Recovering Production and Energy Potential of Hazardous Production Facilities After Natural and Industrial Disasters and Catastrophes

A. M. Platonov, V. A. Larionova, and S. V. Polovnev

1 Introduction

When natural and industrial disasters and catastrophes happen, first of all, there occurs a dramatic transformation of different energetically saturated flows (electric, chemical, nuclear, bacteriological ones, etc.) with an instant loss of flexibility control of their energy in space, in time and as per the territories.

The most dangerous risk situations (RS) for the enterprises that are connected with the control of energetically concentrated flows may occur and quite often do occur at the hazardous industrial facilities (HIF), extremely hazardous industrial facilities (EHIF) and facilities, critically important for the territories (CIF) (i.e. dams, pipelines, water-storage ponds, etc.) [1–6].

It is necessary that businesses, state and society be ready to conduct emergency recovery operations in the shortest possible time and with minimum expense and to recover the production and energy potential of enterprises.

In case of emergency, the life cycles of enterprises being created and operated (Fig. 1) break and continue again along the line 3–4–5–6, describing destruction (3–4) and recovery (4–5–6) processes for the enterprises and their production and energy potentials.

Risk cannot be managed, but the damage from the effects of the RS in the sphere of managing significant volumes of energy at HIF, EHIF and CIF facilities can be considerably reduced due to preparing special design, construction, and reconstruction investment projects being implemented under extreme conditions after the occurrence of natural and industrial disasters and catastrophes [7–10].

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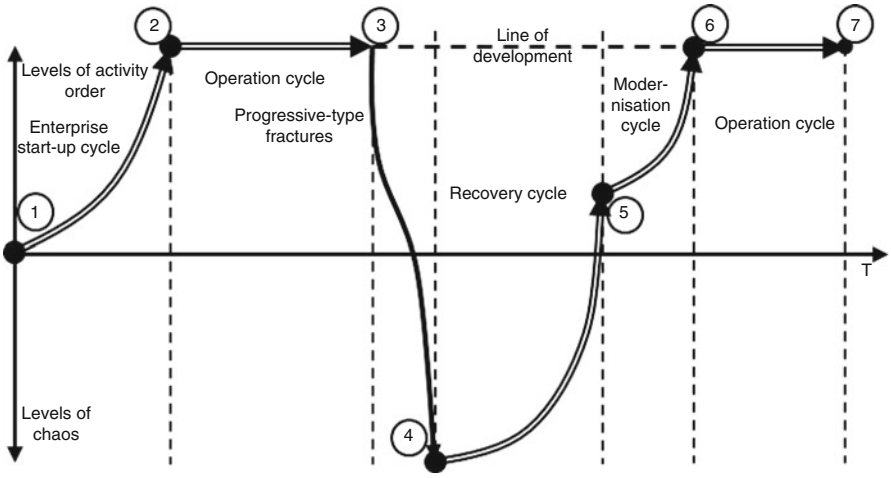

Fig. 1 Change in the life cycles of the enterprises (HIF, EHIF and CIF) before and after natural and industrial disasters and catastrophes, line 1–2–3–6–7 shows the anticipated life cycle of the enterprises; line 1–2–3–4–5–6–7 demonstrates the anticipated life cycle of the enterprises with the account of natural and industrial disasters and catastrophes; and the points 3–4–5–6 represent a "triangle" of conducting emergency recovery operations and repairing the enterprises after natural and industrial disasters and catastrophes

These projects, which must be developed in advance, allow you to reduce the costs of design, construction and recovery operations, to recreate production and energy potential of the enterprises as soon as possible and to return them into the financial-economic and industrial-technological sphere of the country's economy.

2 Modern Realities as the Basis for Production and Distribution of Natural and Industrial Risks, Threats and Hazards

Today, mankind is living, creating and developing in realities that are constantly changing – in the physical reality, and in the reality, created by centuries of human activity, which is in the energetically saturated noosphere [11].

