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INSPECTION OF NUCLEAR ACCIDENTS: A CASE STUDY OF FOUR NUCLEAR TRAGEDIES FOLLOWING STRATEGIC PLANS

Afsaneh Karshenas Najafabadi[1] and Abbas Moini[2]

[1]*Shahreza Azad University, Isfahan, IRAN*

[2]*Isfahan University, IRAN*

ABSTRACT

The world's uranium resources is enough to supply 26 times current electricity consumption of the world forever, and the nuclear energy will be more economical rather than fossil fuels, even if the cost of electricity production doubles. But the importance of nuclear safety at all stages such as Integrated program, applying strategies beyond the probability of incidents, The necessary training for staff, The correct arrangement of personnel According to their expertise and the occasion, to provide in time decision at crisis, Modeling of countries at the higher stages, analysis of errors in recent accidents in order to avoid in future , observance of Nuclear Convention principles , and finally the management of nuclear energy use is inevitable and more considerable than the nuclear energy itself. Disregarding of the case causes not only no advantages, but to regression and going back the procedures. So its consequences such as those nuclear tragedies in recent decades; for human beings and living things are devastating and Irreversible. The survey intends to observe safety mechanism that disregarding of it, led to 3 severe nuclear accident in recent years. Also at the end of the research some solutions will be presented.

KEY WORDS
Nuclear safety, Irreversible nuclear accident

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***Corresponding Author**
Email:
Afsankarshenas@yahoo.com

INTRODUCTION

Nuclear safety and nuclear security are two important issues in the nuclear energy field to establish nuclear power plants. The former one means Access to suitable operating conditions and accidents Prevention or Reduction their consequences resulting to protect employees, citizenries, and environment from radioactive radiation. The latter issue is related to any sabotage action about nuclear or radioactive material and their equipment. So the first one deals with unintentional cases while the second one is planned in intentional actions area. [1]

There have been many unexpected nuclear events in recent years such as what happened in Three Mile Island, Tokai-Mura and Fukushima Daiichi and Chernobyl in which awful and terrible Human and financial losses were outcome of inner or outer factors caused respectively by human errors and natural disasters. As a whole, a large part of these scenarios predominantly was the result of negligence about Mobilize the systems, before the case, or Inefficiency and hasty decision of operators after or during the accidents.

Three mile island plant

This accident has been considered as the worst nuclear case in America. It happened in 1979. This plant was equipped by pressurized water reactor with power of 900MW. Part of the core of unit 2 was melted and caused releasing 3 million Curie radioactive gas a way. So over 140,000 people left their homes and radioactive gases such as Xenon, krypton were released in environment. [2]

The commission after while concluded that:" to prevent nuclear accidents as serious as Three Mile Island ,fundamental changes will be necessary in the organization, procedures, and practices and above all in the attitudes of the Nuclear Regulatory commission and to the extent that institutions we investigated are typical of the nuclear industry".[3]

Defect handling

Checking over the system illustrates that some trivial but important factors involved the case. It is evident that if the warning lights was visible, or had been set in front of the system, the rest of the perilous case would never have been occurred. Also the absence of operators or their tardiness, deteriorated the problem. The next crisis deals with negligence about fixing up the water storage; meaning, despite of being aware of failure (in its discharging) the repair project was put off several times by staff. Regarding the alternative process, Environmental Protection program should have been done in time of accident, while it started at inappropriate time and right after radiation.

Consequences

1. Breaking 2 feeder valves following abrupt plunge in water level leading to stop the turbine and reaching a peak of pressure and temperature in heart of reactor.
2. Non reversible pose of regulator after leveling off the pressure led to nonstop water flow on reactor shield and wasting cooling system.
3. Being out of order of safety locks in reactor shield.

