

Investigating Principles and Requirements of Passive Defense in Dams

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Abstract: Protecting infrastructures and vital areas are among the most important measures in order to increase the national security and preserving important resources and human life. Dams and their related equipment are among these important areas. These structures have always been exposed to the danger of natural disasters such as earthquake, flood, etc. and also unnatural dangers such as attacks by enemies or sabotage operations. Passive defense is a set of measures which reduces the threats to their lowest level through spending less equipment and facilities compared with active defense, reducing or removing vulnerability, controlling the results of attacks and increasing the ability of restoration against sudden attacks of enemies and without using any weapon and direct fight. The present research investigates the consideration of passive defense about dams regarding measures and the research done in the past and experiences of different countries in this area and the researchers have tried to introduce some solutions for increasing the safety of these important structures.

Key words: Passive defense, dam, safety of dams, safety measures, crisis management

INTRODUCTION

The history of human life has always been faced with threats which put in danger what human has made, spiritual assets and even his own life. So in order to survive, human has had no other choice but to get equipped against these threats. These threats can be classified as natural threats and man-made threats. Therefore, we turn to defensive measures called passive defense.

The engineering of passive defense is a collection of engineering and architectural measures with which we can resist using the least technical equipment (compared to active defense) through reducing or removing vulnerability, controlling and the results of attacks and increasing the ability of restoration against sudden attacks of enemies and without using any weapon and direct fight. The engineering of passive defense from the moral and humanitarian and political point of view has a peaceful concept.

The first mission of passive defense is to reduce vulnerability and increasing the safety of national infrastructures and vital and important centers of the country against extorter threats. Among the most important infrastructures of every country are the water industry and its related areas. In the present study, passive defense in this area has been investigated (Hamid, 2013).

The necessity of applying passive defense in dams: Upon building and starting to make use of dams, there can exist

potentially dangerous situations. The breaking of dam is a disastrous phenomenon which results in flood in the areas around the dam and can cause noticeable financial and human damages. The range of these damages regarding both time and place is great and even cause the reduction of the national credit of a country.

In the process of designing a dam, the consultant is responsible for designing the body of the dam based on geotechnical studies, designing the hydraulic structures such as overflow, dam's pond, stilling basin, etc., conducting the hydraulic studies of the project, providing the instruction of using the tank of the dam regarding the water needs of the surrounding areas of the dam, providing the report of the evaluation of the environmental effects of dynamic designing of the dam and the studies of the place of the building of the dam in terms of seismology, etc. and each these cases is supposed to be done by numerous engineers with different expertise during the process of designing and building the dam. But it seems that someone else is needed here. Someone who not only has the general knowledge and skills of the above-mentioned experts but also knows the defensive tactics so that he designs precautionary measures in order to reduce the danger of the destruction of the dam and its related equipment caused by unnatural accidents such as enemies to the lowest level. Engineers of passive defense study the effect of security and military threats, etc. in order to improve the stability of the dam against these factors in



Fig. 1: Eder dam on 17 May 1943

addition to giving their opinion on locating of the infrastructures and defining locations with the lowest probability of danger.

As example, we can refer to the England air strikes on the dams located in the industrial zone of Germany called Ruhr Valley during World War two. This case can be thought of as a very clear example of considering the engineering principles of passive defense in building dams. Ruhr was thought of as a completely strategic zone since many of the weapon factories of German army was located in that area which was close to Dortmund city. Damage to the Eder Dam is shown in Fig. 1.

If passive defense measures in the course of history studied, preventive measures to protect the lives of different nations, to survive and preserve land, avoid surprises and upgrade combat power is considered. Still on the threshold of the 21st century, the world was full of geopolitical conflicts and a sign of the end of armed conflict does not appear imminent, passive defense measures by different countries were involved and a special place in his country's defense policy has different nations and is maintained as a vital need and continued with various methods.

In countries such as America, former Soviet Union, Germany, France, England, Canada and even countries like Switzerland that has maintained its neutrality during both World War, increasingly turned to passive defense. Continue to the corner of the passive defense measures taken by the leading countries in this area are mentioned.

