Estimating Risk at the Energy Production Unit of "AHS" Keratea-Lavrio

KERPELIS P.[1,2], ARGYRIOU A-C.[1], ALEXAKIS D.E.[2], KOTINAS V.[2]
[1]Department of Civil Engineering, University of West Attica, Campus 2, 250 Thivon & P. Ralli Str., GR-12241 Athens, GREECE
[2]Laboratory of Geoenvironmental Science and Environmental Quality Assurance, Department of Civil Engineering, University of West Attica, Campus 2, 250 Thivon & P. Ralli Str., GR-12241 Athens, GREECE

Correspodence: kerpelis@uniwa.gr

Abstract: - Every business should protect its employees in matters of Safety and Health. It is deemed necessary to access, analyze and classify risks to achieve these issues. The study aims to analyse and estimate occupational risk based on the appropriate empirical " Checklist " method by the responsible staff. Specifically, the relevant legislation and Regulations-Directives from Greek and European sources were studied to approach the Safety and Health issues and data for Risk Analysis. Considering the theoretical background of the energy production, a rapid visual screening of the Unit of Keratea-Lavrio Steam Power Station ("AHS" Keratea-Lavrio) was conducted. In addition, discussions were held with the facilities' managers, who are responsible for developing and implementing safety and health plans and highlighting and analyzing critical points of the station. Afterwards, the total risk(after taking into account several factors) is identified and classifiedinto three categories, revealing the corresponding risk reduction measures. Conclusions about safety and hygiene were drawn about the "AHS" Keratea-Lavrio Energy Production Unit.

Key-Words: health and safety; risk assessment; safety assessment; occupational accident; energy production units; checklist empirical method

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1 Introduction

Small enterprises have given rise to handicrafts and factories that are nowadaysconverted into enterprises of different sizes. In 1527 Agricola, a Saxon physician, proposed the employment of a doctor in mines and mines [1]. The Industrial Revolution movement (18th-20th century), followed by other European cities such as France and the United States of America, created new risks for factory workers, setting new priorities for safety. Defending workers at risk in courts was complex due to the fear of dismissal, lack of evidence, high financial costs and the lack of qualified lawyers. In 1833 and 1844, laws were enacted in Great Britain (as Factory Acts) to protect industry workers [2]. In 1919, at the International Labor Conference, conventions were signed that defined the minimum age limit for workers in Industries and issues related to night work for young people. In 1833, the Inspector of Factories was founded in the same country. In 1835, Massachusetts passed laws prohibiting the employment of children under ten years of age and created a Bureau of Statistics that evolved into today's Department of Labor. In 1911, the first legislation on employer's liability and workers' compensation was introduced in the event of an accident. Later, in 1913, the National Accident Safety Board was established in Europe and the United States. In 1959, the ´´Medical Work´´ policy was created and implemented in order to protect workers following International Convention 112 (recommendation 171/1985).

In the European Union (EU), a legal provision was created to improve safety in the workplace (Single European Act), the year 1987 [3]. The substantial milestone Directive 89/391/EEC introducesthe Europe's minimum safety and health requirements and refers that member states had to incorporate it into their national legislation by 1992. In 1997, the Treaty of Amsterdam defined the responsibilities of employers and employees, and articles 136, 151 were drafted in the Treaty of

Lisbon. Later, the European Parliament and Council legislated on the health and safety of workers (European Regulation 1338/2008). Accordingly, in 2011, the European Regulation 349/2011 regarding statistics on accidents at work was drawn up, and the variables, distributions and metadata to be provided by Member States were approved in detail.

Directives as the Directive 89/391/European Economic Community (EEC), Directive (EU)89/654/EEC: about Working areas, Directive 89/655/EEC: about working equipment, improve health and safety issues of the workers. Other similar Directives are Directive 89/656/EEC: about personal working equipment, such as Directive 90/269/European Economic Community: about Manual movement of loads and the Directive (EU)89/270/EEC: about Work on equipment with a visual display screen.

Eurostat as Health and Safety Authority in Ireland [4] records occupational accidents. The complete list for data collection from the European Statistics on Accidents at Work (ESAW) includes nine (9) variables related to: workstation, work environment, work process, specific physical activity, materials associated with physical activity, deviations, materials related to deviations, contact and injury, and materials related to contact and mode of injury. The categorization of the statistical data highlights the occupational accidents that happened to men-women, and the participation of occupational accidents of specific categories (agriculture-forestry-fishing, industries, constructions, wholesale-retail trade, transport-storage) concerning the whole. Fatal or non-fatal occupational accidents (according the age of the workers or the causes and the mode of injury) are illuminated in the light of statistics.

