HAZARDS AND ITS REMEIDAL MEASURES IN HYDRO POWER PLANT - AN REVIEW

PRAWIN ANGEL MICHAEL
Department of Electrical and Electronics Engineering, Karunya University,
Coimbatore, Tamil Nadu State, India
prawin@karunya.edu

K.VINOTH KUMAR
Department of Electrical and Electronics Engineering, Karunya University,
Coimbatore, Tamil Nadu State, India
kvinoth_kumar84@yahoo.in

Abstract: *The most interminable and incessant source of renewable energy is water. The hydropower plants marks a predominant position in the evolution of the country as it yields economical rated electricity. The hydropower plant thus developed may have few risk factors to the public and thus a high level safety and remedial measures to overcome the hazards is the days need. The purpose of this paper is to give a detailed account of the type of hazards and the relevant safety devices or other assess that can be commissioned to exalt the protection in the hydropower plants. Overall this paper will be giving the reader a complete literature survey of hazards and their remedies equipped in the past decade.*

Key words: *Hydropower plants, Hazards.*

1. Introduction

Hydrogenation is the oldest technology for electricity production. The hydropower potential is richly available in India and stands fifth in the world but unfortunately only 19.9% is been developed [1] even though the first Hydro plant in Asia was developed at Darjeeling at the year 1898. It was reported that hydropower plants thus generated are liable to hazardous factors and accidents. The major 3 factors that remain as the cause for accidents in hydro plant are poor planning, unpredictable natural events and equipment failures [5]. The functional safety and operational safety are also other factors to be considered while analyzing the remedial measures for hazards in hydro plants [2]. The need of safety measures in hydro plant can be analyzed on a case by case basis [3]. Thus the paper will be describing the various types of project features or conditions that can present a hazard to the public and safety measures that can be commissioned to reduce hazards.

1.1 Accident of Hydro Plant in the Past [4] [5]:

It is convincing that power generated with water as the source has minimal fire hazards among the other electricity generating resources, but the truth lies that it is comparatively less hazardous than the other conventional plants. History reminds us on the calamities that had been caused due to the hazards in the hydro power plant.

Switzerland underwent one such fire hazard due to the hydro plant in the year 1996 where it lead to a loss of more than fifty five thousand dollars [4]. The Washington state in 1981 also faced one such fire hazard. City of hazard Tennessee at 2002 and Portugal fire hazard at 1997 add to the list of fire hazards that gave massive destruction to the public and economy of the country. The Sayano-Shushenskaya hydro plant at Russia faced a major fire hazard due to the demolition of the major equipment at the year 2009 which took 75 lives and destructions that will take many years to return to former position [6]. It has been recorded in the year 1975 Banquiao dam failure in China claims in creating the biggest disaster [5].

There was one accident that occurred at Idukki power house – Kerala – India that caused the death of two engineers. It was caused due to a potential transformer blast. There was one generator protection and monitoring unit near the generator. Inside it was a lightning arrester along with a potential transformer. Due to the malfunctioning of the lightning arrester, the potential transformer blasted which led to the accident.

1.2 Hazardous Components in Hydro Projects:

The land use is one major component under consideration where the establishment of generators, turbines and power house equips more land use and an evidential example of the land use in Balbina by hydroelectric plant [7] and in hill stations, the land requirement is comparatively lesser [8] .

Wildlife is also been affected and another factor is the emissions of carbon dioxide which is also comparatively smaller for run off river scheme [9,10].All the above said discussions prove the environmental impact due to hydro plants [11].

The other hazardous features at hydro projects [3] include the ungated overflow spillways, powerhouse intakes and tail race areas which cause hazards to the swimmers and fishing boats. The people who reside in the immediate downstream area are affected when spillway gates are raised. Hazards due to substations and power lines in a hydro projects are to be noted.

1.3 Hazard Identification and Assessment

The hydro power is capable generating energy from water flowing down a slope or coasts with a large tidal range [12]. The introduction of safety management system is an additional feature that is to be considered during the design of the plant [13]. Over the past ten years, heightened interest in dam safety risk assessment has been in use with a search for risk criteria for use in making decisions [14]. The risk can be calculated by taking the product of likelihood and severity which lead to the relation risk. The identification of public hazards at hydropower plant is done by the Federal Energy Regulatory Commission [15]. The awareness of public safety has become a major concern while designing the hydro projects [16]. In the safety management system, the risk assessment is the initial step that it considers the of the structures of the plants starting from head, power intake canal, spill walls, gates, power house tail race and downstream [17]. Thus the risk well identified can be analyzed and solved easily. Risk assessment will play an important role when the power related to the risk within decision made by the organization is to be rationally implemented [18] as shown in the fig 1.

