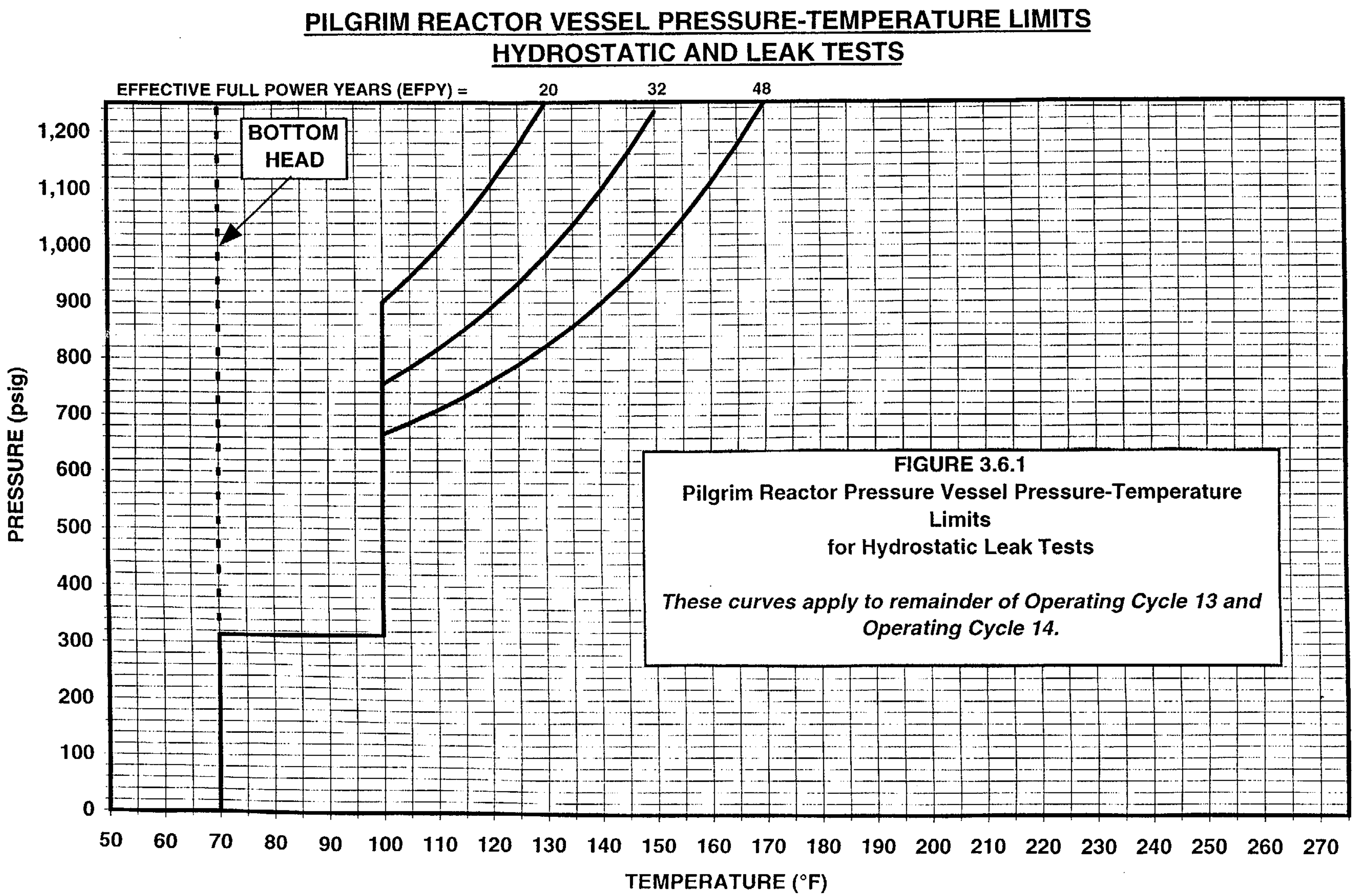

FIGURE 3.6.1
Pilgrim Reactor Pressure Vessel Pressure-Temperature Limits for Hydrostatic Leak Tests

These curves apply to remainder of Operating Cycle 13 and Operating Cycle 14.

