The EPAs used in the ABWR containment will be capable of maintaining leak tightness up to the containment pressure of 1.025 MPa (134 Psig) and temperature of 644 °K (700 °F) (see Subsection 8.3.3.7).

appears to be less likely based on the results of experiments conducted to date by Sandia National Labratories (SNL) and its contractors (Reference 19F-8). In fact, according to the same reference, no leakage was detected from any of the three current electrical penetration assemblies (EPAs) during the severe accident testing (steam environments). Depending on the EPA type the highest temperature loading ranged from 361°F to 700°F, and the highest pressure loading ranged from 75 psia to 155 psia. The leakage estimate in this study therefore concentrates on large operable penetrations.

The leakage potential of operable penetrations depends on both the relative position of the sealing surfaces and the performance of the seal material. The position of the sealing surfaces depends on the initial conditions (metal-to-metal contact is maintained under design conditions for most penetrations) and on the deformations induced by accident pressure and temperature. The seal performance depends mainly on temperature as well as the effect of thermal and radiation aging. The recent SNL tests of seals for mechanical penetrations, Reference 19F-8, indicated that

(1) In a steam environment at a constant pressure of 155 psia, the mean degradation temperature was 520°F for silicon rubber and 630°F for ethylene proplylene rubber (EPR), and

(2) In a nitrogen environment at a constant pressure of 155 psia, the mean degradation temperature was 490°F for neoprene, and

(3) The degradation temperature was not significantly affected by thermal and radiation aging.

Neoprene is not used for operable penetrations in the ABWR containment and the seal degradation temperature is conservatively assumed to be 500°F. The SNL study also showed that even a degraded seal can prevent leakage if the separation of the sealing surfaces is small (less than 0.005 in)).

Sandia (Reference 19F-8) has proposed the following equations for "available gasket springback", S_p, for evaluating the leakage potential as a function of the compression set retention and the degradation temperature:

$$S_p = (1 - C_B) S_q h_i \text{ for } (T < T_d) \quad (19F\text{-}3)$$

$$S_p = 0.005 \text{ inch for } (T > T_d) \quad (19F\text{-}4)$$

where:

C_B = the compression set retention (a dimensionless measure of the permanent set in the gasket caused by aging),

(5) A demonstration of leak tightness under the severe accident containment pressure and temperature loadings described in Subsection 19F.3.2.2.

(2) A simplified one-line diagram showing the location of the protective devices in the penetration circuit, with indication of the maximum available fault current of the circuit;

(3) Specific identification and location of power supplies used to provide external control power for tripping primary and backup electrical penetration breakers (if utilized);

(4) An analysis demonstrating the thermal capability of all penetrations is preserved and protected by one of the following:

(a) The maximum available fault current (including single-failure of an upstream device) is less than the maximum continuous current capacity of the penetration; or

(b) Redundant circuit protection devices are provided, and are adequately designed and set to interrupt current, in spite of single-failure, at a value below the maximum continuous current capacity of the penetration. Such devices must be located in separate panels or be separated by barriers and must be independent such that failure of one will not adversely affect the other. Furthermore, they must not be dependent on the same power supply.

Protective devices designed to protect the penetrations are capable of being tested, calibrated and inspected (See Subsection 8.3.4.4).

8.3.3.8 Fire Protection of Cable Systems

The basic concept of fire protection for the cable system in the ABWR design is that it is incorporated into the design and installation rather than added onto the systems. By use of fire resistant and non-propagating cables, conservative application in regard to ampacity ratings and raceway fill, and by separation, fire protection is built into the system. [Insert 18] Fire suppression systems (e.g., automatic sprinkler systems) are provided as listed in Table 9.5.1-1.

8.3.3.8.1 Resistance of Cables to Combustion

The electrical cable insulation is designed to resist the onset of combustion by limiting cable ampacity to levels which prevent overheating and insulation failures (and resultant possibility of fire) and by choice of insulation and jacket materials which have flame-resistive and self-extinguishing characteristics. Polyvinyl chloride or neoprene cable insulation is not used in the ABWR. All cable trays are fabricated from noncombustible material. Base ampacity rating of the cables was established as published in IPCEA-46-426/IEEE-S-135 and IPCEA-54-440/ NEMA WC-51. Each coaxial cable, each single conductor cable and each conductor in multiconductor cable is specified to pass the vertical flame test in accordance with UL-44.