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Original article

Prioritizing components of water supply systems according to conditions of passive defense approach to achieve sustainable development

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ABSTRACT

Urban water supply network as an integral component of every city is responsible for providing and transporting water which is the most critical needs of the community. Any problem in this system impairs citizens' access to water. In the event of an earthquake or war or other threats, transmission and distribution networks are at risk of serious damage and vulnerable. In designing water supply facilities, it is necessary to consider security infrastructure to cope with the crisis,in addition to the usual considerations of design. This subject is studied in terms of passive defense engineering. Engineering passive defense is necessary to reduce risk, control consequences of crisis and increase repair ability which is discussed by implementing seemingly simple principle, but it is complicated in design and implementation. In this paper, sensitivity and risk-taking of different components of the water supply system with defensive measures is examined. Thus, strengths and weaknesses of each are identified and passive defense research priorities are determined for water supply facilities.

1. Introduction

Lack of water in any way, such as run out of water, lack of access, disruption of water supply systems and etc can place individuals and communities at risk. Factors like earthquakes, air strikes, ground attacks, and terrorist missile at installations must be known in water supply systems and adopt appropriate preventive measures. Passive defense is including all preventative measures which led to increased safety. These actions are completed in peacetime and continue to end of crisis.

Passive defense requirements should be considered in design phase to secure water supply facilities and have had appropriate defense capabilities in terms of defense and implementation certainly. In our country, most of projects have been conducted without regard to principles of passive defense. Thus, country's infrastructures are vulnerable to crises.

To achieve sustainable urban development in the community, it is essential that adequate security be in the community. Lack of necessary safety in each of the main infrastructure of country is an obstacle to achieving sustainable development surely. Therefore, the security and safety are so important critical parameters that must be considered and it must be followed in all projects and construction. In this study, water system facilities are presented then, characteristics of each component are analyzed in terms of defense. According to the interaction model, necessary defensive actions can be considered to achieve the desired level for each facility.

2. The concept of passive defense

Passive defense is a set of planning, design and procedure that reduced vulnerability to threats, this concept is also mentioned as a deterrent. The main policy of passive defense is based on survival and keeps safety, and overall aim of passive defense is safety and reduces the vulnerability of needed infrastructure of people, to gradually create the conditions for security and in fact passive defense reduces costs, avoids wasting time and energy and enhances security in society. Generally, passive defense follows the principles that are consist of concealment, camouflage, strength, cover, construct resistant structures, distribution, transportation, deception and disorder, access, barriers, alarm systems, Culture , education , shelter, defense logistics, weapons Science and geological mapping. Measures are done to conceal unit by help of nature or artificial features that are named camouflage and concealment in term, like construction plants in cavern. Fortifications temporary structures are to reduce risk, including an embankment and concrete slab foundations. Other passive defense parameters are including design and implementation of safety structures against threats. Distribution is another important element of passive defense that reduces possibility and amount of damage with making identify and target difficult.

3. Secure and sustainable urban development

Achieve security and sustainable development can be possible with establish and build defensible spaces and apply principles of passive defense. Although security issue is affected by security situation in the city, but it is even more important. Studying urban security issue is important, because interdependence between security and development is inevitable. Development and security concepts and relationships defined between them leads us to conclude that:

1. Development produce security, so backward of a country in economic, social, cultural, and technology issue increase the country’s vulnerability coefficient and sometimes, it leads to national security treat. Moreover, the development and enhance the national power of a country, would be the introduction of national security.
2. Security, promote development, it has meant that development only shape in security frame (Momenzadeh, 2007).

