Article

Mechanism of hot work accidents in China and Response Mechanism Design

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Abstract: Based on the mechanism analysis of emergency management in hot work accidents, and on the basis of the classification of hot work accidents, this study deeply analyzes the internal mechanism of its occurrence, development and evolution, this paper probes into the construction of coping mechanism based on the"Five-all-20" premise of the whole process quality management theory. The design can be used to deal with China's hot work accident response mechanism, so that the occurrence of hot work accident in the whole process of monitoring, to minimize the frequency of crisis. In order to provide decision-making reference for the effective prevention and scientific response to the fire accidents, the general regularity is explored.

Key word: Mechanism analysis; hot work; mechanism design;

1. Introduction

Hot work in all walks of life are very common in industrial production, construction, transportation and other industries of inflammable and explosive places higher risk, is the key link of accident prevention.These places are often coupled high temperature, high pressure, inflammable, explosive, toxic and harmful, strong corrosion and other potential risk factors, higher safety production is the difficulty and especially in the process of production, repair and maintenance, due to hot work.When hot for industry process, such as measures to prevent a bit does not reach the designated position, can cause fire and explosion, electric shock, burns, produce harmful gases and soot, optical radiation effects cause eye and skin lesions of all sorts of harmful consequences.

1.1.Definition and types of hot work accidents

Outside the forbidden within the fire area may be produced on the surface of the flame, sparks or hot unconventional job [2].According to the specification, the use of electric welding and gas welding (cut), burner, electric drill, grinding wheel, sandblasting machine, etc, are in the hot work.Simply put, is in the security management, those who use open flame or may produce kindling maintenance belong to the scope of hot work.Hot work is one of the eight class special operation of production and business operation entity, is a production and business operation entities temporary difficult point of dangerous operations management, classification is as follows:

1, super hot work: under the fire explosion danger area in the running state of the production unit equipment, pipelines, storage tanks, containers, etc on the hot work (including with no replacement hot work);Being the major hazards of flammable easy detonation medium tank farm fire DiNa hot work.2, level 1 hot work: the fire explosion danger area of hot work, other than the super hot work on the pipe rack of hot work in accordance with the level of hot work management.3, secondary hot work: except for the super hot work and level of hot work of hot work.

In this paper, through collecting 31 provinces, municipalities and autonomous regions in China emergency management departments at all levels of the website information, the article offered database research, the government statistical bulletin, history of news information selected from 2013 to 2023, 100 within a larger social impact of the larger level and above typical hot work accident analysis as a data source, and fine out the following hot work easy to cause accident five seeds types:

Reached 5% proportion is not high, in the event of hardly being rescued.Such as on November 12, 2020 points, according to taikang county city administration organization workers at vortex YangXia road river crossing in construction of CMC, accident getting an electric shock accident, three killed and one wounded.Gas accident: in this paper statistics the hot work sub accident type of accident, the gas accidents accounted for 10%, such as on March 14, 2022, a company of Inner Mongolia baotou maintenance workers in flue hanging straight section of the internal thermal cutting hot work process, produced by cutting metal slag drop lit up box and flue protective layer, the smoke into the desulfurization tower, are working within the tower 7 people are smothering breath all poisoning death.According to the survey, the accident in the part of the project department thermal cutting operation and high operation personnel without the nuclear test, no special operation qualification.Other accidents: including burning hot, radiation and so on, accidents accounted for 3%, also need to pay attention to.

2. Materials and Methods

Mechanism refers to the inherent logic and rule followed by the things [3] [4].For hot work accidents, to study the mechanism, then you will find it hot work accident source, find the rule of its formation and development of the driving force, so as to find the corresponding coping strategies in emergency management [5].For this, this article from China's 31 provinces, municipalities, since the website to collect, filter out the emergency management departments at various levels in 2013-2023 of 100 larger than typical hot work accident analysis as a data source.

2.1 hazard theory

2.1.1, the traditional theory

The first kind of hazards: accident after the accidental release of energy or hazardous substances, its role in the amount of energy through the body, or interfere with the body energy exchange with the outside world, this kind of material is the direct cause of injury, so that exist in the system may be accidental release of energy or hazardous substances is the first kind of hazards.The second type of hazards: in production, life and other social activities, for the rational utilization of energy, energy according to the will of people in the system smoothly conversion, energy constraints, restrictions, measures should be taken, cause the energy restrictions imbalance or destruction of all kinds of unsafe factors is the second type of hazards [6].

