companies through joint venture TVO invested building and operation of new nuclear power station aiming to return financed means by getting electricity (first of all for their own necessities and by selling surplus on electricity market). “Olkiluoto” project is financed by its own means in the form of corporate credits received by shareholders with the support of French state export-credit agency COFACE. Such support became possible because building of nuclear power station is carried out by consortium AREVA.

SPP has certain advantages in relation to standard forms of infrastructural and project financing of nuclear power station building as it provides distribution of risks between partners of state and private sectors.

Hence, SPP agreements may be used as additional leverage for main projects of energy transnational company of France aimed at realization of common targets in the spheres of state activity linked with energy conservation, energy and ecology effectiveness.

In actively developing Russian economy with the growth of society needs the lack of possibilities of state financing is perceived, at the same time there are large investment projects which can't be realized only by means of market mechanisms because of their scale and social importance. It is connected with the sphere of national safety, fuel – energy industry, transport infrastructure and community facilities. Therefore, it is necessary to look at the experience of France to realize large scale projects in the sphere of power industry and in particular in building of energy block №4 Kalininskaya nuclear power station, centre of nuclear medicine of Siberian nuclear power station in Seversk Tomsk region.

## **2.2. Innovational social partnership – the tool to adapt ultra dangerous industries to global climate changes**

All projects on building of ultra dangerous industries suggest the distribution of financial risks however today it's necessary to adapt building to dangerous climate changes. This strategy essentially differs from traditional adoption of technologies and determines its place and role as organic part of process forming national innovation system. It is also predetermined that state should take active part to stimulate (price, taxes, etc.) corporate research and preproduction development (RPD) and financing together with RPD business in the frames of innovational social partnership.

Innovational social partnership is a mobilization of state resources, business, research institutions and society sector to build “green economy”.

“Green” economy is an economical activity which increase human wellbeing and provides social justice and at the same time decreases risks for environment and nature impoverishment (Odero, 2008).

Important features of such economy are: effective usage of natural resources; preservation and extension of natural fund; diminution of pollution; low carbon emissions; prevention of ecosystems and biological variety loss; the growth of profits and employment. Green economy should fight with global climate changes and keep perspective direction of exit out of financial and economic crises. The preferable feature of its growth is radical increase of energy effectiveness. That's why it is called “low-carbon” economy. The concept of green economy doesn't replace the concept of stable development. However, it is now admitted that achievement of stability depends on economy ecologization a lot. It is suggested to mobilize and rebuild global economy increasing investments in clean technologies and “natural” infrastructure, to stimulate economy ecologization, to avoid disastrous consequences of global climate change.

The subjects of innovational and social partnership system are state, business, non-profit organizations and science.

Innovational necessities of society are revealed and recorded by non-profit organizations. Non-profit sector is able to respond to the needs of different socio-demographic groups promptly. It also responds to social problems and administrative expenses and can attract volunteers. Non-profit organizations' activities help to reveal ecological problems and control realization of activities effective for resources.

Non-profit sector is the source of social innovations. Many ecology, management and information technologies, modern methods of social work were firstly introduced by non-profit organizations and then became part of state and municipal policy.

Business together with science takes order on innovations, research and preproduction development carries out and gets innovational product. Science activity is the main source of innovations and the key factor of innovational growth. Dynamics of industrial production, the growth of its concentration made research scales wider and increased the number of people employed in this sphere. However, science only creates knowledge. For full-fledged innovational development we need certain prerequisites which form conditions for their spreading and turning into final economical benefits, promotion of innovational products and services on internal and external markets. This thesis returns us again to the problem of creation of developed system of relations.

State provides business with innovational financial tools, orders innovations from scientific institutions and monitors the effectiveness of non-profit organizations activities.

As a result of mutual work there will be a project responding the criteria of resources, effectiveness, energy safety, budget effectiveness and ecological safety.

The construction and control systems of nuclear power plant must be able to face unanticipated external natural disasters, for example, earthquake, flooding and unexpected external events, which were not taken into account during the period of original designing.

