surveillance testing of the EDGs. The apparent causes of the expansion joint leaks included: (1) the ECW system was being affected by a water hammer problem when the ECW pumps were secured, (2) the initial alignment of the expansion joints was not correct or the water hammer effect has altered the alignment, and (3) the type of expansion joints used may have been inadequate for the application.

The effects of water hammer were observed during a test performed in August 1990. Following the test, a leaking expansion joint was removed for analysis. The analysis concluded the leak was caused by fatigue cracking in the bellows. Short-term corrective actions taken included revising the ECW operating procedures to reduce the effect of water hammer on the expansion joints. The ECW supply valves to the EDG were required to be shut prior to a pump trip in order to minimize the water hammer effect. Although the inspector considered this short-term action to be a symptomatic repair, the licensee initiated a calculation which demonstrated that only the ECW lines serving the EDG were affected by the slightly excessive pressure surges occurring when an ECW pump was tripped. No other portions of the EDW system have been affected by the water hammer events. Additional instances of leaking expansion joint bellows have developed. This has resulted in the following corrective actions: replacing the expansion joints with identical ones, replacing the expansion joints with temporary flanged pipe spool pieces, and monitoring selected leaking bellows to ensure leakage remained below a preset limit.

Long-term corrective actions planned include replacing all expansion bellows at the EDG intercoolers with hard pipe spools, performing pipe stress analyses to determine the need for additional pipe supports, and adding vacuum breaker valves to reduce water hammer pressures. Vacuum breakers were installed in the Unit 2 ECW to EDG piping during the last refueling outage. One permanent flanged pipe spool was installed on the Unit 2 Train C ECW to EDG intercooler inlet piping. The remaining five pipe spools are scheduled for installation during the next Unit 2 refueling outage. The vacuum breakers have not been installed in Unit 1. One Unit 1 pipe spool out of six has been installed to date. The remainder of the modifications are also scheduled to be installed during the next Unit 1 refueling outage. Licensee corrective actions associated with the resolution of ECW water hammer events will be tracked by an inspection followup item (498/9134-03; 499/9134-03).

Through-wall cracks have been found in welds in the aluminum bronze piping. Data from failure analyses indicated that a pre-existing flaw contributed to the development of the cracks. Poor backing ring fit-up is also suspected as having contributed to crack development. Crack growth occurs by a process of propagation of the crack tip after dealloying (a form of corrosion). This process, although slow, results in preferential through-wall propagation rather than an increase in crack length. Leakage, therefore, occurs long before any significant growth occurs in the crack length. The above ground large bore welds are currently monitored for leakage by monthly walkdowns. The piping below the ground is monitored by a walkdown of the ground condition above the pipe. Soil changes have not been detected that would suggest that a leak exists in the buried piping. A JCO was developed to allow for plant operation with through-wall cracks in ECW pipe welds. Calculations generated to support the