Basic principles of passive defense: In order to achieve security and safety of structures and vital infrastructure have to observe some principles and requirements as a result of passive defense measures in projects much closer to the desired goal. Passive defense and the underlying principles of fundamental measures that can be employed for passive defense purposes such as reducing losses, reducing the ability of the system to identify targets, targeted and carefully targeting the enemy offensive and cost facility was granted to him. These principles are described as:

- Choose a safe area in the geography of the country
- Determine the optimal scale deployment in space activities and population
- Dispersion in the distribution of performance commensurate with the threats and geography
- Selection of optimal dispersion and economic feasibility of the project
- Miniaturization and cost optimization and innovation in passive defense
- Parallel dependent on support systems
- Retrofitting, strength and safety of vital structures
- Locate deployment practices
- Management of critical defense scenes
- Camouflage and invisible effects
- Blind the enemy intelligence system
- Notice the use of natural effects
- Coverage in all areas
- Deception, initiative and diversity in all actions
- Protection of critical system information
- Production of dual purpose (barriers)

The principle of passive defense in various stages of construction of dams

Pre-construction steps and during studied project: At this point the fundamentals of passive defense, especially the location, distribution, retrofitting and fortifications, building dam, build shelter, shelter construction and safety equipment and tools dam should be studied in detail and in the design considered.

Locating the dam construction site: Choose a suitable location for water utilities in the zero study steps should be taken into consideration by experts and planners. The location is not usually a cover of separate instance of passive defense but in principle it is known an important principle of passive defense, proper or improper positioning can seriously affect the other passive defense measures. Today, with advances in science aerial surveying, Geographic Information System (GIS) consisting of a network of 24 satellite in orbit, created to analyze and summarize data, environmental changes, identify threats, pollution and many other cases has helped. Application (GIS) in passive defense including the privacy and buffer to obtain elevation models, cartography and mapping services. Given the foregoing, the local elected should have a series of characteristics in terms of passive defense which generally include the following: desired place has maximum physical protection against threats from the perspective of camouflage and have the use of natural effects.

Ability to carry out the mission and activities to be provided in a designated place as well as the desired location for the construction of dams should support the military and defense aid when you have threats.

Place the dam should be of major cities and centers are strategically important demographic and in case of failure in the defense of life and property losses to a minimum.

Today a series of corridors air flight systems for aircraft, there is location should be considered in the review of dam constructions and facilities related to not put it in that direction.

In discussing the damage caused by the earthquake are suitable dam locations of faults and earth must be loose. Spaciousness for proper dispersal of plants and equipment is provided.

Due to the nature of dam construction projects, especially in terms of homogeneity of the environment (use of local materials in the implementation of the dam), placement in narrow valleys and necessary excavation and earthwork done in the construction of many important structures with virtually arrangements and forecasts the low cost allows the use of many passive defense methods will be possible to plan. To achieve this purpose can be used terrain and facility somewhere out of sight the enemy with trees and vegetation are also facilities for the blind hatred or if possible underground facilities related to the construction of dams in addition to not see the enemy's strength and became more resistant against missile attacks (Movahedinia, 2010; Peiman and Goudarzi, 2015).

Exploratory studies of dams: After the general decision to build the dam was from a different perspective and dam place determined, dam must exploratory studies that are required for any type of dam is to be made.

Examine the geology and topography: In general geological studies for a dam construction project is different in each reservoir but overall the most important result of all geological studies to prepare a geological map and the characteristics and extend the existing materials in the project which includes the profile rock, surface soil and different forms and structures such as faults, stratigraphic, layering and care should be taken in this phase of preliminary studies sealants if possible, place the dam after satisfying the security situation mentioned in the previous step, in places where the geology is not suitable and the ability to raise the vulnerability of the dam in case of incident does not fall.

Safety studies of reservoirs dams: Potential that reservoir dam in order to help failure at the time of the events is undeniable. For example, positions fall loose around the reservoir in the event of rain, earthquakes, flooding, explosions, etc. may occur in the water, causing huge waves and thus create instability in motor dam structures. Therefore, at this stage should be detailed studies on the reservoir and the walls around it and check the water levels in the different season (Peiman and Goudarzi, 2015).

Operation step: During the operation of dams observing the principles of passive defense in order to increase dam safety recommendations that below will be explained.

Inspections: Regardless of whether the dam against earthquakes and flooding have also made large, it may be defects caused by aging and life safety dam to protect different levels need to be modified. Although a rare occurrence, but the life of the dam, dam failures, defects in the structure, inadequate maintenance, earthquake and weather events will contribute to the failure of the dam. To reduce the risk of dam failure and defect inspection are essential to identify shortcomings and correct the defects should also be done. Continuous inspections on the performance of dams, especially embankment dam not only from the perspective of cognitive development in different parts of the dam is important but the point of view of safety and eliminate potential defects and help curb the phenomena that may be destroyed has crucial importance. Inspection of dams in both normal and special circumstances occurred.

