OPTIMIZATION OF EXTINGUISHING AGENTS FOR NUCLEAR POWER PLANTS

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Abstract

Focus is placed on use of extinguishing agents in nuclear power plants. The advantages and disadvantages of these agents are compared. Further perspectives for using particular extinguishing agents in nuclear power plants are outlined.

Introduction

Fire protection is an indivisible part of power plant's nuclear safety. A fire in the plant can cause big material damage, electrical power production failure, but it may also cause an accident and radioactive leakage to the atmosphere. This is why a maximum care for the fire protection from designing to decomissioning of a power plant is so neccessary.

In my talk, I would like to focus profoundly on the last phase of fire protection - extinguisthing.

Talking abour particular extinguishing agents I will focus on their present use at PWR NPPs, their perspectives and disadvantages of their use.

Water

It is the extinguishing agent used the most often in power plants. It is used in outer unit transformer fixed extinguishing devices in the form of water fog and in fixed extinguishing equipments protecting cable areas and Diessel-generator stations.

Water can also be used in the form of a water stop as an agent dividing fire-dangerous places where other forms of division are technically impossible or too expensive.

Water is available at all the buildings of a nuclear power plant through the water distribution systems and through underground and overhead hydrants.

Water can be used for voltage electrical equipment extinguishing. No devices and extinguishing equipmet have been designed for larger voltage electrical equipment fires.

Devices important for safety reactor shut-out and residual heat withdrawal cannot be turned off nor in the case of fire. In the EGU Bechovice, there has been an experimet carried out proving that voltage electrical equipment can be extinguished by water in case of keeping certain technical conditions and space-gaps. Based on this experiment, the Slovak Standardization Authority allowed some Slovak Technical Standards exeptions for voltage electrical equipment extinguishing in Slovak NPPs .

Perspectives

Water will be the most often used extinguishing agent at NPPs, henceforth. It is also possible to upgrade its extinguishing effect by adding modern foam creating concentrates and wetting agents (AFFF, Pyrocool).

Usage of new forms of extinguishing Micro drop, Infex.

Disadvantages

Arising of contaminated water in the primary circuit and thus rising amount of radioactive waste. Water extinguishing and using boric acid at the same time brings the danger of boric acid dilution.

Foam

Foam is used mainly for inflammable liquids extinguishing at nuclear power plants and in older projects also for cable areas fixed extinguishing equipment. Highly expansive foam from mobile foam agregates is advantageous for being used for filling cable areas up in case of fixed extinguishing equipment failure or in case of fire in oulet cable areas which are not equiped by fixed extinguishing equipment. Nowadays, foam is also proposed to be the extinguishing agent for protective fixed extinguishing equipment for Diessel-generator stations (Siemens). Foam is unreplaceable in case of outer transformers fixed extinguishing equipment failure. Foam fixed extinguishing equipment is also advantageuos for main turbo-generator oil tanks and oil feeding pump systems protection.

Physical, chemical and extinguishing features of foamers used in nuclear power plants has been analysed. It is necessary to pay higher attention to choosing foam creating concentrates for risky places focusing on their service life, effectiveness and their neutralization after the service life elapse.

Perspectives

For its great inflammable materials extinguishing qualities and since there is a lot of such materials in a nuclear power plant, mobile equipment and also fixed extinguishing equipment foam wil be mainly used in future.

Disadvantages

Rising of radioactive waste amount in the primary circuit. Necessity to replace the foamer after its guaranatee term.

Extinguishing powders

Experience has showed it is not suitable to install powder fixed extinguishing equipment in power plants. The use of powder is concentrated into extinguishers. It is also useful to have some powder supplies in a fire-extinguishing tanker mainly for imflammable materials, cable areas and voltage electrical devices extinguishing.

Perspectives

Powders are supposed to be used broadly in nuclear power engergetics in case of fast neutron reactors with a liquid sodium cooler.

Disadvantages

Invalidation of extinguished electronic devices and rising of a radioactive waste amount in the controlled zone.

Carbon dioxide

Carbon dioxide is used mainly in extinguishers for electric voltage devices. After the use of halogens had been reduced the importance of carbon dioxide rised also for fixed extinguishing equipment for example oil systems (NPP Temelín) and for main circulating pump deck extinguishing projects (Siemens).

Perspectives

Henceforth, carbon dioxide will be used mainly in extinguishers. It may be used as a possible replacement of halogens in fixed extinguishing equipment.

Disadvantages

Comparing to other alternatives, there is a higher extinguishing concentration necessary which is of fatal danger for the service personnel. Extinguishing agents contributing to strenghtening the greenhouse effect (GWP) are being reassessed nowadays.

Halogens

Halogens are extinguishing agents very suitable for nuclear power plants. Their usage is limited by the 1987 Montreal Protocol. It is a nearly unreplaceable extinguishing agent in nuclear plant conditions. They are used for voltage electrical devices, electronic devices and important cable areas extinguishing.

Model experimets with halogens and halogen alternatives should verify the effectiveness of closed room flame extinguishing and their ability to prevent reflaming of

infalmmable materials. These experiments are being proposed since the information on extinguishing abilities of halogen hydrocarbons available till now are tested by Cup Burner Test. According to the search of literature, room extinguishing concentrations are designed with 20% reserve. Since from the point of view of chemical mechanism the alternative agents effects are lower than the halogen ones, the experiment should verify the extinguishing agent's ability of volume extinguishing. There is to be halogen 1031 compared with halogen alternatives (CAE-410, FM 200, Halotron II) within the experimet.

Perspectives

The use of halogens at nuclear power plants was not openly prohibited in Slovakia. Halogen 1301, used mostly in fixed extinguishing equipment, is not available at the market. Considering demanded extinguishing abilities, non rising of a radioactive waste amount and non invalidation of extinguished devices, halogens are still a very perspective extinguishing agent in Slovakia.

Disadvantages

Damage of the ozon layer (ODP), contibution to the greenhouse effect (GWP) and proportionally long term of life in the atmosphere (AL).

Conclusion

In conclusion, it can be claimed that there are all kinds of extinguishing agents used within modern fire protection in conditions of nuclear power plants. We have to undertake several aspects using extinguishing agents for manual extinguishing, fixed extinguishing equipment and fire-extinguishing tankers. The extinguishing agent has to have good extinguishing effects, must not divaluate the extinguished material, must not support further rise of contaminated waste amount and must not have an enviromental impact.

Having undertaken all these aspects we have to choose the most suitable extinguishing equipment for the particular area of the plant.

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