Stabile Systems for Fire Protection - Drencher Type Systems

RADOJE B. JEVTIĆ, School for Electrical Engineering „ Nikola Tesla“, Niš

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Stabile systems for fire protection have a great importance in fire protection and fire extinguishing. These protection systems can be realized on different ways and with different fire extinguishers. As fire extinguishers, water, CO_2, dust, foam, inergen, halon or some „new fire extinguishers“can be used. These protection systems are particularly suitable in cases of fire fighters absence or if they are too far; in cases where big fire spreading and potentials of great damages are very possible; in cases where difficulties of fire spreading with fire mobile equipment exist; in cases where quantity of fire extinguishers in beginning moments are small etc. Systems that possess fire detection in early stage are not in situation to stop the occurrence of fire and its spreading. However, if these systems possess installed extinguishing systems at the existent systems, the potentials fire detection and fire extinguishing are much bigger. This paper has written to present the stabile systems for fire protection of drencher type and FDS computer simulation of extinguishing with this kind of stabile fire protection system.

Key words: *fire, extinguishing, drencher, simulation*

1. INTRODUCTION

Fire protection systems have several different roles in fire protection, such as right timed reaction, early fire detection and of course, protection of human lives and material properties. Some of these systems are systems for fire detection, which implies that they can only detect fire products such as smoke, flame or heat, but without any extinguishing action. However, these systems can detect fire fast, so, the time needed for the beginning of extinguishing is shorter and results are much better than systems without any kind of fire detection. These systems are very effective and complex. For their proper and correct functioning, they should have proper parts-elements, such as automatic and manual fire detectors, central device for fire detection, sound and light alarming devices, proper electrical installations for noted elements connection, additional power supply devices, parallel indicators and many other additional devices.

Stabile systems for fire protection present systems that can detect fire and immediately start to extinguish the same with suitable fire extinguisher. These fire protection systems use different types of fire extinguishers, so, related to that fact, they can be divided on stabile systems that use water as fire extinguisher (sprinkler and drencher types), stabile systems that use CO_2 gas as fire extinguisher, stabile systems that use halons as fire extinguisher (the different derivatives of halogen elements and carbon), stabile systems that use inergen as fire extinguisher, stabile systems that use dust as fire extinguisher, stabile systems that use foam as fire extinguisher, stabile systems that use pyrotechnic generated aerosols and other [1-4].

2. STABILE INSTALATIONS OF DRENCHER TYPE

Stabile installation of drencher type presents automatic stabile installation for fire protection with water as fire extinguisher. The extinguishing process is simultaneous. It means that all installed nozzles above protected area take part in extinguishing at the same time (group extinguishing). The main reason for this kind of extinguishing is very fast fire spreading that can be occurred in fire situations. It was noticed that there are fires with such fire of fire spreading that sprinkler systems cannot react properly, although they were activated automatically. The reason for this is long time of activation reaction. Drencher systems also have long time of activation reaction but, after their activation, they are extinguishing all protected area. These

Author’s address: Radoje Jevtić, School for Electrical Engineering „Nikola Tesla“, Niš, Aleksandra Medvedeva 18
e-mail: milan.jvtc@gmail.com
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installations are intended for fire protection of objects with significant fire risk, where the occurrence of great fire speed spreading exists.

These also include objects that must be momentary submerged by water in case of fire. These objects are objects such as refineries, garages, sawmills, dry kilns, transformers (figure 1) etc.

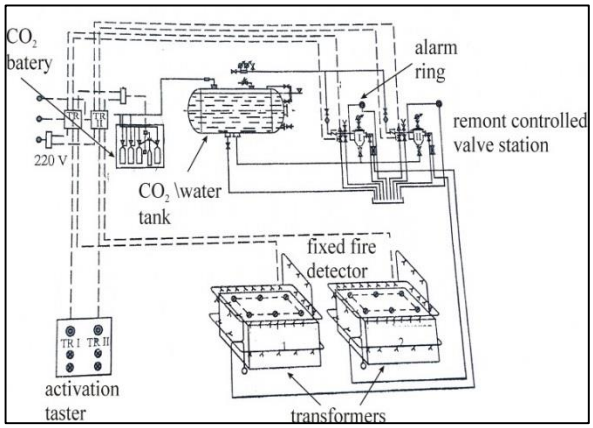

Figure 1 - An example of fire extinguishing by drencher installation (figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 502)

The drencher installation scheme is presented on figure 2.

