UNIQUE TECHNOLOGY DEVELOPED BY UKRAINIAN SCIENTISTS FOR ELIMINATION OF UNDERWATER ACCIDENTS IN OIL AND GAS PIPELINES

On the 3rd of December 2010 the E.O. Paton Electric Welding Institute of the NAS of Ukraine presented a revolutionary development made by the Ukrainian scientists: technology and facilities for prevention of disasters, such as that occurred in April 2010 in the Gulf of Mexico. The presentation was attended by representatives of the scientific community from a number of institutes of the NAS of Ukraine, the Chamber of Industry and Commerce of Ukraine, associates of embassies, and mass media. Representatives from the Administration of the President of Ukraine, ministries, agencies, L.K. Kadenyuk — pilot-cosmonaut of Ukraine, as well as representatives from oil-producing companies «Chevron», «Conoco Phillips», «Exxon Mobil», «Royal Dutch-Shell» and «British Petroleum» were also invited.

The presentation was opened by Prof. B.E. Paton. He evaluated the disaster that took place near the U.S. coast as the most large-scale one in the history based on the consequences for the environment — over a million of barrels of oil in water, pollution of the coast of four American states, losses of the «British Petroleum» Company and U.S. Government worth of billions, and contamination with oil followed by contamination with chemicals used to eliminate oil.

The oil and gas production technologies have been improved during the last thirty years. However, the methods for controlling the accident consequences have remained unchanged. Therefore, the tragedy in the Gulf of Mexico may recur in other countries as well. At the same time, people will not stop extracting hydrocarbons, as the demand for them will grow by 15–20 %, according to forecasts for the next ten years.

The disaster forced the world leading countries to take the unprecedented measures aimed at developing new approaches to prevent accidents in production of hydrocarbons in offshore areas. Leaders of the G-20 countries gave special consideration to this issue at the summit in Toronto, which was reflected in the statement of this summit. The European countries having territorial waters decided to revise the rules for companies involved in oil and gas production in their shelves. Reaction of the Russian Government to the accident in the Gulf of Mexico did not to take long to appear either. It repeated in many ways approaches of the American Side. One month after the accident in the Gulf of Mexico the Russian President charged the Government with working out of the «Protection of Russian Seas from Oil Contamination» Law, which had to regulate obligations and responsibilities of the producing companies in case of oil contamination of the Russian shelf.

In Ukraine, the oil and gas deposits in the Black Sea shelf have been exploited since the Soviet times, and now it is planned to explore new deposits. Moreover, there are huge deposits of noxious and explosive hydrogen sulfide gas in the Black Sea at a depth of more than 50 m. If a high pressure pipe fails at the bottom, it would cause an irreversible damage to the coats. N.Ya. Azarov, the Prime Minister of Ukraine, noted in this connection that «…after the catastrophe in the Gulf of Mexico, I have a question of the price. If such an accident had occurred in the Crimea, we would have lost not only the Peninsular, but also the entire Black Sea coats, starting from the border with Moldova and ending with the Taman. We have to think over this price very seriously».

The accident at the Deepwater Horizon forced the Caspian states to look in a new way at their plans to increase the volumes of extraction of hydrocarbons from the Caspian Sea deposits and their transportation to external markets by using tanker fleets.

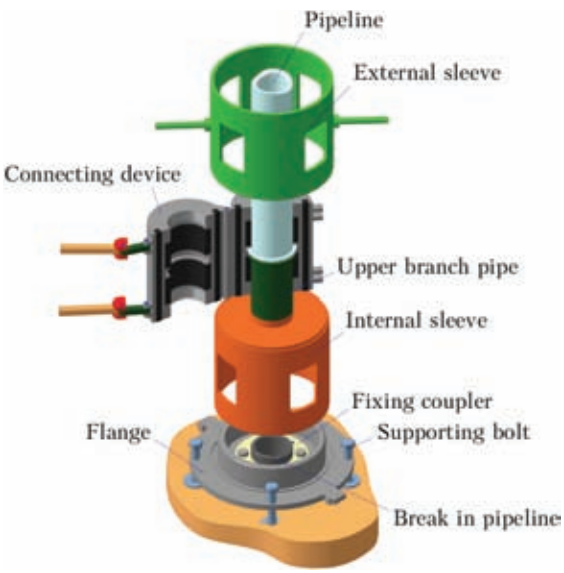
Turkey's Energy Minister Taner Yildiz pointed to the necessity to take the urgent measures to protect the Black Sea from catastrophes and accidents related to extraction and transportation of hydrocarbons. Turkish authorities are considering different tools to minimise threats of such events.

Address made by Prof. B.E. Paton

Turkey declared its intension to establish the foundation for protection of the Black Sea ducts. It is expected that foreign companies will take part in its formation. Contributions to the foundation can exceed 30 Billions of U.S. Dollars. This issue was discussed at the International Conference in Istanbul with representatives of twenty world-leading companies, including from Russia and Kazakhstan. The administrative decisions were followed by the technological ones. Four world oil companies — Exxon Mobil, Conocco Phillips, Chevron (USA) and Royal Dutch-Shell (British-Dutch Company) — decided to set up the system for elimination of oil spills in exploration of deepwater regions.

Ukraine is consistently pursuing a policy of ensuring international environmental safety. It supports initiatives of governmental and non-governmental organizations on prevention of accidents and ecological disasters related to extraction of hydrocarbons as the most hazardous material for the present and future of the mankind, being very active in development efforts in this sphere. Our state approached the international community with a proposal to unite and intensify efforts in addressing this problem, which is one of the most serious threats to the international safety. In his speech at the UN General Assembly Meeting in September 2010, the President of Ukraine declared a number of proposals of Ukraine in the sphere of international security.