2,.1.2,three types of hazard theory,:

many scholars have 2 kinds of hazard theory is improved, because the hydrophobic and behavior of people, human error behavior, safety management mistakes, organization, organization defects, organised unsafe behavior, safety system damage caused by emergency response error such as this kind of unsafe factors known as the third kind of hazard [7] [8] [9].Related to the cause of the accident analysis shows that caused by unsafe behavior of people accounted for more than 95%.Therefore emphasizes man's mistakes and organization alone, put it as the third kind of hazard there is a reason.

the first kind of hot work accident : the first kind of hot work accident hazards all can produce heat and toxic and harmful gas inflammable and explosive hazardous substances.Fuel widespread is the root cause of the deterioration of hot work accident.In hot work environments, any combustible material is likely to be the first kind of hazards, they have their own combustion characteristics, respectively.Prevent mist device this is a safety

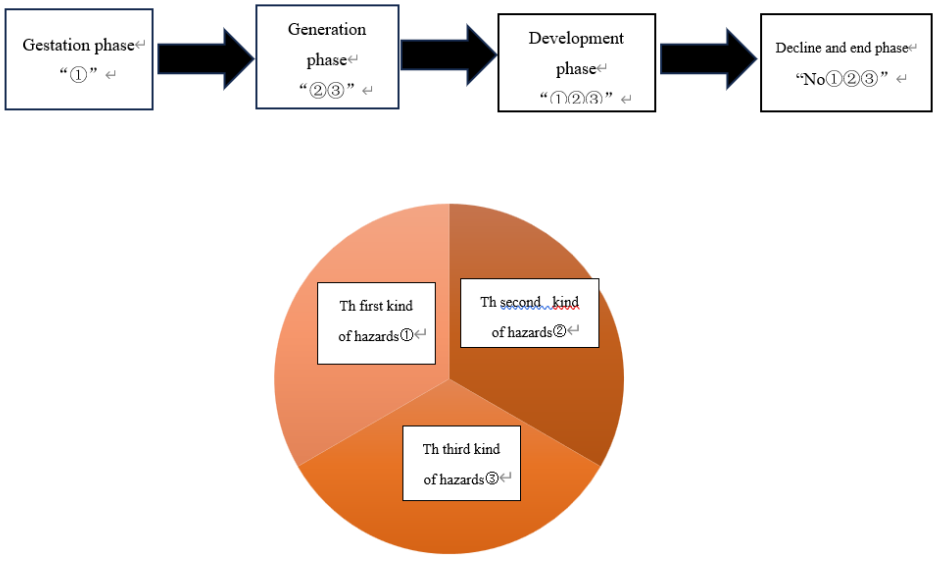
device, for example, has industry in special circumstances due to its own materials for fuel become a specific hazards.

the second category of hot work accident: the second category of hot work accident hazards is spread in order to prevent accidents, and reduce the loss taken by the protective facilities, the flue gas control facilities, facilities, personnel evacuation, detection and fighting measures of fire safety measures such as defects.Find the relevant part of report.

the third type of hot work accident :hazards if only protective system is obviously not enough complete, at the same time, you have to take all kinds of management strategies and methods to control, coordination and maintenance of the protection system.The third type of hot work accident hazard refers to the hot work safety management decision-making errors, tissue defects and mistakes, organised unsafe ACTS and emergency response errors such as safety system damage caused by this kind of unsafe factors and unsafe behavior of people, in fact, this kind is an important factor of hot work accidents, such as electric drills in the use of electric welding, gas welding, grinding wheel, burner, etc are a direct result of improper operation in the process of operation and management of hot work accident.

2.2,the hot work the multistage mechanism analysis of the accident

Hot work accident has strong potential and chance, belong to the disaster energy accumulating, break through the threshold at a certain moment in the "energy accumulation type", is a change over time and the energy concentration process.According to the energy change of state, hot work accident life cycle can be divided into inoculation, occurrence and evolution, recession, end five stages.In this system, the hot work accident stage is characterized by hazards agglomeration.When the change of system parameters, system balance is disturbed, hazards gathered hot work accidents.To further pick up, hot work accidents, characterized by the expansion of space and intensity on the increase.When the system energy accumulation to a certain extent, qualitative change occurs, evolved into other types of emergencies.Finally, as the system energy gradually released, put an end to the hot work events.