European Council reveals the guidelines on topics such as: Directives-Frameworks, workplaces, equipment, signage, Personal Protective Equipment (PPE), exposure to physical, biological and chemical agents, provisions for ergonomic, psychosocial risks and workload, as well as special provisions for various sectors and workers. Some of the main Directives are: 89/391/EEC Directive – Framework, 89/654/EEC workplaces, 89/655/EEC Work equipment, 89/656/EEC PPE, 90/269/EEC Manual Handling of loads and 90/270/EEC: Work on equipment with visual display screen. EU promotes the Occupational Safety and Health Administration (OSHA) for minimizing the occupational accidents [5].

In Greece, the former Social Insurance Institution called “IKA”, in collaboration with the Ministry of Labour, had collected statistical data on occupational accidents, from 1964 to 1998. Law 1568/1985 establishes the Safety Technician, the Occupational Physician, the Health and Safety Committee and the worker protection measures. The Hellenic Statistical Authority (HSA) has been recording occupational accidents since 1998. European Regulation 1338/2008 and Implementing Regulation 349/2011 apply [6]. At the same time, the Laws that apply nowadays are the Law 551/1915 and the Mandatory Law1846/1951 (Article 8, paragraph 4). Law 1568/1985 establishes essential issues for the health and safety of employees (safety technician, occupational doctor, etc.). Other Law literature is Law 3850/2010 about the participants (Technical Safety, Occupational Doctor, Committee for Health and Safety at work), Law 4075/2012 about “IKA” insurance regulation issues and Law 4808/2021 about the establishment of an Independent Labour Inspectorate. President's decree as 294/1988, 395/1994, 396/1994, 105/1995, 16/1996, 17/1996 etc regulate partial health and safety issues. Also, circulars from the former “IKA” 27/2011, 52/2011, 45/2010, 22/2004, 55/2001 and 15/1987 assist these issues [7].

Statistics on fatal accidents at work in mines and quarries were released in 2021 and showed that the percentage ranges till 3.2% of the total. Over the years, the needs, amendments and new jurisprudence were followed with the aim of ensuring Health and Safety in technical projects, industries, and every professional branch of the country.

2 Problem Formulation

It is evident that essential enterprises/infrastructures like energy production units must implement health and safety rules [8]. It has proved that all the participants must work cooperatively with prevention from the beginning of infrastructure to address potential risks in time [9]. Researchers reviewed safety and risk management methods for long periods, from decade 60s until the present [10]. The main scope of this research is estimating the risk at the “AHS” Keratea-Lavrio. The risk analysis must also consider all the potential factors involved. Frankly, occupational accidents are multi-parametric incidents, including latent and active possible causes.

Implementing the legislative framework includes the obligations of employers and workers, cooperation between them and the competent authorities, the existence of a Safety Technician, an Occupational Doctor and a Committee for the health and safety of employees (“EYAE”). Alternatively, its services may be provided by an External Service for Health and Safety (“EXIPP”). Continuous education and training must be performed, and protective measures about first aid, fire fighting, and the evacuation method must be implemented.

Risks in the work environment are the non-observance of instructions, the incorrect use of PPE and personal protective measures, the failure to report any omission or problem and the failure to make arbitrary decisions (e.g. moving equipment). The enterprise must draw up Safety and Health Plan (SHP) and the Safety and Health File (SHF). The working area during the construction period must be kept safe, using fencing, signage, pharmacy and PPE, according to the SHP. Similarly, SHF provides the project details and valuable information for its later life (such as maintenance, cleaning and conversions) must bind the plan.