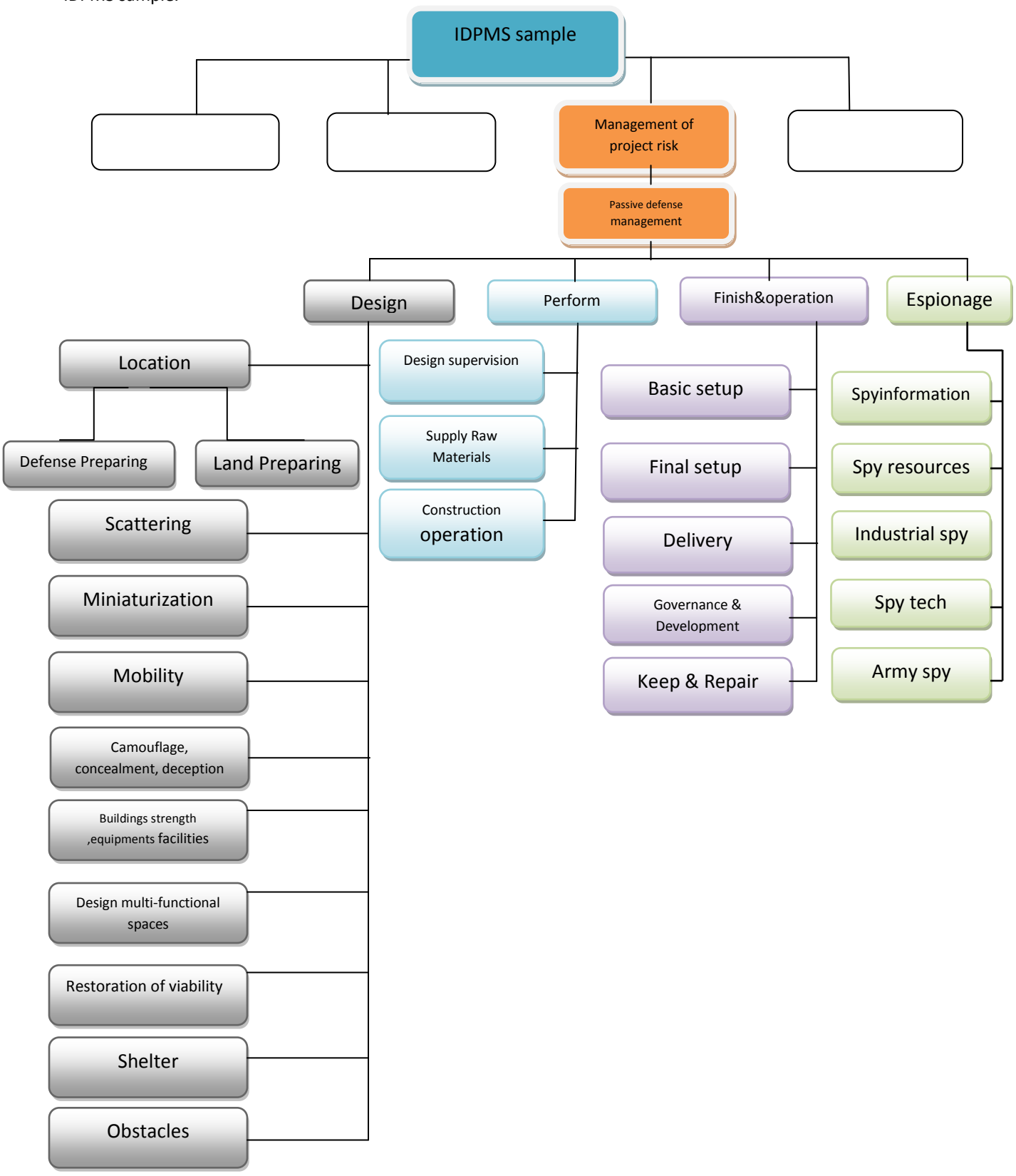
4. Water supply system facilities

Main steps of water production and water supply is consequently consist of water resources, stored raw water, pumping station , raw water pipeline, water treatment plants, water distribution networks. Rivers, lakes, underground aquifers with deep shafts are including water resources. As you see, these components have a high extent and their risk of infection is very high. Dams, ground indoor or outdoor tanks are raw water tanks that because of the extent of the damages caused by damage and due to high volume water supply they are in high rank of importance. Pumping stations are another component of water supply facilities that water flow is stopped in impaired performance. But since rebuilding pumping stations is less difficult than other components, they are considered less. Although buried pipelines and raw water transmission line channels are massive and scattered and physical protection is practically not possible for them, but their rehabilitation isn't difficult like pumping stations rehabilitation. Also, Most of these lines are being buried and it is an innate immune factor. Water treatments are another component of water supply facilities that often act common methods of water treatment. Water treatment plants often are the last point for possible infections, but these facilities are centralized and can easily be identified because they are centralized and are so important from passive defense view. Risk identification is high in overhead water tanks, while underground tanks don't have this problem, but the risk of getting infected is high because of easy access. Distribution networks are the last point of delivery to the consumer that are consist of buried pipelines, valves, switching valves, hydrant etc. Distribution networks are extensive and air, land and missiles threats are not very effective. But they are vulnerable because of special access, such as fire hydrants, against terrorist attacks and subversive.