External hazard safety cases corresponding to an exceedance probability of not more than  $10^{-4}$  per year should be used for earthquakes as well as for flooding. For all sites in Europe, the Design Basis Earthquake should correspond to a peak ground acceleration of not less than 0.1 g. (Foxon, Reed, Stringer, 2009).

Seismic monitoring systems should be installed and associated procedures and training developed for those NPPs that currently do not have such systems. On-site seismic instrumentation should be in operation at each NPP. A study to investigate the overall cost- benefit and usefulness of automatic reactor shutdown induced by seismic instrumentation is recommended.

As a good practice, the use of a “hardened core” of safety-related systems, structures and components capable of withstanding earthquakes and flooding significantly beyond design basis should be considered.

For example in Russia the systems of seismic monitoring and remote notice defense of reactor plant are being developed. It will give the signal to activate reactor emergency protection system in the case of seismic impact. Such new earthquake defense systems will be located around Russian nuclear plants at 10 km distance. The main idea is that in the case of seismic danger the system will give the signal to activate defense and reactor shutdown before tremor reached the station. When seismic activity will reach the nuclear power station it can cause damage or fault in control and defense systems more over managing bars, but it won't influence ecological situation in the region. By that time the reactor will be shut down by new system.

The partnership of state, business, science and non-profit organizations will also activate limitation and adaptation mechanisms. Parts will be interested in decreasing of environment pollution and will have an opportunity to prevent the consequences of ecological damage.

With mutual interest of state, business, non-profit organizations and scientific institutes it will be possible to equip all nuclear power stations with analogue systems to prevent anthropogenic disasters.

### **3. Research Questions**

1. Study and analysis of the theoretical and scientific and practical literature on the subject of the study;
2. decomposition of the notion of "global climate changes" into its components;
3. consideration of problems of global climate changes from the perspective of the social responsibility of a state and businesses.

### **4. Purpose of the Study**

The purpose of the study is to analyze the state and business partnership as an adaptation instrument of ultra dangerous industries towards global climate changes

### **5. Research Methods**

As main methods of research are systemic and interdisciplinary approaches, comparative, statistical and empirical analysis. The application of these methods allows us to analyze the essence of the object of study, to identify the relationship of the global climate change with other spheres of society

### **6. Findings**

In the process of research we got the following deductions.

1. Global warming is a kind of negative externals not taken into account by market. There is a wide spectrum of methods to limit the existing external effects: laws, the establishment of market price, financial instruments.

2. Global warming is a part of constantly changing natural conditions of economical activity. That's why it's necessary to work out methods to adapt business to this situation.

3. Effective economical strategy supposes that limitation and adaptation measures will give synergetic effect.

4. Today the agreement of state and business interests is achieved in the frames of state – private partnership which is seen from France experience in building and modernization of nuclear power engineering. However, for precise adaptation behavior it is necessary to attract scientific institutions and non-profit organizations.

5. The author suggests the mechanism of social innovation partnership which allows summing up the managing resource of state, production resource of business, adaptation resource of science and control resource of non-profit organizations.

6. With constant danger of natural disasters and their influence on ultra dangerous industries the suggested system has the possibility for state to order research and reproduction development from scientific institutions in the sphere of ecological defense. With corresponding financing business can

implement research and preproduction development in production and non-profit organizations can monitor the effectiveness of innovation project and its influence on anthropogenic disasters prevention.

## 7. Conclusion

This article shows that global climate change is one of the largest risks for the world society. The researchers note that global warming provokes hurricanes, tsunami, earthquakes that negatively influence ultra dangerous industries. In the article, in particular, there is an example of anthropogenic disaster at “Fukushima – 1” in Japan. It was the first big accident caused by external factor – earthquake and tsunami. It became the main reason of necessity to review the safety systems at nuclear power plant, aimed to find vulnerabilities to natural hazards. There has been a misconception since the early days of nuclear power that human error or mechanical failure, in other words risk factors within the plant itself, are the most significant variables regarding possible radiological release to the environment. In fact, the greatest threat to a plant’s operation may lie outside its walls. As France and Russia are in the top of the rating on nuclear power stations usage and exposed to global warming influence it determined the importance to conduct analysis of choosing tools for adaptation of ultra dangerous industries to global climate changes.

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