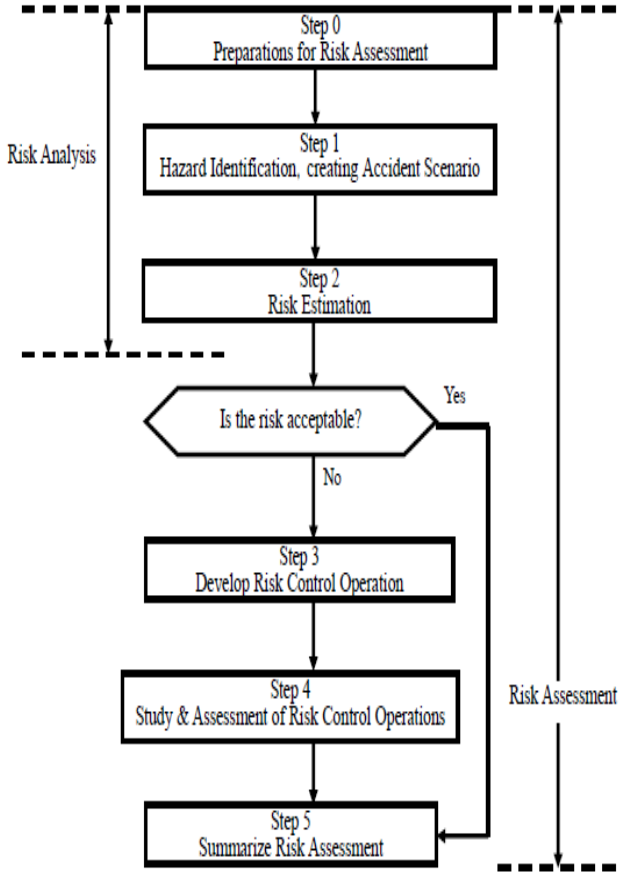

Fig 1: General flow of risk assessment (Nippon Kaiji Kyokai, 2009).[18]

1.4 Check List

For check list such as Worksite details, Training, Work processes, Record keeping, Fire emergency, Procedures, Mean of exit, Lightning, Machine guards, Tools and machinery, Confined spaces, House-keeping, Sound level, Employee facilities, Personal Protective equipment are to be manufactured before managing the risk of any plants.

The risk analysis and the risk management can be a strengthening factor in any hydro power plant. The hazardous factors can be analyzed, managed and safety measures can be implemented during the design of the hydropower projects. The HIRARC (Hazard Identification, Risk Assessment and Risk control) has to be done in every plant before designing new machines and new processes.

1.5 Safety and Protective Means

The safety and protective measures can be discussed on various categories such as public safety, its safety devices, equipment and their remedial measures.

2. Basic Public Safety Measures

The hazards in a hydropower plant do not exist at all times and thus leads to the lethargy of the public, thus a complete orientation and awareness program has to be conducted to the people residing near the areas where the hydro plants are constructed.

(i) The total spillway, run off river operation has to be monitored.
(ii)Tail race area will be highly hazardous by the opening of the spillway gates without warning.
(iii)Nowadays automation of hydro projects also exists which leads to accidents in the plant.
(iv)Providing fences around the dam area and restricting the public reaching the power house are other ways of safety.
(v)National Electricity Safety code has to be adopted as a measure to reduce hazards.
(vi) Boaters will be much precautious during the change in climatic conditions such as snow, wind, fog, ice etc.
(vii)Education to the public on the hazardous aspects plays a vital role.
(viii)Programmes promoting the hazards in hydro power plants are the need of the hour in the hydro projects.

3. Protection Amenity

In general any type of power plants needs a minimal safety equipment and mechanism to be followed. These parameters should be equipped at the time of design and the installation of the plant. The category of safety devices can be in different grouping such as educating the public, warning posts, devices in use, escape devices [3]. The decision making body of the plant should comprise of the local people with at least three

representatives. They can constitute few other committees such as Technical Committee, Administrative Committees and Financial Committees. Warning devices include signs and warning alarms and the location of signs can be done as per presented in Guidelines for public safety at hydropower projects. Equipping sirens, horns or buzzers are generally used. The plant can also be equipped with guards and watchmen. The persons working in a power plant can wear Helmet, Shoes or Gloves. The escape devices must be available in the plant at all times because in case it has been available to escape at hazardous times, these devices such as safety ropes, nets, ladders etc. can be used. Above all frequent surveillance of the plant plays a vital role in minimizing the hazards in hydropower plants.

4. Conclusion

The paper had aimed at narrating the common hazardous factors in a hydropower projects and the HIRARC study will facilitate the safety in the plant. Finally suitable approaches had been presented for safety in terms of equipment as protective measures in the design for controlling the hazards. Thus the safety policy presented will be able to prevent the hydro plant from hazards. Furthermore in order to increase the safety precautions, the implementation of different methods of hazard identification such as fault tree analysis, event tree analysis as well as hazard and operability study (HAZOP) can be adopted and if series of hydro units are available, then the HIRARC can be done separately for every unit.

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