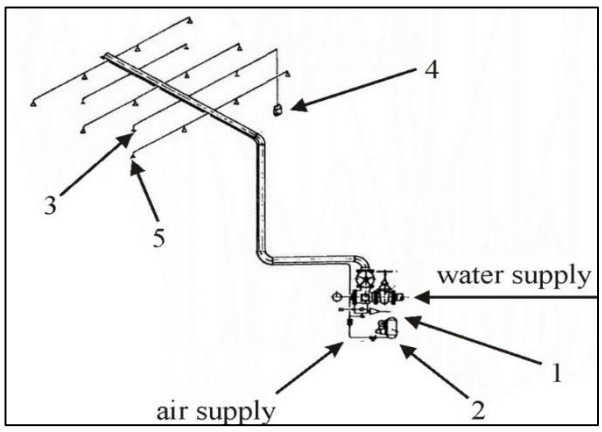

Figure 2 - The scheme of the drencher installation (figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 503)

Numbers on figure 2 indicate: vent station (1), compressor (2), temperature element (3), manual activation (4) and nozzle (5). The water source is connected through vent station and pipelines with open nozzles.

The fire detectors are located in the same space were the nozzles are located. In the case of fire, the drencher nozzle opens and enables that water comes into pipelines and at the same time, exits from all nozzles in the form of spray. The spray purports small quantities of water that cover all protected area and extinguishing the fire. There are several technical solutions for drencher installations. The differences between these solutions are in the way of installation activation, the way of water supply and in the activating system.

Drencher installation possesses special activation system because the nozzles are open and it implies pipelines and activation elements. Activation of drencher installation can be realized on several ways, as mechanic (manual long range or manual on the vent), pneumatic, hydraulic, electric and combined.

If pipelines are filled with water, the activation system type is hydraulic. If pipelines are filled with air, the activation system type is pneumatic. The activation elements can be temperature elements or nozzles with melted element. The drencher installation with hidraulic way of activation is presented on figure 3.

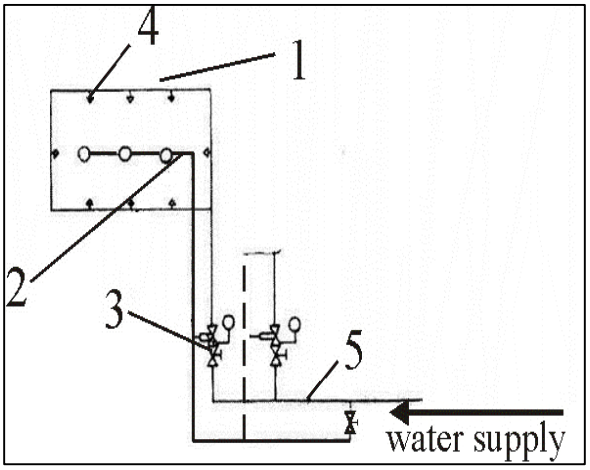

Figure 3 - Scheme of drencher system with hydraulic way of activation (figure source: figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 504)

This type of system is appropriate to adequate wet sprinkler installation. The main characteristic of these systems is that they are activated after pressure decrement in pipelines. The pressure decrement is caused by melting of temperature element what presents consequence of fire. The vent station starts to activate and the water comes to nozzles. Also, after the vent station is activated, the alarm signal starts to activate.