5. An interactive model of country's defense project management system

The total structure of country's defense project management system and position of passive defense is shown in follow figure. As you see in this figure, passive defense is considered as set of management of projects risk. According to this chart, passive defense management will be analyzed base on design, implementation and operation considerations. The inherent characteristics of each component must be examined from the perspective of passive defense in design phase of water supply facilities. For example, filtration units of water treatment plant is easily identified, so some measures such as camouflage must be considered in its design but distribution network is essentially buried and has secrecy principle with itself. In this article we have tried to confirm inherent characteristics of water supply system components conforming to the principles of passive defense. This adaptation is an appropriate guide for the design and implementation of defensive measures that is in interactional model of management system of defense project.

Table 1
IDPMS sample.



6. Intrinsic nature of water supply system components due to defense manner

Qualitatively, that by too many categories is high. Well as to classify casualties or economic human loss is provided for each. The defensive characteristics to adapt the principles of passive defense , has been under study in this table , only referred to scattering factors, extent, detection capability, availability, reliability focuses and repair. The scoring table is numeric and weighted grades, is including high (4) High (3) Moderate (2) Low (1).

After grading, members prioritized based on defensive considerations to accordance with the Following table

Table 2
Grading the different parts of the system based on the seven criteria.

items		Dispersion	Area	Detection	Accessibility	Repair	results	
							Casualties	losses
Origin	Surface	4	4	4	4	2	1	2
	Ground	2	1	1	4	2	1	1
	Dams	1	3	4	2	1	3	4
Untreated water resources	reserviors	1	2	3	3	2	1	1
Transportation		4	4	1	1	3	1	2
Pump station		1	1	2	3	2	1	2
Water treatment plant		1	1	3	2	1	3	3
Reservoirs		1	1	2	3	1	1	1
Distribution network		4	4	2	3	2	3	1

After grading, prioritizing items based on passive defense is as below:

Table 2
water supply system priority.

Priority	Sector	score
1	Surface water resources	21
2	Distribution network	19
3	Dams	18
4	Transmission line	16
5	Water treatment plant	14
6	Untreated reservoirs	13
7	Pump station	12
8	Reservoirs	10
9	Ground waters	10

Figure 2, the impact of threats, property damage and loss of life on both factors, is observed. As it is observed, dams, water treatment plant sand distribution networks in terms of human casualties' economic damages are the above priorities.