Hot work accident mechanism schematic diagram

2.2.1, the incubation period of hot work accident

inoculation mechanism of the incubation period is mainly composed of the first category of hot work accident hazards, this refers to before the accident, the surface is not obvious stage, a variety of potential hazard -formative factors have undercurrent.During this period, can produce heat and toxic and harmful gas inflammable and explosive hazardous substances have been produced scale gathered, such hazards is the place with big energy, potentially damaging substances, including but not limited to directly used in the production of auxiliary material, indirect help production material, and production activities irrelevant material.In functional materials, for example, in the process of the construction of cold storage, if do not conform to the standard of polyurethane materials as thermal barrier, will rise to push wave to help in the event of accident rings in the consequences, polyurethane material release 5 methyl divinyl three amine, N, N - dicyclohexyl methylamine, etc., will be mixed refrigerants containing 1, 1-2 fluorine ethane, etc. To promote combustion and explosion.It can be said that the first kind of hazard provides "soil" of the hot work accident., for example, in boiler burning hot accident, the first kind of hazards is the accident of a coal-fired boiler (with boiling water inside the furnace), the material in accident period there is no clear vision, and then is inadequate for the accident provides the necessary conditions, without coal-fired boiler high energy of disasters, even if the hot work, also will not result in a larger irreparable consequences, once again confirms the first category hazards which phase of the "biggest killer".

2.2.2,The period of hot work accident occurrence mechanism

The results of the effect.Therefore, spontaneous and hot work accident mode can be divided into two broad categories.Spontaneous model is mainly due to the objective material in place to decide itself, leading to the inevitability of hot work accidents, no longer in use standard equipments such as, the second category of hazard refers to the various need not perform safety protection measures in place, thus leading the happening of this pattern.For example in the above mentioned boiler burning hot accident involved boiler have been listed in elimination catalogue, are not regular maintenance, and for the safety valve failure case disorderly stoker workers did not examine, adventure homework, not for boiler pressure real-time monitoring all the way, not in accordance with the procedures to open the gas cylinder connected with the main steam valve, and the consequences of the second type of hazards, "he said.

Trigger type hot work accident is the subjective factor decisive contingencies.Lack of job management, such as dynamic fire supervision does not reach the designated position, mainly focus on the hot work implementation behavior.This pattern dominated by the first three types of hazards, the third class of hazard refers to the hot work accident hot work safety management decision-making errors, tissue defects and mistakes, organized the unsafe behavior of partial subjective decision-making errors.Such as electric drills in the use of electric welding, gas welding, grinding wheel, burner, etc are a direct result of improper operation in the process of operation and management of hot work accidents, this mainly refers to the errors of hot work behavior itself.Although the third type of hazard is an important source of hot work accidents have, but simply by such hazards of accident is not in the majority, and the damage caused by general is limited, more it is worth noting that the first class and second class hazards of common cause, such as in warehouse move hot work accident, the workers in the factory at the top of the refrigerator inside condole violations for hot work, on the basis of fuel on site before construction is not clear, did not take the non-combustible material exposed on the surface of a cold storage heat preservation material (polyurethane foam) for covering or isolation, welding work splash slag in ignition polyurethane foam and other combustible content is the direct cause of fire."Not before hot work on surrounding fuel to clean up" is triggered the second category hazards, "welding work splash slag contact fuel" is triggered the third type of hazards, both the arrival of the coupling leads to the occurrence period, and promote an escalation in development.

2.2.3,Development mechanism of hot work accident

At 29, changchun shuangyang district of changchun city of jilin province deer deer township village the deer supreme products group co., LTD., a fire accident happened, the accident was due to welding work on metope ignition polyurethane foam flammable insulation materials, immediately after the cause of flashover, spread by.Phase contrast the incubation period and accident hazards, the two accidents are welding work, however, the first kind of hazards of flammable gas respectively and polyurethane foam flammable insulation materials, deep understanding, the combustible gas in space has formed a diffuse distribution of material itself high risk fold plus a lot of space distribution, the consequences are evident: the former 18 killed and 32 wounded, the latter five killed and one wounded.Although the end result is that many factors contribute, but also anticipated, development situation dominated by three kinds of dangerous source, is a key period leading to the final result.