For drencher system with pneumatic type of activation, the pipeline with determined pressure must be installed (three bars). This pipeline comprehends melted elements (marked as 2 on figure 4). After fire, these elements are activated and cause pressure decrement. This also causes activation of vent station and water arrival to the nozzles (marked as 4 on figure 4). Activation of vent station causes activation of alarm signal. Pneumatic way of activation is appropriate to

adequate dry sprinkler installation. The scheme of drencher system with pneumatic way of activation is presented on figure 4.

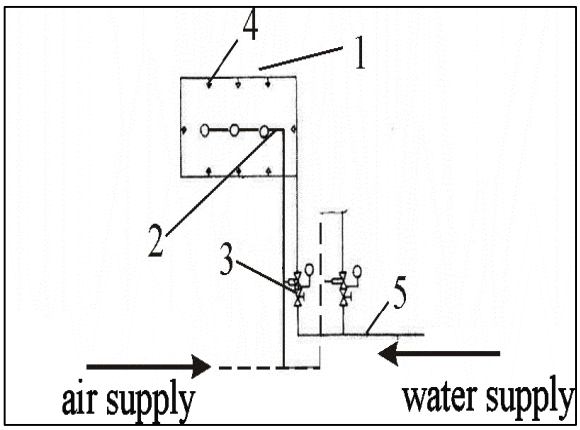

Figure 4 - Scheme of drencher system with pneumatic way of activation (figure source: figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 505)

The activation of drencher systems with electric way of activation is realized with automatic fire detectors (marked as 2 on figure 5). Fire causes the occurrence of electric impulse. This impulse is amplified in the alarm control central and causes activation of the vent station (marked as 3 on figure 5).

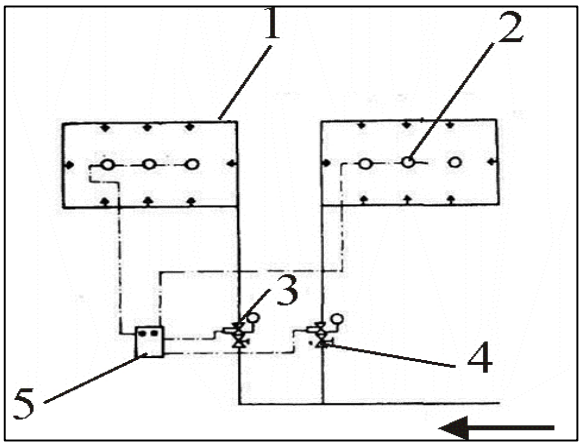

Figure 5 - cheme of drencher system with electric way of activation (figure source: figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 505

After that, water leaks into the pipeline with nozzles (marked as 1 on figure 5). It is important to note that alarm control central realizes, beside vent station activation, sound and visual alarm signal and sends it to the nearest fire station.

The scheme of drencher system with electric way of activation is presented on figure 5. One of the most important parts of these systems is drencher nozzles. According to these nozzles, the diameter of the nozzle gap should be at least 8 mm. The each other distance must not be bigger than 3 meters. It is very important that water that leaks through nozzles should be equally distributed on the covered surface.

That kind of distribution must be achieved at 0,5 meters below nozzles yet. The drencher nozzles types are presented on figures 6 and 7.

Figure 6 - Drencher nozzles types (figure source : Stabilni sistemi za gašenje, Tošić, A.)

Figure 7 - Drencher nozzles types (figure source : Stabilni sistemi za gašenje, Tošić, A.)

Drencher installations have a very important role in stopping of fire spreading so as in cooling of surfaces while fire in order to protect these surfaces from high temperatures that can be achieved during fire (water wall, the refrigeration of tanks with flammable gases and liquids).

Water wall and stabile installation for cooling of landline tank for flammable gases and liquids are presented on figures 8 and 9.

Related to the technical specifications, every landline tank for flammable liquids storage that does not have thermo isolation must have cooling system. It is very important to note that enough quantities of water must be provided in duration of two hours.

