DECISION SUPPORT SYSTEM IN VARIOUS EMERGENCY CASES

Eugene D. Vyazilov, Alexander A. Bashlykov
All — Russian Research Institute of Hydrometeorological Information — World Data Centre, Russia, Obninsk

ABSTRACT

The problems and difficulties are considered regarding the use of information on the state of natural environment under decision-making. A research variant of DSS is given. There are possibilities of introducing mathematical models in the system for specifying impacts, recommendations and also graphical means of information display, which enable one to envision the given situation more illustratively. It is proposed that this system should be used in disaster situations and various types of emergencies. The mechanism available in the system makes it possible to use within one environment the sub-system of most various orientation (flood, environmental pollution, et al.).

1. INTRODUCTION

Efficiency increase of the use of information on emergency cases is already impossible without automatization and making information promptly available to the heads for decision-making. Throughout implementation of PC computers enables decision maker to regularly apply computers in making a choice and underlying grounds for taking measures. The best known way of organizing an assistance to decision-maker at present is Decision Support System (DSS).

An account of Emergency cases at mills is an important part of the work of managers (decision-makers), especially in such fields as, ecological disasters, fires, etc. A number of mills which are affected by Emergency cases and their diversity as to the importance and the needed information type (current, forecasting, climatic and past weather) require not only general recommendations but quite specific indices of Emergency effects on plants as well as specific recommendations for mitigation or prevention of these effects.

2. DSS FOR EMERGENCY CASES

With a view to computerizing the preparation of decision, classification of impacts on industry objects and actions on their decreasing and preventing it is proposed to develop the decision support system to produce recommendations under different values of environmental parameters.

The following consideration is underlying in the approach to the creation of DSS. With criteria of emergency cases known before, it is possible to determine the list of impacts on objects of industry and population. Having determined the impacts it is also possible to work out recommendations for decreasing or preventing these impacts.

For creating the system the «shell» of the expert system SPRINT originally developed in Russia is used. SPRINT enables creating simultaneously to about 250 diversely oriented subsystems. DSS for

supporting the merchant marine ships and ecology can be given as examples.

The major principle in developing a DSS has been combining processes of creating message (effect) bases, bases of recommendations and knowledge as stages of individual process which gives the possibility of very quick debugging of the knowledge base. Associations between the values of the environment parameters and the messages are established in the form of logical conditions «if..., then...». To decrease the volume of the knowledge base and the time for preparing data on diskette the key words «if, then» are omitted.

The form of knowledge presentation, reflecting the impact of hydrometeorological phenomena on drilling rig is given below:

a1a (wind)10,a1c,a1b
a1b 1,11
a1c (ice)3,a1e,a1d
a1d 2
a1e (ice)3,a1g,a1f
a1f (temperature),a1g,a1l
a1g (waves)5,a1k,a1h
a1h 4
a1k 15
a1l 3,7

A fragment of the message is given below :

1. Drift of vast ice fields consisting of large broken pieces of ice of different continuity.

2. Separate sets of ice formations emerge (icebreccia, ice floes of old ice fields).

3. Accumulation of broken ice get frozen as one unified field.

4. An intensive splash generating is observed. Urgent measures on drilling stoppage can hardly be taken.

5. Frazil and grease ice as well as snowsticking is observed on the construction.

6. Drill rig construction becomes covered with ice.

7. A space between drill pipe strings and floating hulls is blocked up with ice floes.

8. The repeated bumping of ice against the drilling rig is observed.

9. The construction of a drilling rig is subject to the ice dynamic attack.

10. The rig becomes icebounded.

11. The rig is moved along with ice.

12. The rig vibration develops. A danger of resonance emergence can take place.

The respective recommendations have the following form :

1. To carry out operations to move from the point.

2. To choose the way of transportation.

3. To determine the number and location of towing vessels.

4. To keep unmoored floating submerged drilling rigs in the drifting ice.

5. To choose the way of eliminating an emergency.

6. To provide a crew with efficient rescue facilities.

7. To prevent an oil spreading.

8. To tow the torn off drilling rig.

9. To evacuate a crew.

The list of impacts and recommendations may be continued and changed during the creation and development of the system.