The constantly changing economic and global political realities are, respectively, the third and the fourth realities, also designed by mankind.

Today, the processes of mutual interaction between the aforementioned realities of the external environment take place against the background of the fifth reality implying the dynamic change of mankind's development phases from the ideology of "modernity" to other stages, i.e. "counter-modernity" and "post-modernity" [12].

All the realities described above are in constant motion, interacting, crossing and mutually influencing each other, and in their negative synergy form a united,

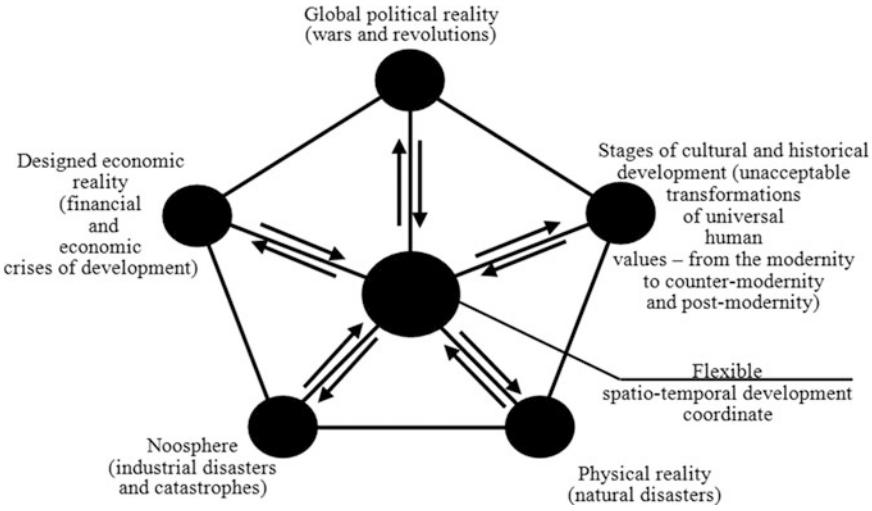

Fig. 2 Flexible spatio-temporal development coordinate in the system of real and critical risks, threats and hazards

temporal and endlessly dynamic "development coordinate" of mankind, ethnicities and states, regions, cities and enterprises (Fig. 2).

Thus, mankind faces not a blissful future, but a future with qualitatively different development risks, more severe than before.

Here, the risks of loss of control over production and energy potential of HIF, EHIF and CIF facilities under the conditions of mutual influence of critical realities remain the highest, and their effects are the most devastating at all stages of transformation of the energy potential of production facilities – from extraction, preparation and utilisation up to energy saving and recycling (Fig. 3).

Here the possibility of integrated influence of the aforementioned realities on the processes of human development and enhancement of negative synergistic devastating effects cannot be doubted.

Only a systematic approach to predicting possible serious disasters and their consequences at HIF, EHIF and CIF facilities (based on statistics and their own experience) can be a response to the given challenges [7–9].

The next step for further development of this approach is the development of respective investment and construction (extreme) projects on recovering the destroyed production and energy potentials, facilities and infrastructure of enterprises [10–15].