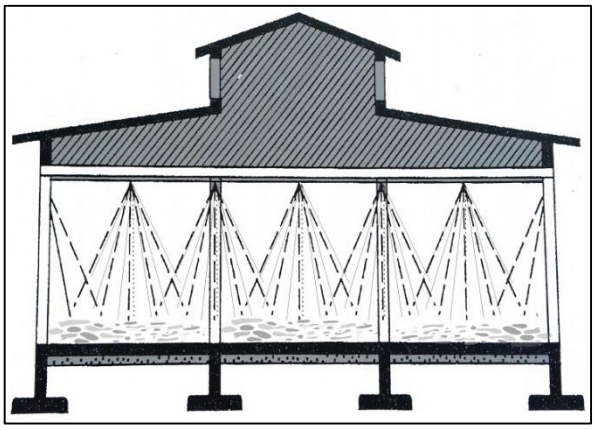

Figure 8 - Water wall as a form of fire protection (figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 506).

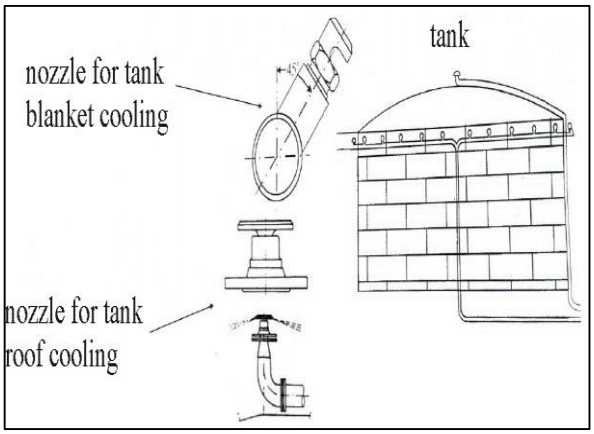

Figure 9 - Stabile installations for landline tank cooling (figure source: Jevtić, B. R.: Material for the preparation of the professional exam in the field of fire protection, pp. 507)

Every installed drencher system must have a proper additional documentation, what includes proper certificates and technical documentation. Domestic institutions issue proper certificates and they prove the coordination of determinate product with proper technical rule, standard or specification.

These systems also must have technical manual that explain correct installation, safe and secure functioning, malfunction eliminations, dangers warnings etc. It is also important that each installed system be controlled and tested after some determined time. Periodical testing of these systems are usually realized in accordance of the law. Each installed system must have a control book, where all of data related to operation and maintenance are noted.

Design, maintenance, installation and testing of drencher systems can do only professional and law persons with proper licenses and technical qualities [5-7].

3. SIMULATION MODEL

Simulation model realized for purposes of this paper was realized in FDS software (version 6.6). The purpose of this software is to simulate the fire and smoke occurrences and their spreading and it presents very important tool in fire protection.

Simulated object presented auto garage with dimensions 50 m x 30 m x 3.5 m. Whole object was built from concrete. Cars were modelled as mixture of steel, rubber and upholstery. Car dimensions were 4,2 m x 2 m x 1,5 m. The side distance between cars was 1 m, while the width of the roadway was 4 m. The enter to the garage was located at the right upper corner. The 2 D and 3D simulation model with drencher nozzles arrangement of the auto garage are presented on figures 10 and 11.