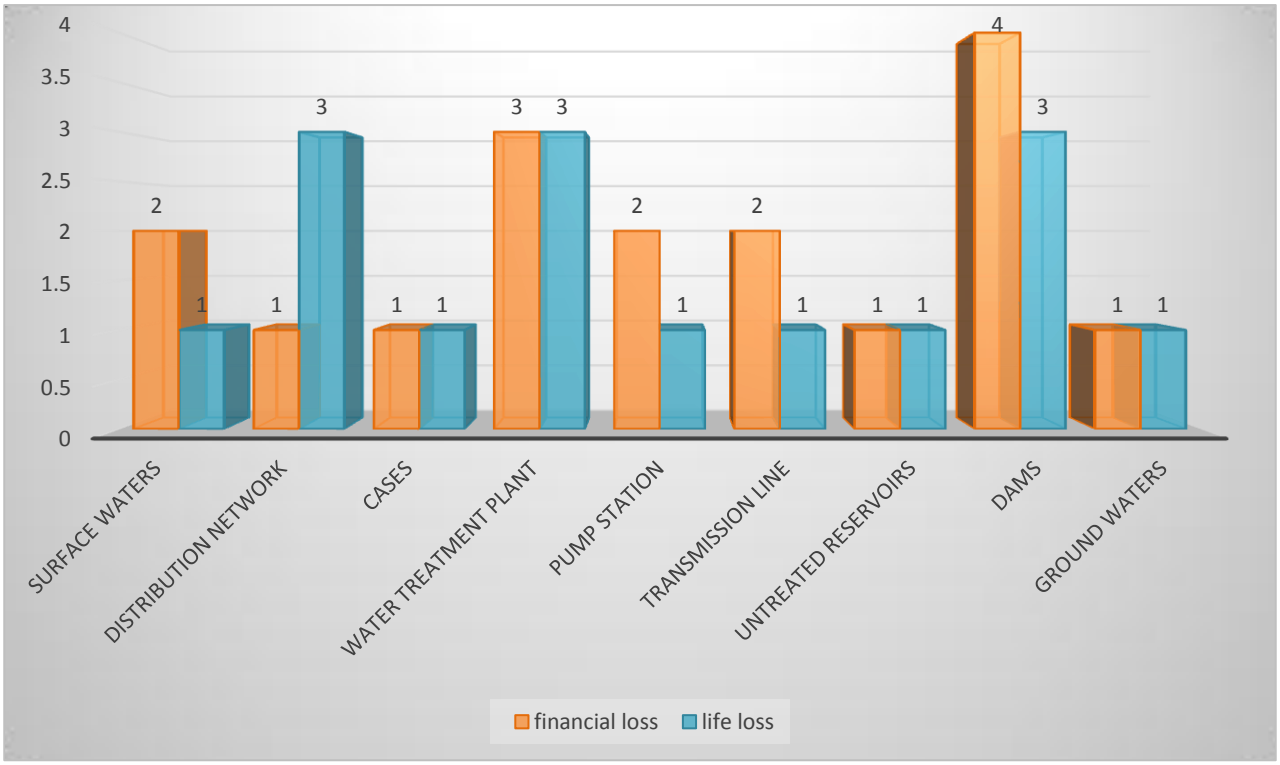


Fig. 2. damage level of property and life.

Figure3 shows the optimum form of passive defense in plants and water supply. Defensive approach to the restoration of a structure or other appropriate high-be easy, and the possibility of high dispersion. Identify, and the ability to gain access and its should between lower extent possible.

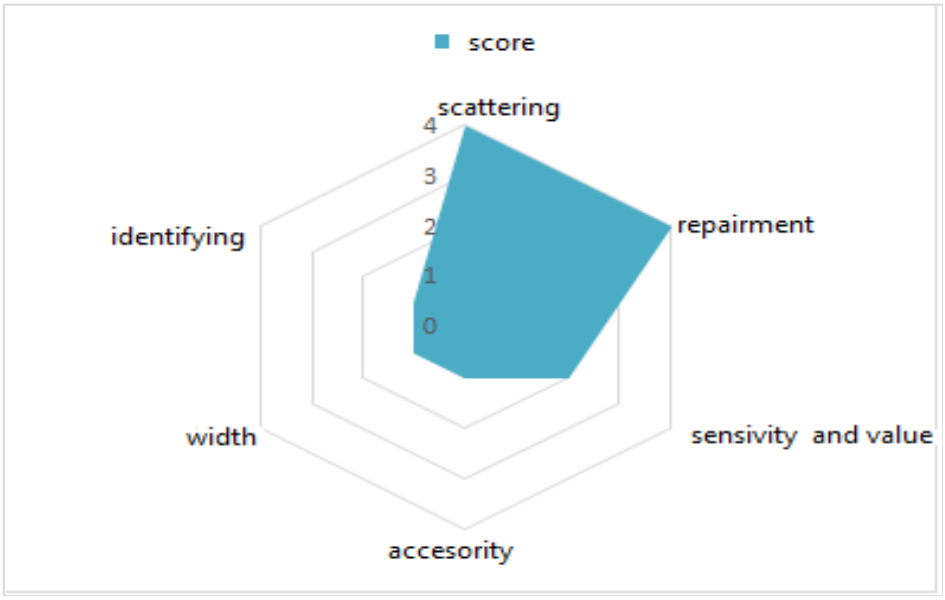


Fig. 3. Proper form for water facilities with passive defense considerations.

The graph for the other components of the system is depicted separately.