Inspection under normal conditions: This inspection is done according to a predetermined schedule and it can be called periodic inspection. The frequency of these inspections depends on the type of construction and its importance and location to be determined in accordance with the instructions.

Inspection in special circumstances: The effects of natural disasters such as earthquakes, floods important, war or abnormal behavior dam is necessary. The special inspection on the operation of administrative services operated by competent experts (personnel dam) and in the engineering services operation by experts (personnel office engineering services) takes place. Because the destruction of and damage to dams regulations in different countries to assess and safety and determine the likelihood and the destruction of dams have been established. Inspection records as well as details of

construction, test results, etc., all in short supply dams are important so that the contractor should be aware of this issue and should provide methods and systems and prepare staff for the job. A perfect natural process of regular inspection control drainage water and any type of deformation of levels.

Dam safety inspections to evaluate the overall operation life of structures and the structural integrity of the dam and related structures and to ensure the protection of life and property of people is required. In countries such as the United States, Canada and New Zealand, inspection has great importance. Regular and comprehensive inspection of the dam with the planning and provision of adequate capital and will be trained by experts (Qaderi *et al.*, 2008; Rahimi *et al.*, 2014; Ali, 2010; Ali and Moradi, 2010).

Safe operation of dams: Operation, maintenance and proper supervision should be to achieve an acceptable level of dam safety considered. For this recipe operation, maintenance and monitoring of all relevant considerations during detailed design of the dam must be properly prepared and administered. The recipe that contains adequate information for monitoring, operation and maintenance in a safe condition and monitor behavior in order to detect any signs of abnormal behavior at intervals of every good must be updated. In this recipe Dam general information include the type, size, classification consequences of failure, location and access is available. The details in this instruction depend on the type and classification of the dam. To ensure you make any changes, recipe operation, maintenance and monitoring should be reviewed at least once a year is recommended. All information and necessary items in the dam should be properly documented and saved. Information and events must be recorded on a regular basis and depending on the type of dam. Records must provide a history of the dam or owner or operator is responsible for new devices or used for safety review. A copy of this file should also be kept outside the dam. Monitoring and studying the problems of exploitation issues, sedimentation, curves operation, increased demand and the lack of appropriate models operation is assigned. Many operational problems due to lack of attention to these issues in the past there was no reason for it to poor management and operation of dam experts noted. Therefore, operation and management of dams, inspections, repairs annually, preparation of safety instructions and operation of dams, according to expert specialists, training of farmers as well as monitor the operation of dams play a major role in safe operation, reducing damage to dams and their safety (Qaderi *et al.*, 2008; Rahimi *et al.*, 2014).

Behavior of the instrument in dams: Seismic behavior to observe the behavior of the dam and its affiliated structures by means and methods that can accurately prepare and record sufficient information to say. The precise role of the malformation or abnormal instrumentation is the behavior of the dam so that the alarm can be before the injury. The different nature of natural complications in the construction of earth dams on the one hand and the complex behavior of soil materials of dam on the other hand qualitative and quantitative parameters of soil behavior is necessary. Research shows that the erroneous assessment of these parameters is often compromised due to the stability of earth dams. Installation of instrumentation and recording their behavior during construction and the initial period of operation will help to detect these parameters (Steering Committee Member of the American passive engineers). Control and stability of the foundations of the dam, ensure no leakage and lack of internal erosion, permeability between the foundation and the environment around the reservoir, performance or cutoff walls, performance drainage network downstream of the dam deformation and vertical and horizontal movements of the parameters that all dams and especially dams and threatened the pebble. The dam implement the necessary tools (instruments) for dam installed but the protection of defense against severe accidents or are not collapse. With continuous reading tools used in different parts of the dam behavior with regard to data analysis and interpretation to be placed and based on the results of the measurable parameters can be predicted behavior of the dam in stages. Monitoring can also experience other barriers to designing the future. It may be due to lack of poll and precise tool damages arise dams that created the crisis, so do precisely it would be one of the considerations as passive defense considered (Hassani *et al.*, 2003; Keivanfar and Qaderi, 2009).

Period maintenance: Generally, the most efficient way to increase the useful life of equipment through proper maintenance is funded. Undoubtedly, the cost of major repairs and reconstruction of dams is very high in case of serious problems. If you do not address this matter, the vulnerability of small dams threats were also more likely and this negligence to ignore the principles of passive defense in the repair and maintenance of the dam.