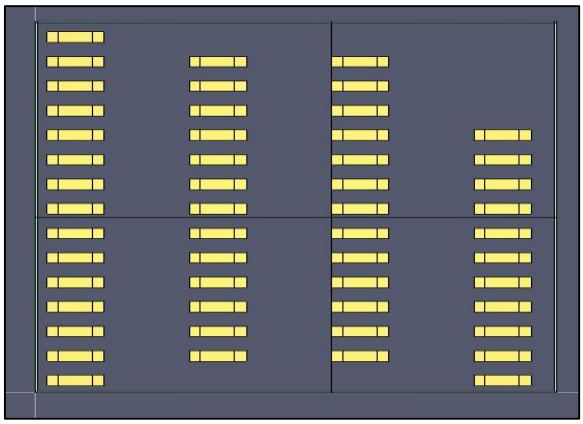

Figure 10 - 2 D simulation model of the auto garage

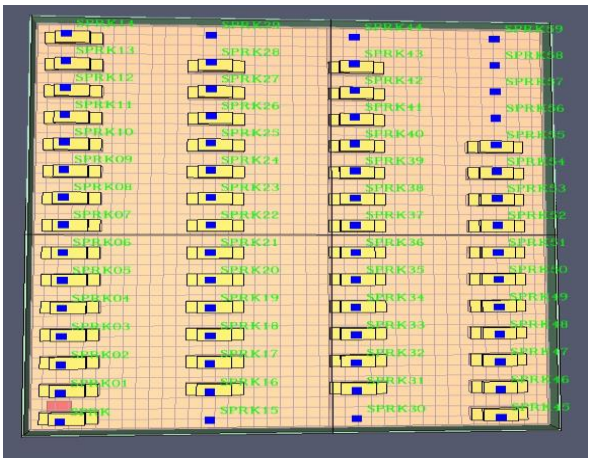

Figure 11 - 3 D simulation model with the drencher nozzles arrangement of the auto garage and burner`s position at the corner of the garage

Fire was presented as burner in form of rectangle with dimensions of 0.7 m x 0.95 m and HRR (Heat release rate per area) of burner 2000 kW/m^2. The burners positions were in the left corner of the garage and in the centre of the garage. The drencher nozzles were set to 60 l/minute under 3 bars pressure and their reaction temperature were set to 70 ° C [8].

4. SIMULATION RESULTS

The computer used for purposes of this paper was laptop Lenovo Yoga C930, Intel Core i7-8550U quad-core processor, 12 GB of RAM memory and 256 GB Solid-state drive (SSD). The duration of the whole simulation was set to 360 seconds. Because of the paper limitations, only some results were presented on figures from 12 to 18.

Figures 12 and 13 present the potential spreading of fire and smoke in garage without drencher activation. Figure 14 presents the drencher system activation for the case where the burner position was at the left corner of the garage.

Figure 15 presents drencher system activation for the case where the burner position was in the centre of the garage.

Figure 16 presents thermal presentation after several moments from the drencher activation.

Figure 17 presents thermal presentation after 30 seconds from the drencher activation.

Figure 18 presents thermal presentation after 65 seconds from the drencher activation.

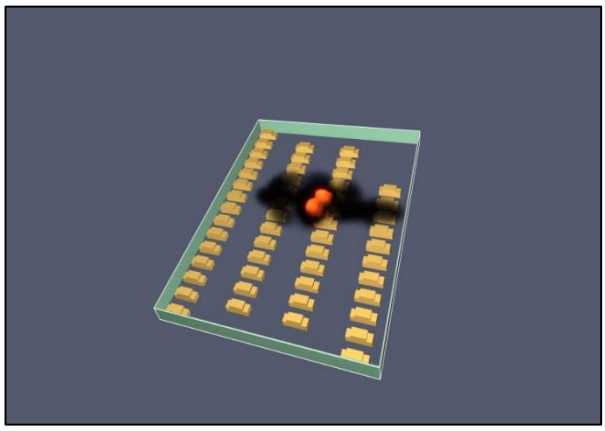

Figure 12 - The fire and smoke spreading without drencher system activation after 56 seconds from the fire start

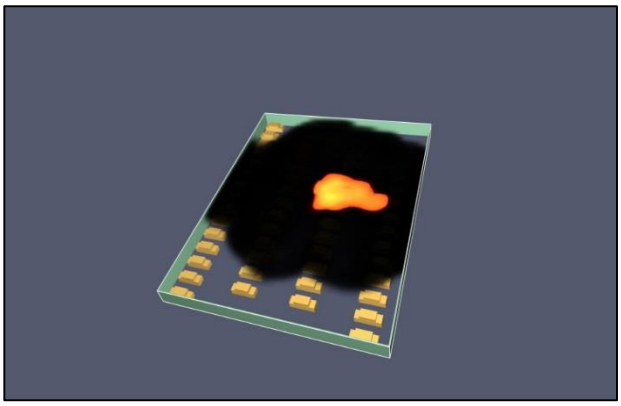

Figure 13 - The fire and smoke spreading without drencher system activation after 132 seconds from the fire start