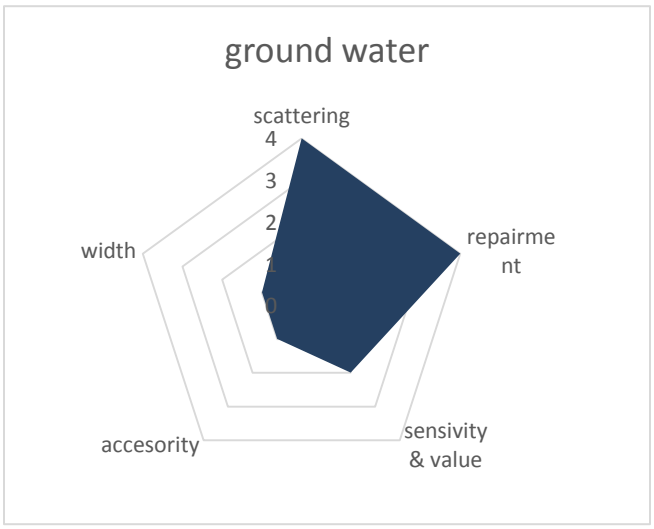


Fig. 4. parameters of passive defense in the groundwater

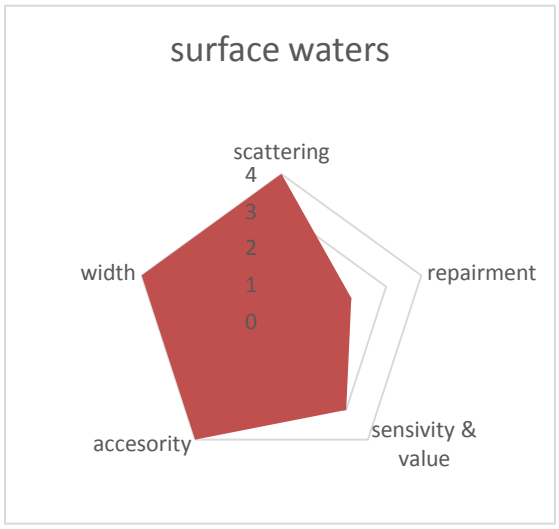


Fig. 5. parameters of passive defense in surface waters.

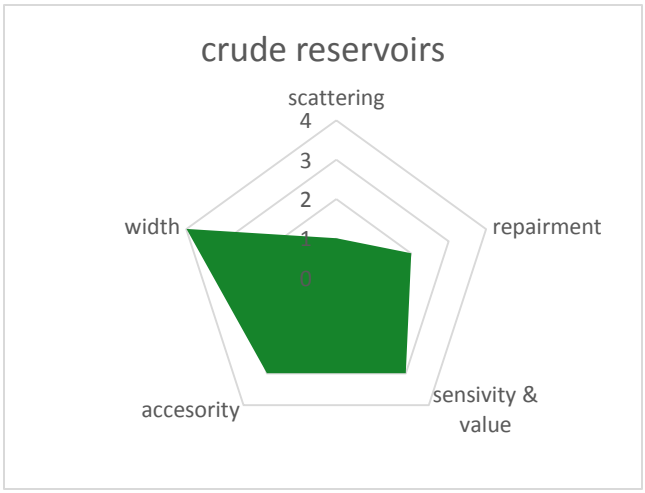


Fig. 6. parameters of passive defenseincrudereservoirs

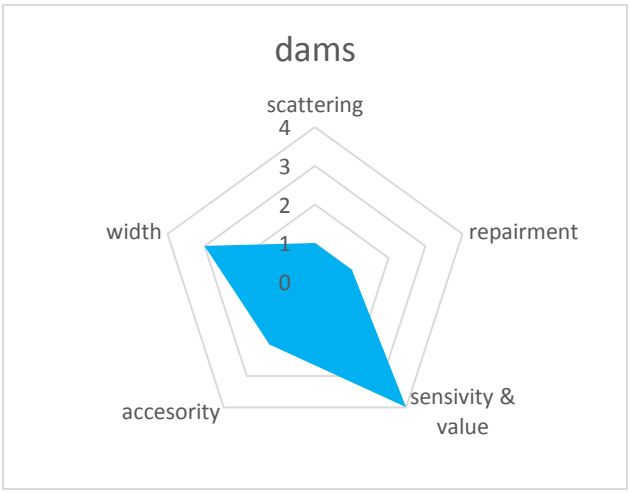


Fig. 7. parameters of passive defense in dams.

