

Appendix C Example Problem Description

C-1. In order to discuss the engineering reliability analysis, the hydroelectric power benefits analysis, and the economic modeling process, a brief overview of an example rehabilitation project is warranted.

C-2. The “Chapman Hydroelectric Power Project” consists of a single powerhouse with four Francis turbines that were placed into service beginning in 1947. The total rated capacity is 200 megawatts (MW). There are two three-phase generator step-up transformers, each serving two generating units. The plant is a storage project located in the southeast portion of the United States. There is a relatively small variation in lake elevation due to seasonal flows and the need for flood protection. The storage in the lake is very large in relation to the flow in the river. Therefore, all of the flow into the lake either evaporates or passes through the turbines for power production. The plant factor is 25 percent.

C-3. Problems include turbine runner cracking, severe cavitation damage, generator coil degradation, and deterioration of the generator step-up transformers. Over the past 10 years, the turbine runners have exhibited increased cracking. On three separate occasions, pieces of the buckets have broken off. An enhanced maintenance program was instituted. This program, which includes more frequent inspections and welding repair, has prevented further breakage. However, cracking and cavitation damage continue to increase at an accelerated rate. Deterioration of coil insulation has caused coil failures in three of the four generators in the last two years. Spare generator coils are not available, and there is no spare transformer. Unsatisfactory performance of either the generator or turbine runner will cause a unit outage. Unsatisfactory performance of a transformer will cause an outage of two units. Field testing has shown that the units have experienced an efficiency loss from their original condition. Average unit availability has also deteriorated from 95 percent 10 years ago, to 93 percent 5 years ago, and to 88 percent this year.