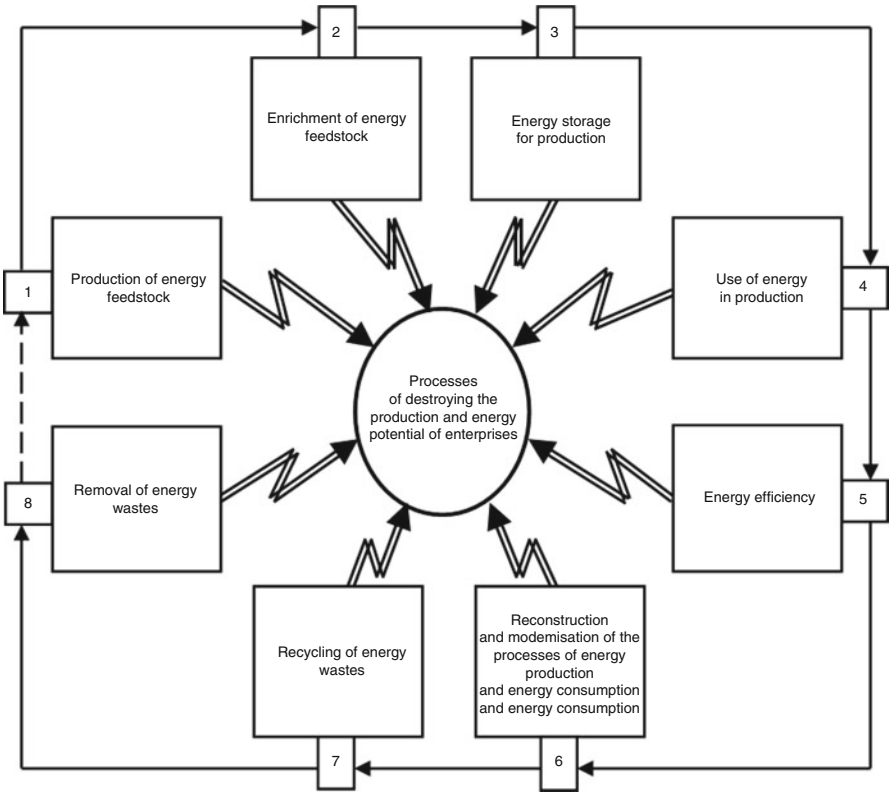

Fig. 3 Energy potential transformation processes as per technological stages of production and utilisation and energy saving, recycling and elimination of energy

3 Setting Up Extreme Projects of Recovering Production and Energy Potential of Enterprises

The practice-oriented algorithm of setting up investment and construction (extreme) projects on recovering production and energy potential of enterprises starts with the determination of the hazard levels of their plants, industrial sites and particular territories depending on volume and power of energy and on the size of possible damages (green, yellow, orange and red levels) and ends with the compilation of the respective maps of hazards (risks).

The conducted analysis allows to define the places of energy concentration that are the most dangerous in terms of emergency occurrence.

The system of hazard (risks) maps on predicting disasters and catastrophes at the potentially hazardous facilities is created on this basis.

Three possible contradictions between the level of threats and the measures being developed can occur when conducting emergency recovery operations at the

enterprises and recovering their production and energy potential. In particular, these contradictions can occur between the existing potential of managing the enterprises and the strategy of conducting emergency recovery operations, between the threats of disasters and catastrophes and the level of strategies for conducting emergency recovery operations and repairing the enterprises, as well as between the system of objectives of conducting emergency recovery operations and repairing the enterprises and a set of traditional and extreme investment and construction projects for conducting emergency recovery operations and repairing the enterprises.

On the whole, a practice-oriented design approach to the arrangement and functioning of the extreme recovery system of the enterprises' production and energy potential after emergencies should involve management of content and time of implementation, cost, resources, quality, risks, contracts and interactions among those participating in the implementation of the extreme project under the emergency conditions.

The experience of scheduled reconstruction of the enterprise's facilities shows that the proportion of preparatory period operations reaches 15–30% of its complete cost. It is obvious that the reconstruction of the destroyed facilities and infrastructure of the enterprises after emergencies will require much greater efforts for carrying out preparatory operations. In the absence of statistical data, those works can be estimated within 30–50%.

Success can be achieved by means of timely preparation for carrying out design, construction and recovery operations.

Such kind of preparation involves authorities' and facilities' timely preparation of recovery sets of design documentation on developing extreme projects and establishing appropriate groups and departments for carrying out design, construction and recovery operations, preparation of the enterprises belonging to municipal facilities and construction sector for carrying out recovery operations and creation of the necessary bank of material and technical resources.