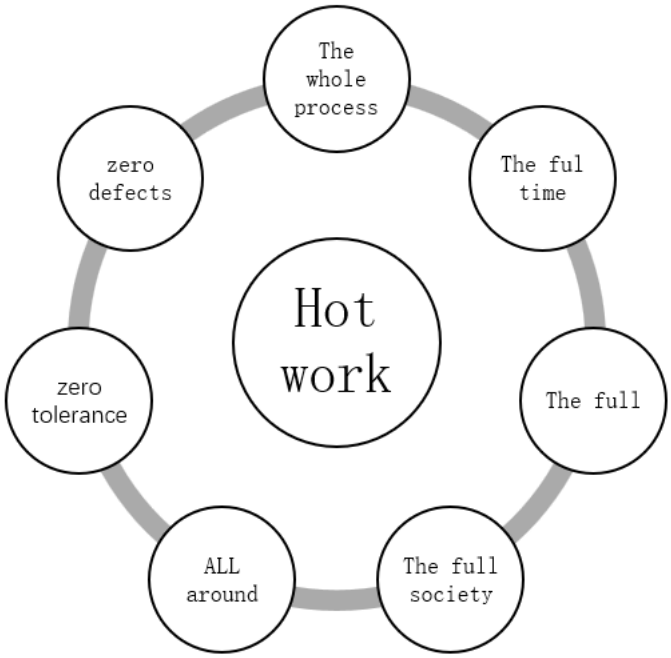
2.2.4,Mechanism and end the period of recession, decline phase and put an end to the mechanism

Three types of hazards effectively curb is characteristic of recession and the end.This process depend on outside intervention, often with the help of powerful contingency measures can control the process of the period.On February 25, 2017, a major fire accident happened in nanchang red valley beach district, 10 people were killed and 13 people were injured.On the accident reports, nanchang municipal party committee, municipal government immediately launched the emergency response, organization of public security, fire fighting, civil affairs, safety, health and other departments set up on-site command, vigorous fire, rescue, rehabilitation and stability work, information report and release and update on accident.Quickly adjust the eight squadron, 20 away the car, more than 160 fire officers and soldiers rushed to the scene, province fire corps, nanchang public security fire control team full-time command department carries out out.Which are already in recession, emergency rescue force input greatly turn the tide, from 8 28 points to 12 08, when the flame blackout, finally entered the end stage, at the beginning of the end of the three types of hazards of hot work accidents screen: the first kind of hazards, the cause of the fire spread quickly abandoned sofa fuel;The second category hazards, fire control facilities was discontinued, evacuation channels blocked, fire control facilities management, improper maintenance, etc.;The third type of hazards, decorate construction personnel to use gas cutting torch in the construction site is illegal in metal cutting operations, did not take any safety measures to cause cutting of high temperature metal slag splash down in the working platform below.This three kinds of hazards of renovation completed events will mark the hot work altogether.

3.Mechanism Design

In three kinds of hazards, should be based on three types of hazards that exist in the system of identification, the hidden danger, eliminate the hidden trouble in the bud.For the first kind of hazards, as far as possible use of non-combustible don't explode, flame retardant and flame resistance of blasting construction and materials, improve the safety level of structures, the nature of the system safety.For the second category of dangerous source, the main building active and passive protection technology and equipment level of the system.For new project, we will strictly implement fire control examination and approval system;The old buildings to upgrade the standards for fire control facilities.According to the third type of dangerous source, must strengthen the education and management, resolutely correct illegal illegal and unsafe behavior.

Theory of TQM (Total Quality Management, TQM), to carry out the whole process, the whole party, all the time and full, the whole society, zero tolerance, zero defect (hereinafter referred to as the "five paulo: here's" full) principle is a powerful weapon in hot work to prevent accidents [10].



Hot work accident coping mechanism design diagram

3.1,the whole process of mechanism:

work before: should be in accordance with the risk assessment, check the certificates, permits, on-site inspection (key to move the weeks around the fuel to safe locations, such as unable to move or non-combustible material cover sealing) sequential assignments before operating mechanism.

Work during : should be in accordance with the following regulations for preventive care.1. In the process of hot work shall be in strict accordance with the security controls.2. When hot, people working in the hot point of the upper hand barricading the homework should be taken and control sparks.3. (cut) with gas welding hot work, safe use and to stay focused on the cylinder distance, such as oxygen cylinders and acetylene cylinders should keep a safe distance, acetylene cylinders are strictly forbidden to lie, are not allowed to be in the hot sun exposure, etc.Encountered in the process of hot outdoor category five more than the wind, rain and snow weather, in principle, should immediately stop the hot work.5. In the process of hot work, hot guardians should stick to job site, site inspections and emergency measures to prepare.Homework: after the construction work to eliminate fire immediately, thoroughly clean up the scene, and monitored for a period of time, there is no problem to leave the scene, do not stay hidden dangers.1. After the hot work, should be timely tidy up neat when hot equipment, cut off power supply, air supply, etc.2. Hot work, care workers, and to participate in the work personnel should be carefully examined, to eliminate the residual fire together confirm no legacy fire, can leave the job site.3. Arrange personnel within a certain period of time at the end of the hot work repeatedly patrol hot work area, to ensure safety.