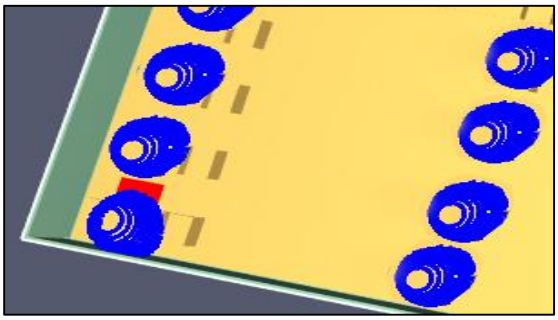

Figure 14 - The example of drencher system activation with burner position at the corner of the auto garage

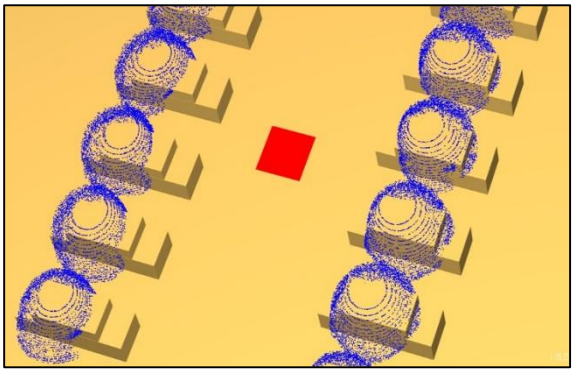

Figure 15 - The example of drencher system activation with burner position at the centre of the auto garage

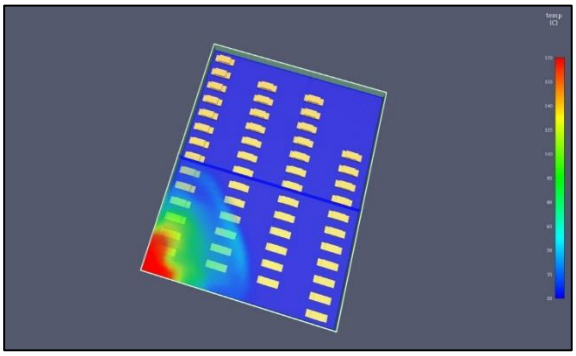

Figure 16 - Thermal presentation after several moments after the drencher activation