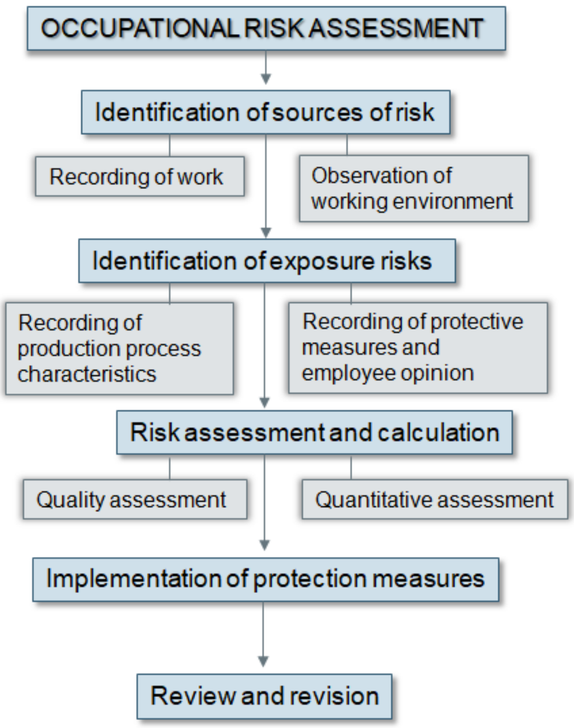

Fig. 1:Steps of occupational risk assessment

Law 3850/2010, President's decree as 305/1996 and certifications of ISO (as ISO 45001:2008, ISO 45003:2021, IEC/ISO 31010:2019 and ISO/TR 14121-2:2012) must be respected [11]. Hellenic Labour Inspectorate is monitoring the processes of health and safety.

Occupational risk is linked with exposure to harmful factors, including the frequency of accidents, probability, and consequences. Researchers verify that accident occurrences and their consequences show a non-uniform fluctuation during the years and confirm the uncertainty and the unpredictable nature of accidents [10]. ELINYAE categorizes the risks into three (3) classes: Safety, health and ergonomic hazards. The first step for risk analysis is the recognition of risks directly at work. The next step is the protective measures that must be taken. Occupational risk assessment can reduce or even eliminate most risks. If some of them cannot be completely eliminated, it is possible to adopt the appropriate measures to reduce them. It is necessary to record the sources of risk and the number of employees exposed to them. Figure 1 presents the steps for the occupational risk analysis.

Safety and health problems can be easily solved using simple mathematical tools such as pocket calculators, spreadsheets or even programs like Mathcad using models (as the exposure to acetone vapors from a small acetone spill in a place). Safety professionals become more effective if they have robust math skills, but different industries have their own specific equations based on the type of work. The advise is that safety expert must lean on their colleagues in their community for retrieving data [12].

Table 1. Methods of risk analysis

a/a	Qualitative estimation	Quantitative estimation
1	Checklists	Event Tree Analysis (ETA)
2	Preliminary hazard analysis (PHA)	Fault Tree Analysis (FTA)
3	Safety Flowchart	Failure Mode and Effects Analysis (FMEA)
4	What If Analysis (WIA)	Failure modes and effects and critical analysis (FMECA)
5	Bow-Tie Analysis	
6	Hazard and operability study(HAZOP)	
7	Layers of Protection Analysis (LOPA)	
8	Security Vulnerability Analysis (SVA)	

OSHA has established specific mathematical calculations enabling companies to report their recordable incident rates, lost time, and severity rates [5]. The standard base rate for the calculations is based on 200,000 labour hours. These hours equate to 100 employees who work 40 hours per week and 50 weeks per year. Using this standardized base rate, companies can calculate their rate(s) and get a percentage per 100 employees. Safety professionals can use comparing, and benchmarking tools via internet to calculate these indicators (occupational injury and illness incidence rates) [13].

The present study uses the qualitative estimation method of "Checklist". It's an empirical method of estimation, just like the methods of questionnaires that are used by the European Union (OSHA). Oral communications with the responsible for the station and frequent visits to it revealed the danger that the working area runs through. Statistical Science is used for the analysis of occupational risk.

Table 1 presents the risk assessment methods [14]. Another significant categorization of the qualitative risk analysis are the categories including Brainstorming, Interviewing, Delphi technique, Historical data, Operating hazard analysis (OHA), Risk matrixes [15], as well as Toxicity assessment (TA), Structured "What-if" technique (SWIFT) and Scenario analysis (SA). Additionally, other methods are: Business impact analysis (BIA), Route cause analysis (RCA), Cause-consequence analysis, Cause and effect analysis, Decision tree analysis, Human reliability assessment (HRA) [16]. Between the qualitative and quantitative method exists the semi-qualitative method. Many uncertainties exist to all the methods [17].