Foreign policy: Foreign policy is one of the areas of passive defense that produce the common interest between neighbors can be effective in reducing vulnerability. The use of passive defense can complete the country's defense capability. Passive defense of the

political dimension and the relationship with other countries is important because the expansion of relations with neighboring countries and improve relations between the countries. So, consider foreign policy out of the hands of the passive defense dams are very important considerations.

Principles of safety in the housing and utilities dams:

The body of the dam is perhaps the most important part of any structural dam in terms of its obvious effect on the safety of the entire system. In this study, more technical principles various regulations are required. Stability control dam different structures in different parts of the body in stages during construction of the dam, after dewatering the reservoir and dam during discharge must be monitored. With regard to the gender of building materials, large-scale, scope and structural conditions, the body is resistant dam against enemy attacks and only very precise attacks and the limited time of the year (at full reservoir conditions) can cause serious damage to this one. At this point, it must be in addition to the technical principles of design parameters such as thickness of the body and the impact of events such as the height of the dam blast and wave and hit the dam considered with respect to peer review or in times of crisis measures such as reducing water levels in the reservoir.

Some principles of passive defense such as camouflage to achieve any mechanism such as the following should be considered: camouflage dam utilizes appropriate cover such as planting grass in downstream procedures or taking advantage of the cover of stone that are in harmony with the surrounding environment enabling the detection of dam area in photos or air strikes simply not possible.

Cover crest in a manner consistent with the road and the surroundings and the lack of multiple lights, color guard rails, etc. in this section. In this connection, in order to deceive the enemy can be multiple lights and color guard rails on adjacent roads (at least near the reservoir) design.

Predicted free height (distance between the water level in the tank to crest), so that even in terms of possible attacks, falling bodies and the areas around the dam explosion, risk of water overtopping of the dam creates waves and rising sea levels are not provided.

Anticipated high robustness such as fencing and utilizes to protect people around the dam area so that unauthorized access to sensitive sectors and utilities subdued.

Operation and control and maintenance of buildings in the distance from the dam so that the distribution and division to reduce the damage caused by the attacks of enemy.

Other new technologies on defense strategies to prevent further damage suggested, multiple dam is that especially in the dirt dam is proposed. The main idea is to use the dam fuse system is such that in case of explosion and the loss of the first dam in the reservoir have been the second or third dam and the volume of water released downstream reservoir to prevent.

In the case of camouflage and construction of important facilities underground and mountains, conservation and appropriate cover to avoid enemy access to these places provided. The remarkable thing tunnel to protect people and facilities is important entry and exit doors which should be 90 degrees after intake and exhaust into, out and with camouflage incoming and outgoing attention to prevent them. After the Persian Gulf War that important places were constructed at ground level of high vulnerability due to the construction of underground facilities were considered important. By following the removal of important facilities added more to their safety and enemies of access and identify them fails on the other hand the strength of the facility will be added. Today consultants design and optimal management fortifications and underground utilities in such a way are done that the multiple uses of them provided.

MATERIALS AND METHODS

Materials used for the construction of dams: Materials used in the dam of the importance of the technical principles estimated the principles of passive defense and safety of the entire system is very important. For the characterization of materials used in the construction of the dam and the following is proposed:

- The possible use of materials that have similar tissue surrounding environment
- The thickness of the materials used to be considered a bit more than usual
- Composite materials are used as much as possible with the surrounding environment or measures taken for the same color materials

Subject to technical principles found in the surroundings of materials with dimensions close to the materials used. Identifying and studying the materials in the creation and construction of defensive structures, particularly above ground structures is very important. The massive use of reinforced concrete structures compared to other materials, according to all aspects is very appropriate. In addition, the use of special concrete (high power concrete, heavy concrete, fiber concrete, etc.)

improves the behavior of structures against explosion. In the case of materials taken from loans the key point is to achieve the objectives of passive defense and the materials are picked so that there is not much change in the context of environment and natural to look after harvest.

