

PARTIAL DRAFT SAFETY EVALUATION
BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELAXATION REQUEST FROM ORDER EA-03-009 REGARDING THE
VESSEL HEAD PENETRATION CONTROL ELEMENT DRIVE MECHANISM NOZZLES
FACILITY OPERATING LICENSE NO. NPF-6
ENTERGY OPERATIONS, INC.
ARKANSAS NUCLEAR ONE, UNIT 2 (ANO-2)
DOCKET NO. 50-368

X.1 Stress Analysis Using Finite Element Method (FEM) Modeling

The staff has evaluated information regarding the FEM modeling. Since the entire information is classified as proprietary, the staff can only discuss its findings at a very general level. The licensee's FEM model considers welding processes by simulating melting and solidification of individual welding passes through a combination of thermal and structural models. Heat treatment history has also been considered. This method of calculating residual stresses is consistent with industry practice and is acceptable to the staff. In addition, the licensee considered all test and operating loads. The basic stress-strain properties for Alloy 600 nozzle and 182 J-groove weld materials used in the stress analysis are generic in shape, which were modified based on some basic material property from ANO-2's certified material test report (CMTR). Considering the lack of plant-specific data, this engineering approach in modifying the generic stress-strain curve is appropriate. Further, the CMTR material property affects the maximum stress of the nozzle more than what the generic stress-strain shape does to the stress, providing additional support to the licensee's approach. The use of the stress-strain law for an elastic-perfectly plastic model for the 182 weld material may not be a good representation of the material's real behavior. However, it was used to overcome a modeling limitation of the FEM Code so that more realistic weld stresses would result. In summary, the FEM modeling is more than adequate, and the resulting stresses can be used as input to the licensee's fracture mechanics evaluation.