3.2,the omni-directional mechanism:

according to the three types of hazards take technical measures and management measures and legal measures, economic measures, such as daily monitoring and maintenance of fire control facilities of update, implement the responsibility system for hot work safety, fire spread and the escape safety knowledge education, strengthen the government's punishment of hot work hazards and to supervise.Particularly for process monitoring, for example to safe operation of the implementation, regular check and nuclear

test, analyzes the common reasons of existence, take targeted measures to exert safety operation ticket as a final barrier preventing work safety accidents of safety.Must choose good manage contractors.From the contractor qualification selection, contractor's personnel training, safety technical disclosure before construction, construction personnel related certificates, check in the process of operation, etc.

3.3,full time mechanism:

spring, summer, autumn and winter, day or night, hot work safety of the nerve to tighten loose.Especially the holidays and other special circumstances, the enterprise staff less, management strength weakening, the more need to strengthen the management of hot work.Holidays, GB 30871-2014 is put forward, and other special circumstances, hot work should promotions management requirements.Revised GB in 30871 also increased the public holidays, the night also need promotions management requirements, its purpose is to strengthen the risk control of special period.

3.4, full mechanism:

mainly includes the head of the hot work, when hot, fire, safety supervisors, hot work approver behavior mechanism.1, head of the hot work: the implementation of hot work workshop leader or outsourced project director, head of the hot work, take full responsibility for hot work, must be detailed understanding of the homework before hot work content and hot area and the surrounding situation, formulate, implement the hot safety measures, metasomatism homework tasks and fire safety precautions.2, 4 hot: hot person before hot work shall verify all the content is withheld, examination and approval procedures are complete, if discover do not have conditions shall have the right to refuse when hot.When hot before a fire should be the main trend of the prison is check the hot work permit, after signed by both parties and indicate the hot time, Fang Keshi hot work.3, prison fire: fire people shall be specified by hot location, facility management authority unit responsibility heart is strong, the knowledge of fire safety personnel.Did not divide the administrative authority of locations, facilities for hot work,By hot work units assigned to fire people.4, safety supervisor: the implementation of hot work unit or hot place, place unit (branch of administrative authority) safety personnel shall be responsible for check the implementation of this standard and safety measures to carry out the situation, correct illegal work at any time.5, and approver of hot work: the approver is of hot work safety, fire departments;Industrial and civil coal gas, oxygen production facilities (tank, vessel, etc.) and pipeline of hot work by the department in charge of security audit before they send fire review by the competent department for examination and approval;Inflammable and explosive zone of hot work after checking by fire departments to send security review by the competent department for examination and approval;Approver before hot work of examination and approval must be familiar with hot work site condition, to determine whether you need hot analysis, review when hot level, safety measures.In confirmation of qualified can be approved.

3.5, mechanism of the whole society:

people should pay attention to hot work safety, let "in time of peace prepare for war, prevention first" really is becoming a social theme;Territorial governments, regulators should strengthen daily check, for often need to hot work of enterprises and institutions and places should establish relevant system, to carry out the business guidance, timely screening violations when hot industry, according to the laws and regulations on disposal of violation behavior.Regularly carry out training, propaganda, enhance practitioners of fire safety consciousness, learning safety protection regulations, compaction on fire control safety responsibility, further improve the level of jurisdiction of fire prevention and control, to create a good social atmosphere of fire safety.

3.6, zero tolerance and zero defect mechanism: "

zero tolerance" for illegal illegal behavior and ensure the alarm system, fire control system, indoor fire protection system, smoke control and extraction systems, evacuation shelter system, fire fighting and rescue system of "zero defect", strive for the early detection, early warning, early evacuation, and rescue.1, when hot card without the approval, when hot.2, not from production system reliable cases zero when hot.3, not cleaning, replacement unqualified cases zero when hot.4, not eliminate the combustible case around zero when hot.5, not on time for zero when hot hot analysis case.6, without fire control facilities zero when hot.

4. Conclusions

This study aims to study the evolution of hot work accidents mechanism, to preliminarily put forward coping mechanism based on total quality management theory and design, in time of peace prepare for war, prevention is always hot work things so the emergency management guidelines, this study also conduct hot work in the future related research in the field of accident provides reference and reference which can be promoted.

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