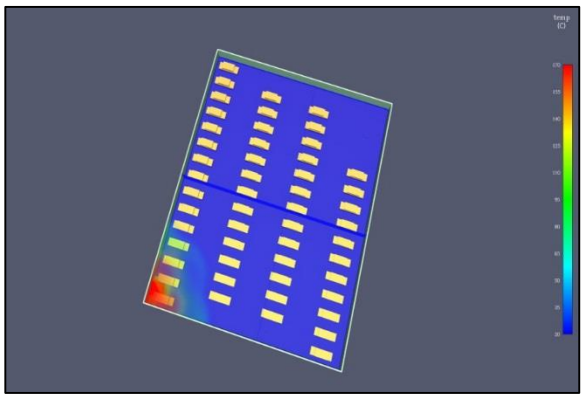

Figure 17 - Thermal presentation after 25 seconds from drencher activation

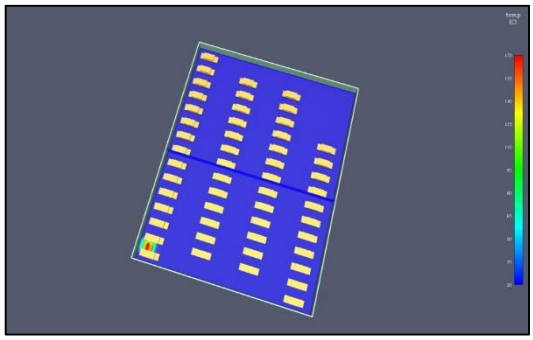

Figure 18 - Thermal presentation after 65 seconds from drencher activation

5. DISCUSSION

Presented simulation results showed the advantages of the drencher systems usage. On figures 12 and 13, spreading of fire and smoke without drencher reactions were presented. It is obvious that enormous quantity of smoke would cover the complete space of the auto garage and cause problems for evacuation and extinguishing. Figures 14 and 15 showed the activation of drencher system, for both cases, when burner position was at the left corner of the auto garage and when burner position was in the center of the auto garage. The main advantage of the appliance of these systems was obvious and it was in the fast fire extinguishing and stopping of the fire spreading. On figures 16, 17 and 18, the thermal presentation after the drencher activation was presented. The figures showed the reduction of the fire source and temperature incensement from more than 200 °C to 50 °C. The thermal presentation of the complete extinguished fire is presented on figure 19. The similar results were achieved and for the case when the burner was in the center of the auto garage.

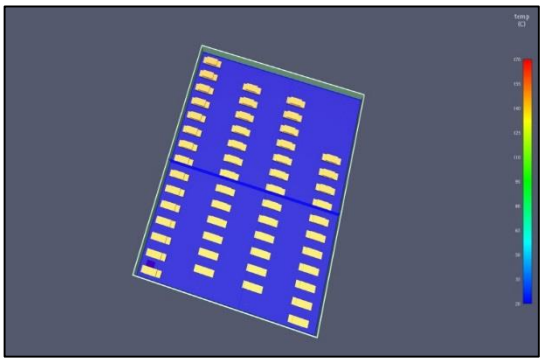

Figure 19 - The thermal presentation of the complete extinguished fire

6. CONCLUSION

Drencher installations have great advantage in the fire protection in the sense of fire extinguishing and stopping of the fire spreading. The correct design of these systems implies the solution of many different problems and tasks, such as: water supply, water pipeline net, enough volume of water needed for extinguishing, pumps, vents, hydro motors, minimal time needed for fire extinguishing, the calculation of needed water volume flow, electrical supply of drencher installation, nozzle selection and their number, minimal pressure on drencher nozzles, the way of activation, alarming etc.

Only correct installed, controlled and maintained drencher systems are in condition to meet all requirements that one fire protection demand. Application of simulation software in automatic stabile fire protection systems design and calculations can be very useful, in the sense of correctness, safety and cost decrease. [9-11].

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REZIME

STABILNI SISTEMI ZA ZAŠTITE OD POŽARA - SISTEMI TIPA DRENČER

Stabilni sistemi za zaštitu od požara imaju veliki doprinos u zaštiti od požara i gašenju požara. Ovi sistemi zaštite mogu biti realizovani na različite načine i sa različitim sredstvima za gašenje. Kao sredstva za gašenje mogu se koristiti voda, CO_2, prah, pena, inergen, halon ili „nova sredstva za gašenje". Ovi sistemi zaštite su posebno podesni u odsustvu vatrogasaca ili u slučaju da su vatrogasci daleko; u slučajevima kada postoje mogućnosti velikog širenja požara i velikih šteta; u slučajevima gde postoje poteškoće sa mobilnom vatrogasnom opremom; u slučajevima gde je količina sredstava za gašenje u početnim momentima gašenja mala itd. Sistemi koji poseduju detekciju požara u ranoj fazi nisu u stanju da zaustave pojavu požara i njegovo širenje. Međutim, ako ovi sistemi poseduju instalirane sisteme za gašenje požara sa postojećim sistemima, gašenje požara je znatno brže. Ovaj rad je napisan da prikaže stabilne sisteme tipa Drenčer za zaštitu od požara kao i FDS simulaciju gašenja pomoću ovog stabilnog sistema za zaštitu od požara.

Ključne reči: *požar, gašenje, Drenčer, simulacija*