Tokai-mura plant accident

It occurred in 1999 when some inefficient workers used more enriched uranium in precipitation tank than amount which really should be used. So, many staff were exposed by accumulation of large amount of radioactive wave of enriched uranium. The most significant rules and instruction which ignored by management of the site, was reported by commission as general causes of the accident such as" inadequate regulatory oversight, the lack of an appropriate safety culture at the JCO facility and inadequate worker training and qualification."[4]

Deficiencies and outcomes

Reading over the incident led to some critical points that caused by violation of absolutely drastic and vital ground rule which was enacted to provide site safety programs. It is noticeable that, by them could have prevented the accident from occurring. The first and major disaster happened, when some unskilled technicians added the bucket contents directly to the precipitation tank instead of buffer tank. Also, they arbitrarily added seven times more enriched uranium than permissible values which had been defined in license of company. In other word the wrong case simply happened due to personnel's ignorance and lack of their expertise.[5] The next perilous case happened when the operators received radiation doses in high level due to lack of existing neutron detection, and protecting cover. The third problem arising the weakness of operators' performance, happened when the flow of water was discontinued and caused stopping the cooler system. As for leaving the site, it is clear cut that if the warning system functioned timely, undoubtedly fewer people would be injured by the radioactive exposure. In brief all mentioned issues were emerged because of not having appropriate predictive plan namely crisis management.

Suggested modification

It is worthwhile to say that lessons taken from such these events will be helpful to avoid doing them in future, though approximately all don't believe that such a negligence be justifiable and stands up to scrutiny. In terms of solutions, it can be noticeable that some inspection about equipment, operating procedures, plans and polices and modifications could have prevented the accident in future and made more safety." One potential design flaw was the ease by which the buffer tank could be bypassed. A different equipment layout of the buffer and precipitation tank, warning signs, and stricter adherence to proper operating protocol could have greatly reduced the potential for this type of accident. One possible design modification would be to install equipment that would prevent bypassing the dissolving tank. The operating procedures could include a better information management system in order to follow government and company restrictions. Analysis of 235U, other uranium isotopes, impurities, etc., could be made at various stages in the process to due to reactors connection, the first, third and fourth reactors destroyed by Hydrogen explosion and it resulted in seepage of radioactive material which was defused within fifty kilometers. By that the real crisis was reported to level seven.

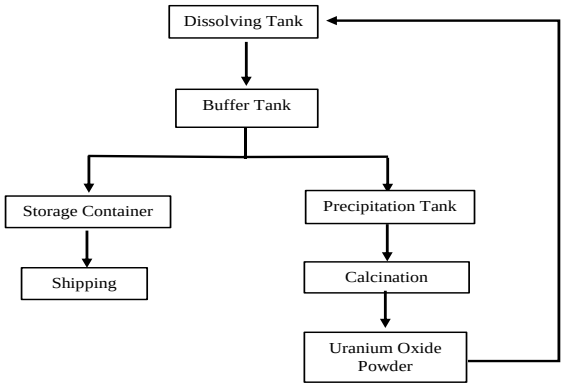

Fig.1 *Block Flow Diagram for the Purification Process at the JCO Reprocessing Plant* [6]

There major deficiency

It is noticeable that negligence of some small but vital and subtle factors surely leads to tragic event. In other words by elaboration in the aforesaid case, it can be investigated that some factors relating security were underestimated by managers. Two major faults became problematic about the case. Surely both of them was related to poor performance of Risk Management.
It consists of:

1. Considering just Design [7] Basic Accident phase.
2. Adopting Certainty Approach as presumption

3. No considering Probability [7] Approach

According to the first one, nuclear plants are designed so that they are resistant against natural disasters such as earthquake. Fukushima Daiichi plant was designed for earthquake within 8 Richter, while the recent one was 9 Richter. The second one which also defined as Structuralist Defense in Depth, involves considering credible worst case accident scenarios and predicting safety barriers. [7] In this sense, if one system is designed and equipped against the worst case of events, then it will be protected against all kinds of accidents. But by this approach, the probability of accidents and their consequences (risk) can't be figured out at all. So it's worth mentioning that, by the effect of events, one can never indicate the possibility of their occurrence. A case in point was the nuclear plant in Japan which experienced the worst and infrequent earthquake within 9R following irremediable consequences. As for the third point, it is cut and dry, that if the security plan was comprehensive and also was examined for all possibilities about accident occurrence, and not limiting to frequent cases, the tragic case would never happen. In other words, probability Approach which is applied in order to logical [7] and quantitative control about uncertainty of accident, could be helpful to tackle the problem.