Principles and elements of passive defense and crisis management in all dam construction projects:

In the United States of America Federal Emergency Management Agency (FEMA) is responsible for coordinating institutions related to the crisis associated with the various crises and the main policy reference for the activities of state and local disaster management act. A recent survey has shown that >22,000 large dams in America with high performance potential danger exist 18300 dam about 83% of them had no emergency action plan. The lack of an emergency action plan in most of America Dam by the Federal Emergency Management Agency for National Disaster prepared as a major flaw in the system was found. Legislative and enforcement measures for dam safety inspection of the dam of America pass a national law in 1972. In that year, the dam and properties and other useful information by (NID) prepared and in June 1979 the Committee on Dam Safety (ICODS) report based recipes safety first operation of federal dams. In Canada, most of its dam for the state department, most states have a formal system for managing dams and their safety is higher. In 1997, the Canadian Dam Safety Association (CDSA) first published Safety Directive dams. In the same year, Canada's largest dam committee merged with the Canadian Dams Association (CDA) have formed a key element of Canada's dam safety and dam safety in the field of technical, environmental, social, economic, legal and management review. The following summary of the characteristics of crisis management and the safety of dams that these countries have proposed is given.

Emergency Action Plan (EPA): Emergency action is an official document in which a diagnosis of potential risk and the definition of the underlying concepts and activities and take appropriate measures in order to minimize loss of life and financial offered. Develop an emergency action plan on two principles based on the type of crisis and the location and extent affected by the crisis. The plan must certainly exist in the dam design process. Emergency action plan procedures designed to detect unusual situations that may endanger the dam and to define the word's responsibilities. It also means that the dam during rehabilitation activities and alert the relevant departments in case of dam failure, dam failures and

impending failure are used, the plan is followed. It also led to a flood in dam when output is large, can be used. Flood Map Service is other parts of the emergency action plan for a dam. Use these maps to determine the scope of damage, determine the institutions responsible for crisis management in the area to undertake. For an emergency action plan can be outlined principles and various organs but the following six pillars of emergency activities are essential components of the project.

RESULTS AND DISCUSSION

Alert chart and warning: Those who should be in the incident in the figure are the order of priority. A warning graph shows those is in what way and with what priority should be aware of the crisis.

Determine the event of an emergency: Evaluation and classification identify and assess emergencies and situations that binding activity is very important. Determination of timely and reliable methods available to classify a critical situation is also necessary because according to these categories and the urgency of the situation trajectories are chosen activities.

Responsibilities: In developing, an emergency plan for dam responsibilities of all individuals and institutions involved should be defined in detail. This is the right decision, effective and timely manner and to avoid confusion for those responsible will be indispensable role.

Preparation: Preparatory activities aimed to reducing the damage and ensure the best response the critical situations go work. In this section, the steps necessary to prepare before any crisis seem like exercises, maneuvers, inspections, etc. are brought.

Flood zoning maps: The most technical part of an emergency plan for a dam can flood zoning maps. Flood zoning maps showing points where flood in their runoff is possible and flood wave arrival time to each of the areas will be of great help to manage crisis.

Annexes and appendices: Complementary information such as records of crises occurred plan for emergency activities for the dam, training programs for emergency action plans and other information that could be useful in the implementation of the plan in this study will be presented. If all the major dams have an emergency action plan in accordance with the given standards suggested by experts in the field, it is a big step towards the realization of the goals of safety and passive defense for

these structures is removed. Because, as is evident every dam that has an emergency action plan and the relevant authorities have entrusted ready to work on passive defense has eaten glue and your own enemy from achieving the goals of the sabotage disappointed (Qaderi *et al.*, 2008; Ali, 2010; Ali and Moradi, 2010).

Hazard potential classification system: Hazard potential classification system is system of dams due to their extremely devastating consequences resulting from failure or incorrect operation is classified. All cases of potential risk classification system does not reflect dam and only pays to categorize dams. In the new text FEMA dam system with four simply, the text is clear, concise and compatible with any other system introduced for dams. This text such as determining or prioritizing inspections did not mention the specific design criteria because such cases to other bodies concerned. In this system, three different levels of classification has been made, low and high, respectively which substantially increase the intensity of damage in case of failure. A major objective of any system chosen category is appropriate design criteria. In other words, the potential for increased human and financial losses, will be more conservative in determining design criteria. Of course, knowing every possible event that might be a poor risk in the event of a dam break flood-affected people in the area should not be a criterion for determining conservative design criteria dam.

Low risk potential: In this category fall those dam failure or incorrect operation, they had no casualties and economic and environmental losses they are small. Damages in this case is mainly limited to the owner of the dam.

Significant potential risk (average): Dams with significant potential risk or medium-sized ones and the effects of failure or faulty operation of casualties does not apply to them but can cause economic losses, environmental such as homeless people or others. Dams often in rural areas with the potential for average-risk population or an agricultural field near residential areas with critical infrastructure are located.