PILGRIM REACTOR VESSEL PRESSURE-TEMPERATURE LIMITS
SUBCRITICAL HEATUP AND COOLDOWN

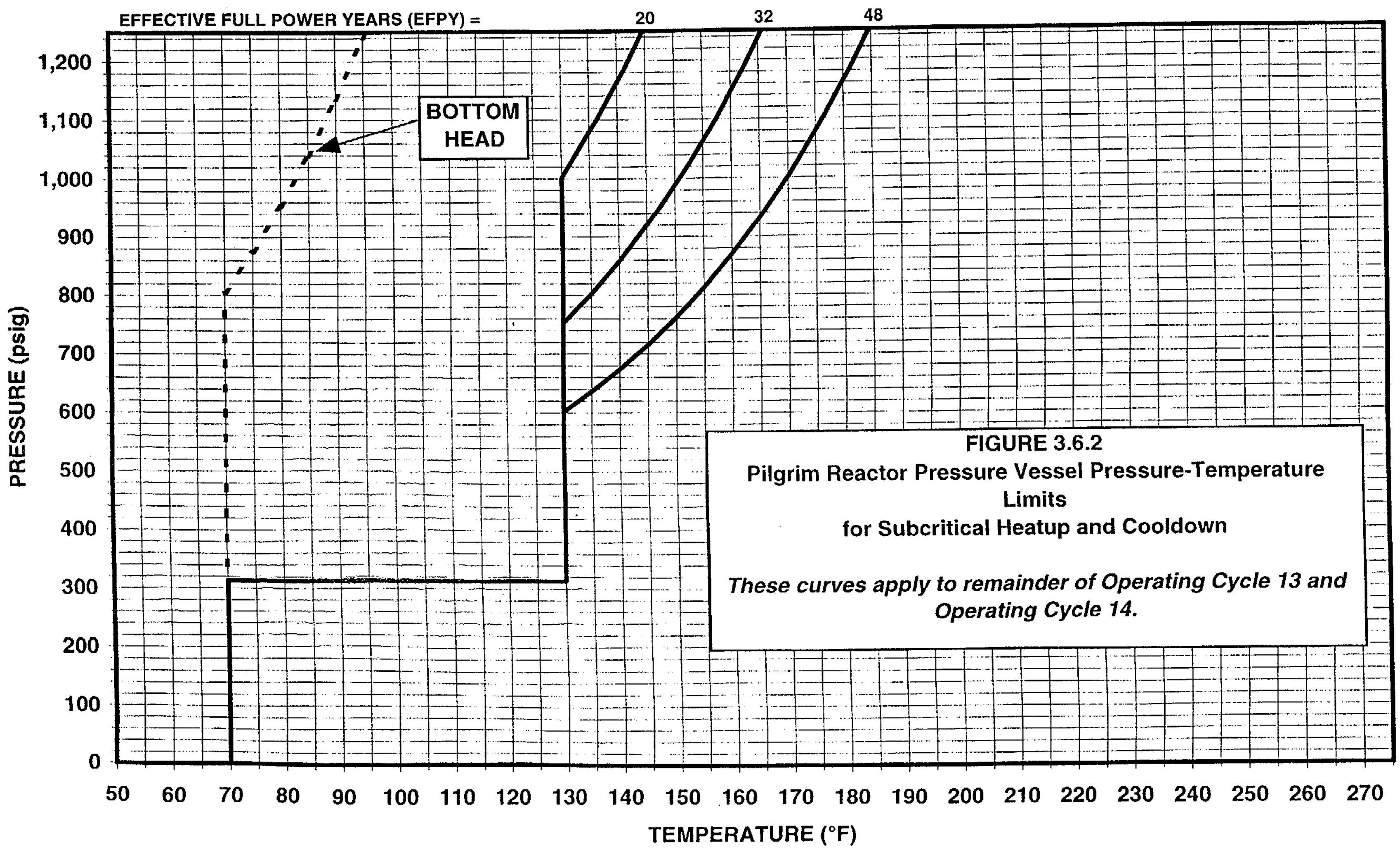

FIGURE 3.6.2
Pilgrim Reactor Pressure Vessel Pressure-Temperature Limits
for Subcritical Heatup and Cooldown

These curves apply to remainder of Operating Cycle 13 and Operating Cycle 14.