Considering the necessity to guarantee safety in arrangement of extraction of hydrocarbons in the Black Sea shelf, as well as participation of our country in international projects, the Government of Ukraine entrusted the National Academy of Sciences of Ukraine, together with the High-Technology Education and Research Centre of the National Defence University of Ukraine, to develop technologies for prevention or, in the case of occurrence, elimination of such accidents in the shortest possible time with minimal consequences for the environment.



Model of the emergency module

Authors of the development answer questions from reporters

The scientists of Ukraine found the answer to the question how accidents in the coastal shelves can be quickly and efficiently eliminated. Prof. B.E. Paton noted at the presentation: «We made the development… and suggest that Ukraine should add it to its arsenal for off-shore oil production and for application abroad. The Ukrainian technology is fundamentally new. It allows solving one of the most important problems of protection of the environment».

The team of the authors proved to be surprisingly harmonious and mutually complementary. As in a well-organised crew, everybody played his role. Boris Paton, Director of the E.O. Paton Electric Welding Institute and President of the National Academy of Sciences of Ukraine, managed performance of the team like an orchestra conductor, introducing elements of his wisdom, experience and intelligence to every part of the development. Colonel Yu.G. Danik, Head of the High-Technology Education and Research Centre of the National Defence University of Ukraine, together with Prof. B.E. Paton generated ideas, principles and variants of their realisation. These ideas were inventively picked up and practically implemented in design documents and working models by V.I. Stepakhno, Doctor of Physical-Mathematical Sciences, Chairman of the Board of Directors of the Pilot Plant for Welding Equipment of the E.O. Paton Electric Welding Institute, and V.S. Romanyuk, Laureate of the State Prize of Ukraine in the field of science and technology, Director of State Enterprise «Experimental Design Bureau of the E.O. Paton Electric Welding Institute».

Connection of the module to the emergency well for further transportation of fluid via the pipeline

Process of connection of the module to the emergency well in hydraulic pool

Yu.G. Danik, one of the authors of the development, said the following about it: «We succeeded in looking at the problem from a new point of view. Consider, for example, the accident in the Gulf of Mexico. The seal of the wellhead failed as a result of explosion at the oil producing platform and fire that followed, and oil gushed out into the sea at a high pressure. How the liquidators of accidents behave in such cases? All of the existing approaches are based on closing, stopping and sealing the leak. To overcome resistance of the powerful natural force means actually to do violence to the nature. But will it guarantee that the leak will be stopped forever? Not at all. There are about thousand and a half suspended wells in the Caspian Sea that continue leaking. And the leak in the Gulf of Mexico has not been fully eliminated either. We used an absolutely different principle to serve as a basis of our technology. It is necessary to be on friendly terms and cooperate with the nature, turn its force in the required direction, and control it».

Patent engineers of the E.O. Paton Electric Welding Institute conducted preliminary search and determined that our principle is applied in none of the known patented inventions. Based on this principle, the team of the scientists developed the emergency module of a special design, resembling in a way a docking module of a spacecraft. It is connected to the leakage location, compensates for the impact blow of a leaking substance, and carefully redirects the flow along the required path. This allows the leak to be stopped and extraction to be continued. The module can be installed by using robots, or it can be a robot itself.

If all of the producing platforms are equipped with such modules, this will make it possible not only to quickly eliminate various-scale accidents, but also to resume production of oil and gas at the suspended emergency platforms and fields, the potential of which is far from being exhausted. The development made by the Ukrainian scientists will solve the problem of ensuring the international environmental safety in extraction of hydrocarbons, and will promote further advancement of this extraction.

The development had to be experimentally tested. The Institute of Hydromechanics of the NAS of Ukraine made preliminary calculations. The Experimental Design Bureau of the E.O. Paton Electric Welding Institute prepared design documents, and specialists of the Pilot Plant for Welding Equipment made working models of the module. The tests were conducted with the simulated well, from which a flow of fluid gushed out at a preset rate and intensity. The experiments were successfully completed, thus proving the effect of the principle. V.S. Romanyuk, one of the authors of the development, shared impressions about the tests at the presentation: «As soon as we performed the connection, the flow became controlled. We used the rotation mechanism to close the flow gushing out into the environment and directed it along the required path. It can be a pipeline, container, etc.».

A video illustrating sequential simulation of the operations on «taming» the blowout of oil from the well and redirecting it along the require path, as well as other video materials on testing the method and facilities offered by the Ukrainian scientists at the laboratory rig of the Institute of Hydrodynamics were demonstrated during the presentation.

The floor at the presentation was also taken by V.I. Stepakhno, Director of the Pilot Plant for Welding Equipment, L.K. Kadenyuk, pilot-cosmonaut of Ukraine, Prof. V.T. Grinchenko, Director of the Institute of Hydromechanics, V.A. Kolyadenko, Vice-President of the Ukrainian National Committee of the Chamber of Industry and Commerce, and V.I. Lakomov, Director of the Department for Foreign Economic Cooperation at the Ministry of Foreign Affairs.

The presentation attracted a keen interest in the subject being discussed and in the proposal of the Ukrainian scientists. Some reporters put questions to the developers of the accident elimination method concerning further promotion of this development and its potential economic attractiveness for Ukraine.

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