

THESIS

**CAUSES AND IMPACTS OF FAILURE OF SHAHID ABBASPOUR
(Karun-I) HYDROPOWER DAM IN IRAN**



By

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ABSTRACT

Shahid Abbaspour Hydropower Dam (Karun-I Dam) had been constructed in 1970 on the Karun River in Khuzestan province of Iran and was put into operation in 1977. This double arched concrete dam has a height of 203 m. The spillway is of the gated-chute type with a width of 6 cm, consisting of three separate chute bays. Discharging capacity of the spillway has been determined to 16,200 m³/s. This dam, one of the highest dam amongst Iran's hydropower projects and No. 1 power production plant, is located some 55 km distance from Masjed Solyman. The spillway of Karun-I dam failed in 1993. The main objectives of the study were to investigate the causes of failure of Karun-I dam and to study the impact of its failure on environment.

The most serious problem in Karun-I hydropower dam being with the hydraulic jump dissipater however was more one of structural strength than of hydraulic efficiency. Firstly, there may be no practical alternative to a hydraulic jump if site conditions make prior excavation or subsequent erosion unacceptable, especially in the case where the spillway is expected to operate for long time. The frequent type of damage is complete floor slabs being torn up, which may be followed by erosion of the foundation of dam. In case of Karun-I dam failure, there was a clear sign of high uplift pressures under large areas of the floor. Discharge capacity under maximum reservoir level was determined from a hydrological study in which the hydrograph of the design flood flowing into the reservoir was the most important factor. The uplift pressures tending to lift the slabs were caused by the intermittent conversion of kinetic energy into pressure energy through any opening there may be in the channel floor of the Karun-I dam. This mechanism poses a threat especially at high Froude Numbers, and is accentuated by intense turbulence, or

macroturbulence, by which the energy of the water is dissipated in the hydraulic jump. Deflector blocks and other obstacles in some basins are very exposed to cavitation erosion in dam. Cavitation erosion was a frequent occurrence in the stilling basin of Karun-I dam.

The violent flood which occurred in 1993 led to serious cavitations and erosion of the chutes due to steep slope of the ending part of the chutes and also complete destruction of the flip buckets and its guide walls which was found due to heavy momentum on unsuitable form of the ending part structure. One channel and the stilling basin of Karun-I dam was completely damaged and the whole structure needs complete re-consideration of hydrological, hydraulic & structural design. The last cause of damage of Karun-I Hydropower dam was abrasion. The basin of Karun-I dam was damaged by abrasion from bed load (alluvium, rubble) from the river channel just below the dam. There was no change in sediment pattern due to the failure of Karun-I dam. Due to flushing of stilling basin both cavitation and back water effect caused the ponding at the toe of the Karun-I dam's which was the main cause of the real damage to the Karun-I dam spillway. The flood was not regularly monitored by the staff appointed at the Karun-I dam and the emergency tunnel of the dam was not properly maintained. The closure of the emergency tunnel during flood also caused the failure of spillway of the dam.

The environmental impact was minimum due to failure of Karun-I dam as there was no loss of human life or property. The solutions used to confront future dam failures in Iran included use of physical and computer models, improvement in dam design and carrying out dam break studies.