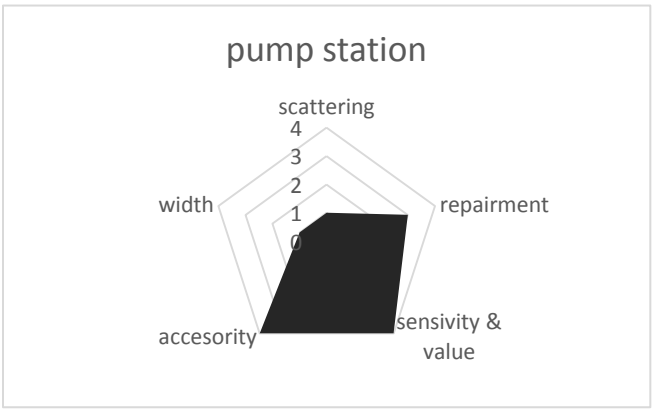


Fig. 8. parameters of passive defense in pumpstation

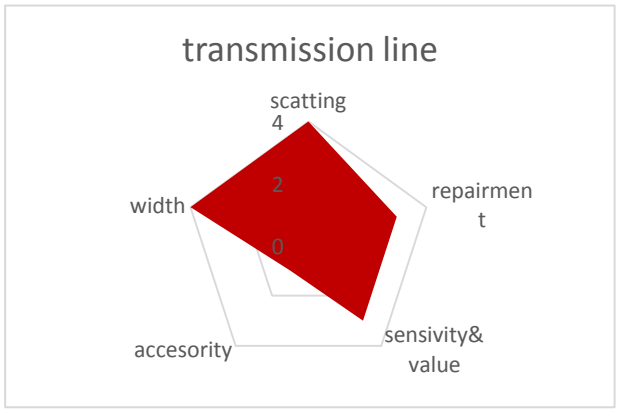
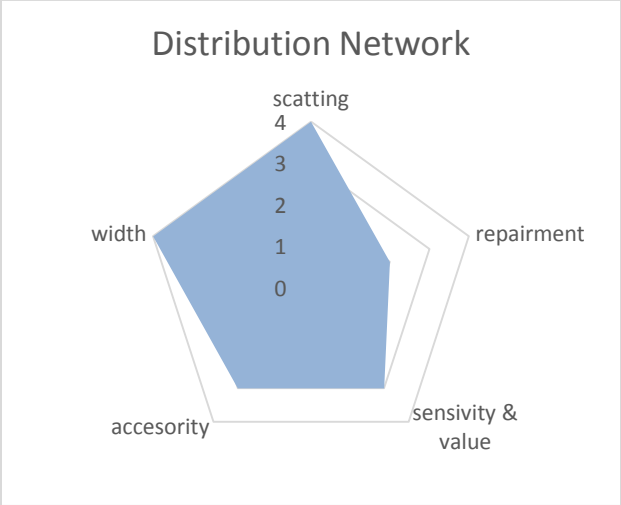


Fig. 9. parameters of passive defense in the transmission line.



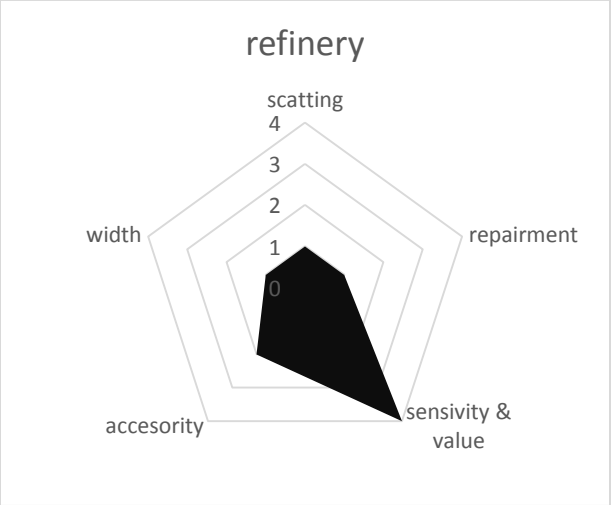


Diagram 10. Parameters of the Passive Defense Distribution Network **Diagram11:** parameters of passive defense in refinery.