There is a specific list of messages for each current, forecast, climatic or past weather value of the environment parameters. The set of messages is also different for different management levels. The list of messages also depends on the type of measures (tactical, strategic, current) to be taken, the season of the year and the objective. A specific recommendation corresponds to each message.

Basing on the created subsystems one can develop trainer to explain the rules of behaviour to students and leaders in cases when natural environment changes. The idea which lays behind is the following. Under DSS development the proper data and knowledge bases are created which include information on impact of natural environment on man, medium and plants as well as recommendations for decision - making to decrease or prevent this impact. After the diagnosis is made the user gets the lists enumerating all impacts and recommendations which correspond to the given conditions. Including additional records, containing wrong messages and recommendations in the above lists, the system makes the «pupil» to choose right recommendations. The chosen messages and recommendations are properly estimated. The objective pursued under development of such trainer is creation of data and knowledge bases for various emergencies.

The advantage of such an approach is the fact that data and knowledge bases are developed first for DSS and then already applied for trainers. As DSS develops for emergency cases the trainers should also be improved.

DSS must interact both with acquisition systems (for obtaining current information on the state of nature) and the data banks «orecast» (obtaining prognostic information) and «Climate» (obtaining climatic information).

In addition to semantic description (what is going on and what should be done on the object) DSS has possibilities to specify the impacts and recommendations at the registration of utilizing the specific characteristics of the object. Some proper mathematical models (economical, optimizing, etc.) are applied with the above in mind. The list of the models which have been realized using PC is rather large. Many of them can be included in DSS without being modified.

DSS enables one to utilize these models both as own computer means on the level of communication systems and being included in DSS after specifying the impacts on the object, population and recommendations with reference to the specific characteristics of plant.

Due to the fact that, the volume of the semantic description of situations is rather large sometimes, a part of reference information (terms, detailed information and/or recommendations, etc.) may be localized in corresponding files, which would be called on DSS demand only.

Graphic presentation of information about object, technological processes, environmental area, etc., would be useful information. Consequently cartographic information must be included in DSS.

The system SPRINT makes it possible to produce simultaneously up to 1000 subsystems of different orientation, scattered over seven subject areas. Such a system can be elaborated for administration of the towns, heads of large enterprises situated in the regions subject to natural disasters.

DSS plays the role of advisor in decision-making using information on the state of

natural environment, it makes more complete and qualitative the produced recommendations for accounting the impacts on objects. This system will help decision-makers and leaders of the enterprises to make plans of measures before, during and after the disaster occurred.

At present above 50 subsystems are at various stage of their realization. The following systems are most complete:

Vessel —allows the captain and navigator to get recommendations for decision-making in different hydrometeorological conditions.

Flood —is designed for determining the impacts of flood on population and industry objects, situated in the flooded area, and producing recommendations for taking preventive measures.

Ecology — allows to determine the impact of natural environment on population and produce recommendations for decreasing this impact.

DSS is designed for wider application, hence it is possible to develop additionally subsystems for making consultative assistance to the leaders (e.g. in case of emergencies and disasters, etc.) when creating the specific variants of the system to order. This variant of the system is presented more with details in the article, Vyazilov (1991).

3. CONCLUSION

DSS will be of great help in making the plans of actions on accounting hydrometeorological conditions. DSS can be relied upon, if it is necessary to:

— develop long — term plan of actions on accounting hydrometeorological phenomena and other emergencies;

— work in environmental conditions and far from scientific centers;

— assess to the full extent safety measures taken against disasters;

— organize teaching of leaders to safety measures to prevent losses from hydrometeorological phenomena;

— work out plan of actions for considering current, prognostic and climatic values of hydrometeoparameters.

4. REFERENCES

1. Vyazilov Eu.D.,Bashlykov A.A.,Kislov G.I. 1991: Decision support system in rendering recommendations assistance in case of natural hydrometeorological disasters.– Safety problems in cases of emergency.– Issue 7.– P. 16-34.