2.1 Description of the Health and Safety at "AHS" Keratea-Lavrio

The main scope of this study is served by the on-site visit of the "AHS" Keratea-Lavrio the summer of 2023. It was noticed that the power station was founded in 1950. In 1974, the Lavrio Energy Center was created with the first Steam Power Unit with a power of 150,000 KW and then the second with a power of 300,000 KW. In 1980 the 234 MW gas turbine units were operated at the Station. The "AHS" Keratea-Lavrio was in regular operation in 1998 with the completion of the installation of the natural gas pipeline as well as with the completion of the "MikroLavrio", with 117 MW power (1997). The power unit consists of the central units of the production, three retired units, water treatment facilities, cooling seawater and industrial waste treatment plants, port facilities, tanks of oil and diesel, natural gas arrival station, warehouses, machine shop, maintenance building, chemical Laboratory, Administration building, restaurant-canteen and other auxiliary buildings.

The station currently has two production units run using natural gas and diesel. These materials are unloaded at the port facility and stored in the existing tanks. In the facilities of the Station, there are storage areas for materials used during maintenance, but also for chemical substances for the control of the Chemistry. The Chemistry operates throughout the day, carrying out continuous checks.At the same time, the facilities for water treatment, seawater treatment for cooling the units and industrial waste treatment are also in continuous operation.

The number of employees (about 170 workers) is variable. It is divided into permanent staff, temporary staff and contract staff. People with disabilities do not exist, but there are provisions for visitors. The enterprise employs Safety Technician, Occupational Doctor and nurses, Committee for health and safety (called "EYAE") and Port Facility Security Officer (called "YALE"). EYAE consists of three (3) workers, and laws are strictly followed. A central and seven (7) partial pharmacies exist. The employees carry out preventive check-ups and their medical records are maintained.

As noticed, the "Health and Safety Plan", the "Emergency Response Plan", the "Port Facility Security Plan" and the "Safety Plan of Operation" were according the legislation and they were reviewed at regular intervals. The "Emergency Response Plan" covers emergencies involving Fire (explosion or chemical spill), Natural phenomena (such as earthquake) and illegal acts (such as terrorism). The "Safety Plan of Operation" is drawn up following the SOLAS XI-2 Convention, the International Code for the Security of Ships and Port Facilities (ISPS Code), Regulation (EC) 725/2004 and Laws 3622/2007 and 4150/2013.

The Safety Technician, the Occupational Doctor, the "EYAE" and the Port Facility Safety Officer "PFSO" were in reaction with the "Book of Written Instructions", the "Accident Book" and the "Book for Measurements of Harmful Factors". The Harmful factors are determined as noise, particulate matters, the microclimate (as lighting and ventilation) and hazardous substances. "AHS" Keratea-Lavrio has been certified for Safety and Health at Work and the Environment according to the standards of ELOT ISO 45001 (evolution of the British standard BS OHSAS 18001) and ELOT ISO 14001. An annual program is drawn up every year trainingunder previous ISOs.

Safety specifications consisted of the equipment's stability, strength and firmness, the cooperation of all the safety contributors and compliance with the regulations. Examples of these situations are the prevention of fire during work, measurement of harmful factors, appropriate lighting, door safety devices, smoking areas, and more. Another crucial specification for safety is the "Lock box" and "Lockout" systems. The first is a safety net based on “Isolation protocol” for the operation of mechanical energy. The second is a method where the isolation is done using a locking mouthpiece with unique padlocks (depending on the number of tasks). Padlocks have unique keys. After all, for the implementation of any work, the “Uniform Regulation for Issuing Work Permits for Thermal Power Plants” is followed, the employees are trained and the appropriate materials and tools are selected, considering the cases of fire and more.

Emergency traffic routes - danger zones predicted in case of emergencies. Emergency exits have been studied, properly planned (according to the number of employees that should evacuate the area) and inspected twice a week. The emergency doors are unlocked and have suitable safety mechanisms (even manual ones) to prevent them from closing suddenly (presence of doors with “push bars”). Vehicle gates were provided space for pedestrian traffic.

According to Presidential Decree 105/95 and the “Written Occupational Risk Assessment”, there are signages in the area. On the traffic roads of the Station, the markings have been signed following the provisions of the “Road Traffic Code” (Law 2696/1999) and frequent checking has been performed. The marking of the premises is divided into permanent and occasional marking. Permanent marking is achieved with signs and paints. It refers to the prohibition, warning, obligation, recognition and identification of first aid and rescue equipment for dealing with a fire, marking containers of materials and pipes, marking possible hazards of impact with objects or falls, and marking traffic roads. Occasional signage refers to the marking of hazardous events, as the danger of slipping (during the cleaning works). In addition, situational signalling also refers to calling people for a specific action, the urgent removal of people and the guidance of people with manipulations (such as sound-light signals, wireless communication systems and signals with gestures).