High risk potential: Dam that fall into this category failure or incorrect operation creates the human and financial losses. Large dams which are located near large cities, high risk potential to the lives and property of downstream residents. However, to determine the classification system need to study the potential risk of dams, research, investment and organizing specialized and technical engineering. By categories dam on the basis of

these criteria can be useful ways to prevent damage in the event before and during the crisis has introduced to establish facilities and programs management and the passive defense for any dam and prevent the damage (Qaderi *et al.*, 2008).

CONCLUSION

The study outlines defense measures in order to improve the safety of dams and related facilities addressed. The points mentioned in this study, in addition to other technical binding hints dam construction projects and should also be considered in line with each other during the project. Finally, the results and conclusions of the points of compliance from the perspective of passive defense in dam construction projects in this study, given that it has been dealt with is as follows:

- Locate the dam of the most important suppliers of dam safety and dam construction projects in all must be considered
- Desired location for the dam estimated maximum physical protection possible against threats from the perspective of camouflage principles used
- Dam place should allow convenient access and support in times of crisis by the defense and relief centers be used
- Dam place should have the proper distance from major population centers and industrial areas and strategic to be threatened in the event of crisis centers
- Dam place should be in the path of air corridors and enemy aircraft access to the site difficult
- Dam place is the correct distance from the dam has faults and lose ground and geological characteristics of the area must be examined from the perspective of dam construction
- Take appropriate distribution facilities and related structures of dam
- Construction of a dam in the vast plains and smooth and near the border, beaches and ... that makes it easy to identify them by the enemy avoided
- In order to achieve a perfect camouflage the dam of terrain available in the region and using green spaces provide adequate coverage for utilities and other structures
- It is recommended that important facilities underground dams to be built as much as possible in addition to proper coverage and protection against enemy sight, the facility at the time of blast resistance increased

- Resistance around the walls of the reservoir should be assessed sure to not collapsed as a result of various events and creating big waves in the tank and eventually prevent overtopping flow from the crown and cause damage
- In order to prevent damage caused by defects in the structures created and facilities of dams in normal and abnormal factors or age, have regular inspections from different parts of the dam inspection program based on existing standards and specifications of the dam is being done is done and appropriate measures to eliminate shortcomings
- Operation and maintenance of dams should be maintained in accordance with the instructions of the dam when the dam design should be prepared and is also available in the form of manual maintenance staff dam be carried out
- For continuously from the dam and dam behavior during operation, tools and instruments in the different behavior based on the standard to be applied different parameters to be controlled in sustainability has always been there and if necessary to fix defects to be addressed
- With appropriate cover such as planting grass and stone-colored coating surrounding the dam by the enemy hard are camouflaged and detected
- The creation of colored lights and guard rails crest and traffic routes to avoid and cover this part is also in harmony with the surrounding environment
- Free Lifting height enough to be considered when creating waves caused by explosions and water overtopping of the crest and the resulting damage is done
- With the creation of the fortified enclosure such as unauthorized access to sensitive parts of the dam and facilities is prevented
- Operational and control structures in the distance from dam construction to prevent damage in the event of a threat to be avoided
- New ideas raised by experts in the field of enhancing the safety and efficacy of multiple dams, including dam, reservoir and used for coating
- Installations and building access routes and doors are properly camouflaged inputs and outputs and the inputs and outputs are made at an angle of 90 degrees
- Materials used for the construction of the dam consistent as possible with the surrounding tissue or by various methods such as the use of colored concrete ... this harmony is created
- Aggregate used in earthen dam of the same size and thickness of materials chosen environment and are more resistant than usual
- In the concrete dam and the installation of reinforced concrete for buildings and special concrete and high-strength fibers such as concrete, high strength concrete, etc. which has a higher resistance to loads caused by earthquakes, explosions, etc. are used
- Building on the perception of microfinance in the region is important caveats that materials removed so that changes are not visible in normal tissue environment
- Preparing a comprehensive program of emergency activities for all strategically important dam should be applied
- All major dam on the potential risk classification system classified to respond appropriately to ensure his or her safety and his or her impact basin by the relevant organs taken
- Room for the entire major dam dams set up crisis management to crises properly managed
- In order to achieve a higher safety level of the new technologies of communication, information, satellite, telecom and ... be used
- Complete information for all dams and transmission networks, storage tanks, water networks and other facilities provided to them in times of threatened crisis management easier and faster done
- The necessary training to raise the level of public information about the actions of passive defense in the pre-crisis times, during the crisis and then, through the media and other means of notification to be made
- It minimizes threats through proper foreign policies and political relationships positive, especially with neighbors noticed infrastructure

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