Suggested modification

According to what mentioned above, the major reason of accident in Fukushima plant was related to poor performance about risk management .Definitely it is wrong to ignore the incidents with low level of occurrence. Therefore, the Combinational Approach can really work to avoid such an accident. This advantageous trend which is known as Integrated Approach, can comprise Probability Approach and Certainty Approach at the same time. By that, Risk management strategy can be followed and achieved effectively. In brief, the combinational Approach as a supplementary approach can be effective to use the different aspects of two former approaches to make decision about safety issues.

Chernobyl plant accident

This event happened in April 1986 in one of the cities of Russia. This accident has been known as the worst nonmilitary accidents in the world. According to reports, Chernobyl case accounts for far more powerful than the atomic bomb expulsion in Hiroshima and Nakazaki in Japan. .This tragic case emerged from Reactor 4 in Chernobyl plant which was RBMK type. By explosion of referred reactor, a large part of 180, 000 kg nuclear fuel scattered in environment. It was estimated that the radioactive substances is equal to make 100 atomic bomb. Approximately all people left the city but a large number of them received radioactive waves.

Major deficiency

It is clear cut that this incident like three former case of accidents, predominantly caused by some how human wrong. In other words unqualified personnel and their hasty decision deteriorated the conditions. As a whole, the two major wrong was the basic and serious reason for the case of catastrophe. The first part of scenario began when some operators deactivated the safety system namely neutron moderator of reactor in order to some testing experiments. This action was the terrible and awful one that a group of working would be committed. The result was a system without inhibitor. So the temperature of the reactor reached a peak of permissible amount and also more than the heat output. After that the system was faced to power loss .In other expression, the reactor power dramatically declined and fell to low point of one percent.

The second wrong was done by the staff right after the plunge in power in order to compensational action and power soar. Then the personnel took out the total control rods from the reactor .By removing the controlling rods, the power of reactor increased shapely and hit a peak of 7 percent.

Consequences

The result of two major wrong was fearsome and terrible expulsion. The initial one, occurred In shield coverage above the reactor. Therefore, much of hot water vapor released .The latter expulsion caused by Hydrogen which was formed by combination of water vapor from broken pipe with Zirconium or Graphite of reactor core. By these two cases, nearly thirty percent of reactor core system destructed .In addition, the Graphite released from the core, caused the fearsome fire. Many workers and staff which was not dressed by protected covering, received the high level of radiation and also really injured by perilous substances such as Strontium90, Cesium137 and Iodine.

Suggested modification

The most important lessons learnt from this tragic case were the pattern which was stated by international agency of nuclear energy and followed by Russia government and other countries .It was included:

1. Major defects of VVR and RBMK following the removing defects cases
2. Making upgrade systems and facilities
3. Adopting safety ways of all kinds of reactors (RBMK)

In addition to commission rules, adopting the right policy and approach about testing case and experiment following trained and qualified staff and also appropriate management before, while and after scenarios should have been done to have a comprehensive and progressive plan.

CONCLUSION

To sum up, the basic reasons of all the aforesaid accidents, focuses on poor performance of human. Definitely lack of a comprehensive and strategic plan to provide maximum safety of a plant, results in such mentioned accidents with irreparable consequences. The rest of problematic cases partly is caused by not having sufficient personnel, and partly by lack of capable, creative, trained and skillful man power. Lack of supplies and equipment such as spare generators and cooler systems to control the emergency conditions, devices to estimate accurate amount of radioactive waves, safety cover for staff, firefighting devices, quality survey of mechanic and electronic systems, all are the results of not having a correct plan as initial requirement and prerequisite to made a nuclear plant. Hopefully, some solutions which are recommended at the end of this survey, may be useful to implement of the ultimate goal. For instance:

1. Planning the modular curriculum classes to train proficient, and adroit staff.
2. Choosing creative and vigilant operators to assign on important posts.
3. Mobilization of public to take part in crisis juncture classes.
4. Simulation of emergency accidents to practice the pivotal and drastic maneuvers.
5. Surfing recourses or different sites around the world to modify the problem.
6. Planning Corporate groups working from different nations in order to profitable interaction

In creating international projects in favor of human and nature rather than one side competition.

CONFLICT OF INTEREST
There is no conflict of interest.

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