Posted boards with instructions (such as safe working conditions and first aid) are everywhere. A thermometric system can measure the temperature of the employees and visitors (because of COVID19). In all areas, there is an antiseptic hand solution and signs for using a protective mask. No smoking areas exist at the Station. Other rooms are appropriate for the resting of the employees. Changing rooms and storage of clothing, their personal belongings and personal protective measures also exist. Guests are provided with a safety helmet, a disposable cap (to be fitted before the helmet), and disposable earplugs.

PPE granted to all the employees, according the European Standards EN [18]. These consisted of safety helmets (according to EN397 and EN166), safety footwear (EN345/92 S3), work gloves (EN388 and EN420), multi-purpose or disposable plugs (EN352-1, EN352-2 and EN352-3), safety glasses (EN166) and face safety mask (EN175). Other means were fluorescent vests, headphones, safety belts, lashing ropes, safety loops, oxygen masks and stored oxygen bottles. Additionally, depending on the specialty and the work of the technical staff is defined extra PPE by the Safety Technician.

In addition, specialized trainings were carried out for the technical staff, either when new equipment is used, training at the Port Facility of the Station, evacuation training for all the station staff, and training for the Physical Safety (Security) staff. In addition, collaborations carried out to conduct drills by the Fire Department and other agencies. The Station has appropriate fire detection and fire extinguishing equipment (CO_2 and powder individual fire extinguishers ABCE) and automatic systems (system Deluge). The deluge CO_2 has backup bottles of extinguishing material. Fire pumps (petrol and electric-driven), tanks, fire stations and hoses connected to the central water supply system join their forces against a possible fire at the station. Fire safety teams for each area of the Station can intervene to suppress fire outbreaks. The installed optical systems and audible alarms assisted in warning. All media is signed, regularly maintained and checked weekly.

The microclimate for workplaces is often checked. The proper and sufficient provision provided fresh air where it was necessary to install a ventilation and air duct system. The temperature during work is adjusted according to the needs of the human body and the climatic conditions of the seasons. At regular intervals, measurements of harmful factors are made, which are repeated approximately every five years or more often if there is a change in the equipment or the use of it. In the event of a fire inside a unit, a mechanical system is installed for direct ventilation of the space. Every workplace has adequate lighting, either natural or artificial.

3 Problem Solution

The survey's main goal is the risk analysis at the “AHS” Keratea-Lavrio, using a checklist recording various potential factors that are taken into account to identify the total risk of this power plant. After many visits into the site and interviews with the responsible staff, the possible risks were identified, recorded and included typical examples of the manifestation of the risks, the degree of risks and the description of possible effects. Furthermore, the participants were called to propose measures needed in order to reduce the identified risks.

The risk analysis processed the aggregated data. A checklist about the above factors was created and is presented in Table 2 and more detailed in Appendix 1. The Safety Technician, Occupational Doctor and PFSO contributed to the rating of the risk analysis. Every factor is categorized with values between 1 and 5 i.e. "Low Risk" (values 1-2), "Moderate Risk" (value 3) and "High Risk" (values 4-5). "Low Risk" values indicate that acceptable risk exists in parallel with certain protective measures, while "Moderate Risk" indicates that programming is needed, protection measures have to be implemented and extended monitoring is necessary. "High Risk" value is an indication of the immediate need for the implementation of several protective measures.

Table 2. Summary table of the main factors of the risk analysis

a/a	Threats	Ranking of risks
1	Occupancy of entrances/exits of the station	Low
2	Occupancy of an internal part of the station	Low
3	Occasional section capture coastal zone or the Port	Moderate
4	Intentional contamination of the coastal section of the station	High
5	Technological infrastructure disasters minor scale	High
6	Technological infrastructure disasters	High
7	Phone pranks, Bombing threats	Moderate
8	Falling of an employee of the station or crew of the fuel transport vessel within the sea area near the station	High
9	Fires inside the station	High
10	Collapse (total or partial) of the buildings and the facilities of the station	High
11	Traffic accident on the internal road network of the station	High
12	Pandemics	Moderate

The analysis highlights 12 factors that may occur at the station, according to the responsible staff of the Unit. These factors are occupations of entrances and exits, sea pollution, technological disasters, employee falls, fires, building collapses, traffic accidents and pandemics. The possible impacts were considered, and proposed measures need to be taken in any of the cases mentioned earlier for their mitigation.