7. Prioritizing facilities with passive defense measures

According to the results, Dams in the terms of compliance with passive defense Include centralized installation and Lower pair and the level of potential losses in passive defense are the priority of engineering design. The analysis performed shows after dams, water treatment plants is the next priority. Likewise, other facilities can be prioritized.

8. Earthquake and its role in damage to the facility

All operational water and sewage projects, mainly the transmission lines ABFA, ABFA treatment plants, pump houses of ABFA, Man sidewalks, utility and storage resources and water supply has been formed and vulnerability of priority is located, it should be noted in Surveying of observational from the point view of Earthquake the injuries are directly related to the wind, and the main reason:

8.1. Permanent deformations of the earth; 2.vibration waves

Dare to be said in relation to the deformation of the network sees serious injury, and evaluate various aspects of design that requires some research as applied that in this summarized there is not time to pay it. But the vibration caused some wave strategies such as 1-ramificationsand connections, valves, other devices will cause great damage to the water network2-corrosionandwearof tubes, under the effect of shaking will more damage3-pipelines across the faults and surrounding reached it to the most damage. Therefore, planning to make necessary arrangements when dealing wave vibrations possible, crisis management should considered described following order to relevant working groups:

- Reforming and reviewing the maps and network processing facilities, and water supply systems
- Using advanced engineering and technical methods in dealing with corrosion and wear Facility
- Design a new network outside the limits of the effects of faults and make appropriate arrangements

Additionally, in order to mobilize relief centers mission which is to provide water supplies list identifying technical requirement that such action is necessary for the relevant table(tools and equipment to aid the flexible tanks in crisis.

Rescue and repair of tools and equipment, plant, tools and equipment listed in critical condition are considered.

Address the following two fundamental assumptions in preparing the action plan before the crisis are as follows:

- informing and related training to earthquake preparedness for disaster identify safe points outside the limits of the crisis

- Establishment of disaster management organizations at community level, regions, areas that ultimately connects to the motherboard Management Center.

9. Passive defense measures in the design of dams to increase the safety of Designed dams

Passive defense measures in accordance with the following is recommended:

- Resistance of to resist impact forces resulting from a direct hit by missiles and bombs,
- Designing of Dam power plant inside the shop,
- Improving early warning systems based on pore pressure changes taking place in the earth dam and Gages and location changing;
- Decision making on crisis;
- Observe the scattering on the lower tunnel, shaft, spillway, power. High Voltage Substation, , etc.
- Limited access roads, designing roads based on that dams are not exposed to direct vision - Strength and concealment and overflow valve and Gage components,

10. Civil defense measures in water treatment plants

The results of the analysis indicated that plant are also considered damageable facilities that their damage level is high therefore proposals for the facility has-been discussed are as follows:

• Camouflage considered filtered into the niches that they use natural or artificial complications,
• to counter with chemical, biological attack and design based monitoring stations SCADA
• consideration of emergency sources of water for drinking purposes (such as wells, water bottles, etc.
• Lack of water treatment plant focuses units including flocculation, filtration, settling, etc units.
• physical protection of the plant and facility layout to reduce identified

11. Results

Subject passive defense is very broad and wide So that addressing any of the details are very time consuming and requires a great deal of research . Overall view of passive defense networks and water systems, to increase safety and reduce the loss rate components will be emphasized. Given the priority that became evident that dams are an important component to address these criteria. Water treatment plants are looking for the next place.

Any interruption in treatment may lead to irreparable consequences. Lack of sufficient strength and high wear is due to age distribution pipes and climatic factors if the crisis is also a factor that could possibly destroy citizens' access to water. Earthquake or a missile attack may occur at a time And a series of financial losses and physical appearance to be followed, But hours after witnessing the consequences are much more severe and more extensive loss Lifeline is one of the most important.

Vulnerability of reservoirs, transmission and distribution networks, water treatment and safe water crisis is not the only cause, but it can be unpleasant consequences such as disease outbreaks, environmental damage, and damage to the cycle of the ecosystem etc to be followed. Finally, it is worth mentioning that for a dynamic and sustainable city according to the principles of considering to passive defense is one of the crucial factors. It is important to note that the lack of adequate safety and security can never promote a cohesive society towards sustainable development.

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