The design documentation package for the development of the extreme project on carrying out design, construction and reconstruction operations in conducting emergency recovery operations after disasters and catastrophes at the facilities of the enterprises should involve predictions of possible destruction of buildings, structures, equipment and process lines; possible options for conducting recovery operations at the facilities; resources necessary for carrying out recovery operations; possible schemes to provide power, transportation and means of communication for the recovery operations at the facilities; sources to provide materials, labour, tools and equipment for the recovery operations; volumes and sources of getting the required assistance and the procedure of interaction between the participants of recovery operations; and schemes of notifying managers and systems of managing recovery operations at the facilities.

In addition, the timely prepared set of project documentation for repairing the enterprise should include:

- Explanatory note containing general layouts of the facilities and their compositional justification; space planning and constructive solutions for the main

buildings and structures; data on the design capacity of the facilities (number of working shifts, daily schedule, etc.); main technological solutions; solutions on providing the facilities with engineering networks, communications and engineering equipment; and fire prevention measures and engineering and technical measures for Civil Defense and Emergency Situation Management at the facility
- Situational plan, showing building lines; site borders; sanitary protection zones; names of streets and driveways; existing and planned buildings and structures, including the adjacent areas; numbers of buildings (structures); explanation of buildings; and their number of floors
- Technological plans with the layout of large and unique equipment, transportation facilities at the areas and layout of all basic technological equipment
- Utility flow diagrams and existing and planned communication lines

The main requirement for the organisation of design, construction and recovery operations at the facilities after natural and industrial disasters and catastrophes is to provide for the minimum time limits for carrying out such operations, with the account of limited resources.

In general, the organisational and economic mechanism of an extreme investment and construction project is a form of cooperation between the project participants that is fixed in the project materials and in the regulations on conducting emergency recovery operations and repairing the enterprises in order to ensure the implementability of the project within the shortest possible time, to provide for the required level of quality and the possibility to measure the costs and results of each participant involved in the implementation of this project.

Organisational and economic mechanism of implementing nontraditional (extreme) investment and construction projects, when conducting emergency recovery operations at the hazardous industrial facilities, also includes:

- Obligations imposed on the participants of nontraditional (extreme) investment and construction project and taken upon by them for carrying out joint actions on carrying out emergency recovery operations and repairing of the enterprises, as well as guarantees of such obligations and sanctions for their violation
- Emergency procedure for financing the project with the aim of implementing it within the limits of the allocated funds in the shortest possible time and with the specified quality of the works performed
- Special conditions of production turnover and resources turnover among the participants of nontraditional (extreme) investment and construction projects (barter, preferential prices for mutual settlements, provision of commodity loans, compensation-free transfer of fixed assets on a permanent or temporary basis, etc.)
- Necessary synchronisation of the activities of individual participants and timely adjustment of their further actions in order to successfully complete the project as soon as possible
- Measures for the mutual financial, organisational and other support of the participants of the investment and construction project under the emergency conditions and under the conditions of extreme shortage of time (providing temporary

financial assistance, loans, payment delays, etc.), including measures of state support
- Measures of the state (or the third party) compensation of the expenses incurred by the participants of the investment and construction project while conducting emergency recovery operations and repairing the enterprises

For the successful implementation of the measures described above, it is necessary that a change in the engineering legislation be made and the concurrent design of the process of repairing plants, industrial sites and infrastructure, subject to potential threats of being destroyed, be introduced (at the cost of the customer or the state) into the practice of designing HIF, EHIF and CIF facilities.

4 Conclusion

Unlike the traditional management of investment and construction projects, the management of extreme projects on recovering production and energy potential of the enterprises after natural and industrial disasters and catastrophes has its own peculiarities both in terms of the pace of their implementation and in terms of quality and cost of operations.

The given extreme projects are, first of all, characterised by the unpredictability of the time and place of emergency situations and, consequently, by the urgent need for recovery operations.

Therefore, timely developments of extreme recovery projects on recovering the enterprises, destroyed by natural and industrial disasters, are today vitally necessary in order to ensure the necessary level of the society's readiness to deal with risks and threats of destruction of production and energy potential of HIF, EHIF and CIF facilities.

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