Table 3. Summary table of the main preventive measures of the risk analysis

Type of risk reduction measures	Preventive measures for mitigation of the impacts
1.	Preventive measures (before the disaster/occupational accident)
1.1.	Create more emergency entrances and exits
1.2.	Installation of a microphone system for emergency announcements to staff/workers
1.3.	Installation of emergency signs (i.e. speed limit signs)
1.4.	Reserve operation planning and communications systems
1.5.	Preparation and elaboration of energy plans, in cooperation with the Facilities Security Director
1.6.	Preparation actions and implementation of emergency response plans (performing emergency exercises and evacuations)
1.7.	Regular training of Station employees regarding the implementation of emergency response plans, the correct use of life-saving equipment, PPE, safety road rules as well as the provision of First Aid

The categorization of the factors revealed that two (2) factors characterized as "Low Risk", 3 factors as "Moderate Risk" while seven (7) factors as "High Risk". These results are similar to our expected values as the "AHS" Keratea-Lavrio is a critical infrastructure facing several dangers/risks. It is remarkable that factors associated with "High Risk" include heavy impacts to the people or/and to the environment. "Moderate Risk" factors are associated with injuries while other operational issues (as the shutdown of the station) are characterized as "Low Risk". In any case, protective measures are proposed. In percentages, "Low Risk" occupies a percentage of 16,7% of the whole risk, "Moderate Risk" occupies 25% while "High Risk" occupies 58,3%.

The survey separates the measures needed due to the station's risk analysis at two central classes: (i) preventive measures before the dangers and (ii) management measures after the occurrence and the impacts of the danger. The first measures are seven (7) and the second is eleven (11). Table 3 presents these preventive risk reduction measures, while Table 4 portraysthe management measures, according the exclusively dangers detected.

Table 4. Summary table of the main management measures of the risk analysis

Type of risk reduction measures	**Management measures for mitigation of the impacts**
2.	Management measures (after the disaster/occupational accident)
2.1.	Implementation of emergency response plans, in collaboration with the Safety Facilities' Division – Estimating of the situation
2.2.	Informing the emergency services and the Public Authorities (Fire Department/ Police / Port Officer-Coastal guard and the Prefecture / Municipality)
2.3.	Inform all staff about the incident over the public address system, using a microphone system
2.4.	Activation of fire safety
2.5.	Activation of ambulance and nursing operation team
2.6.	Activation of Port security plans under by the Port Facility Safety Officer (YALE)
2.7.	Activation of building evacuation teams
2.8.	Interruption of vehicle traffic on the internal road network
2.9.	Granting of PPE for the employees
2.10	Relocation of services
2.11	Creating preconditions for the reception of external aid and the removal of people in danger

A similar risk analysis methodology was applied at the Water Treatment Systems of "AHS" Melitis in 2018, using the consequences of dangers and the probabilities to occur. The result was the proposed preventive measures to those involved [19].

Industries recently used improved safety checklists using intelligent video surveillance to replace on-site inspections. These methods prove the entrance of media and distance checking of vulnerabilities at the altar of the safety and health evaluation [20].

Researchers proved that checklist judgment accuracy was similar to quantitative exposure judgment accuracy observed in studies of similar design [21]. Occupational health specialists applied checklists for the evaluation of psychosocial risk. Increased competence in specific skills was recorded with the sample of physicians that didn't participate [22].

Observation is one of the main discovery issues implemented in qualitative approaches in public health [23]. At this glance, the present risk analysis focuses on all the infrastructure hazards the staff is exposed to. Risk analysis about pesticides and chemical substances also uses preliminary tool models by farmers for practical use [24]. In addition, hazardous materials, and much more are been involved in the final assessment.

The study is a first step in risk analysis of the station, using checklist approach [25] according to construction safety principles [26]. That procedure of preliminary studies (as qualitative methods) is standard to engineering problems and studies, causing positive or negative results [27], when it is compared with quantitative predictions.

The present problem is approached through a qualitative first reading to take immediate protection measures or to give priorities for further study. This is supported by the limited time and finances that the administrations have for taking restrictive measures. It considered the opinion of the responsible staff of the Unit (charged with several responsibilities on the site), who take care of all the procedures and recognize all the parameters of the problems. These estimates also depend on the timing carried out. In this study, the implementation took place during the summer season, which means that the work was carried out with less staff (due to summer vacations), but the station managers were more willing to be recorded their opinions on the checklist. The opinion of the responsible staff depends also from their perception of the danger and the risk. More detailed studies must be done for more focused research, as well as the assessment of the risk.

4 Conclusion

"AHS" Keratea-Lavrio is a critical infrastructure near the capital of Greece, and all stakeholders

(Greek state, municipality of Lavrio and the local society) need to show greater interest and be aware of its potential vulnerabilities, due to several future risks. The Laws are multifarious, including all the parameters of occupational accidents according to European Union Directives and ISO standards. Organizations, institutes, and other government bodies treat all issues related to these aspects.

Safety Technician, Occupational Doctor, Commitees and the responsible staff of the Energy Unit must monitor and implement health and safety, using primary rapid observations, including checklists, as a qualitative risk evaluation method. The participants can indicate danger issues and the risk mitigation must be planned.

Various risks are generated at "AHS" Keratea-Lavrio. The analysis highlights twelve (12) threat factors according to the checklist that was created during this study. The impacts of the dangers are five (5), ranking from a station shut down, a port shut down, injuries, deaths and environmental impacts. Furthermore, the factors are classified as risks according to the description of their effects.

The result is that this energy Unit has a significant percentage 58.3% of High Risk (as expected), and a lower percentage of Moderate (25%) and Low Risk (16.7%). The severity of the five impact factors of threats is closely related to the ranking of the risk scale (high, moderate, low).

Specific measures (that are nominated) must be implemented in any case of future risk to mitigate the impacts of disasters or occupational accidents. Seven (7) risk reduction measures are categorised as protective measures, while eleven (11) are the most common among the interviewees as management measures.

The risk analysis reveals valuable data for their administration, similar infrastructure, and the government to draw up risk management policy, set priorities, and choose the optimal potential solutions. Local construction agencies may improve the safety and health measures for risk mitigation.
Furthermore, the on-site investigation described in this study can assist the professionals understand the role of every involved factor. The future direction may be the more focused exanimation of the risk factors, the correlation with the results of quantitative methods, or even more of the connection of the present method with new technologies (such as cameras). More risk analysis surveys will eventually be required to precisely determine health and safety issues.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

Dr Ploutarchos Kerpelis was responsible for the conceptualization, methodology, writing and supervision.

Andriani-Christina Argyriou implemented the conceptualisation, made the formal analysis visits to the Power Station, and was responsible for the data curation.

Dr Dimitrios E. Alexakis, Dr Vasileios Kotinas have written/edit, organized the resources and had the supervision.

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Appendix 1: Ranking of the station risks and measures needed

a/a	**Ranking of risk (1-5)**	**Description of effects** a. Station shutdown b. Port shutdown c. Injury d. Death e. Environmental impacts					**Risk reduction measures** (Table 3-4)
		a.	b.	c.	d.	e.	
1.	2	√	√				1.1., 1.2. 1.5, 1.7., 2.2.
2.	1	√					1.2., 1.3., 1.5., 1.7. 2.2., 2.6.
3.	3	√	√			√	1.2., 1.3., 1.5., 1.7. 2.2., 2.6.
4.	5	√	√	√	√	√	1.1. - 1.7. 2.1. - 2.11.
5.	4	√	√	√		√	1.4. - 1.7. 2.1., 2.2.
6.	5	√	√	√	√	√	1.1. - 1.7. 2.1. - 2.11
7.	3	√	√	√			1.5. -1.7. 2.1. - 2.3.
8.	4	√	√	√	√		1.3., 1.4. - 1.7. 2.1., 2.3., 2.5., 2.6., 2.8.
9.	5	√	√	√	√	√	1.1. - 1.7. 2.1. - 2.11.
10.	5	√	√	√	√	√	1.1. - 1.7. 2.1. - 2.11.
11.	5	√	√	√	√	√	1.1. - 1.7. 2.1. - 2.11.
12.	3	√		√	√		1.3., 1.5. - 1.7. 2.1 - 2.3., 2.5., 2.6., 2.9., 2.10.