PILGRIM REACTOR VESSEL PRESSURE-TEMPERATURE LIMITS
CRITICAL CORE OPERATION

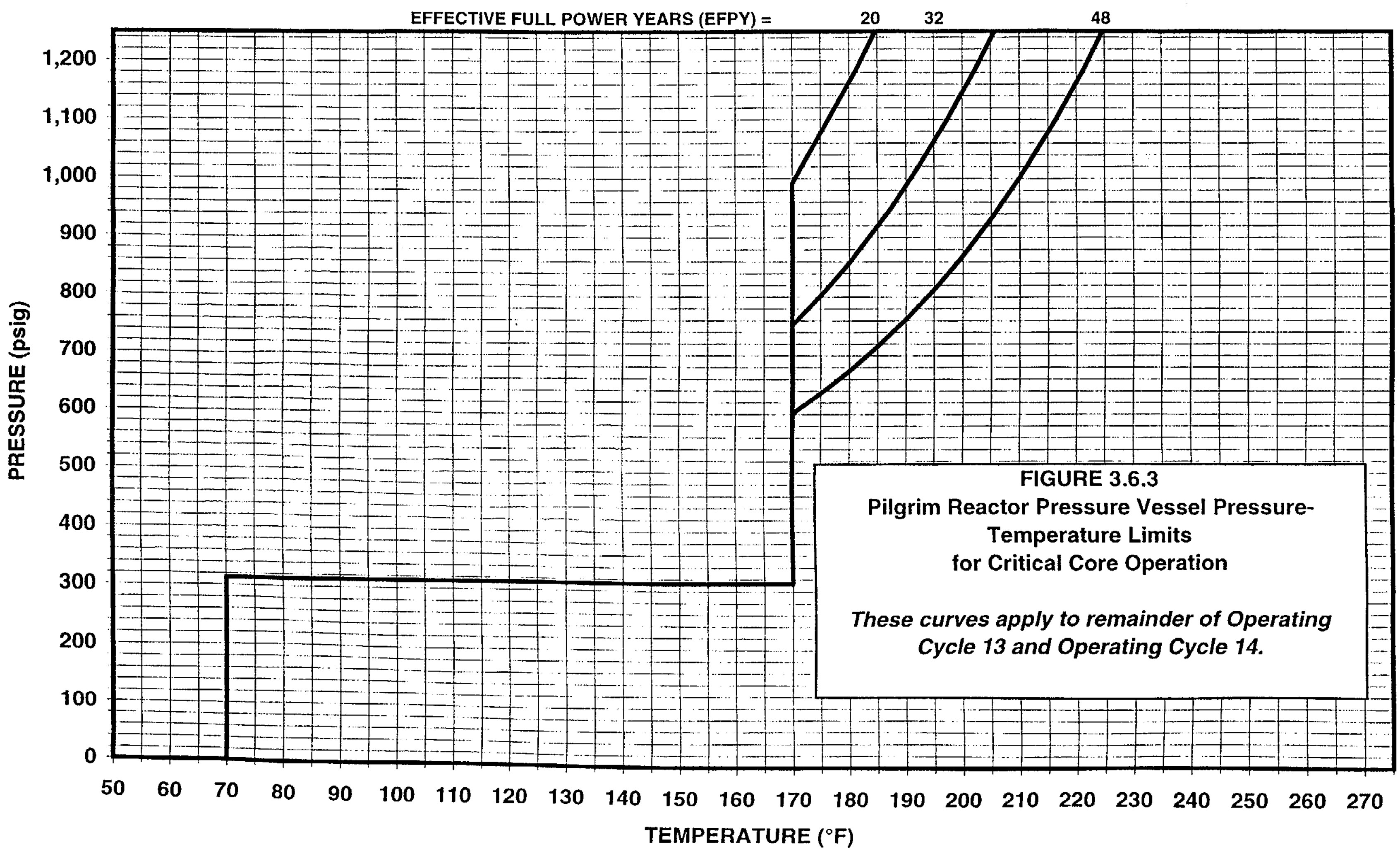

FIGURE 3.6.3
Pilgrim Reactor Pressure Vessel Pressure-Temperature Limits for Critical Core Operation

These curves apply to remainder of Operating Cycle 13 and Operating Cycle 14.

BASES:

3/4.6 PRIMARY SYSTEM BOUNDARY (Cont)

A. Thermal and Pressurization Limitations (Cont)

The bottom head, defined as the spherical portion of the reactor vessel located below the lower circumferential weld, was also evaluated. Reference transition temperatures (RT_{ndt}) were developed for the bottom head and the resulting pressure vs. temperature curves plotted on Figures 3.6-1 and 3.6-2. It has been determined that the bottom head temperatures are allowed to lag the vessel shell temperatures (Reference: Structural Integrity Associates (SIA) Report SIR-00-108, dated September 11, 2000). The referenced analysis utilizes the stress results established in the Combustion Engineering Inc., Pilgrim Reactor Vessel Design Report, No. CENC 1139, dated 1971, and combines the stress analysis results, specific to the bottom head, with the pressurization temperatures necessary to maintain fracture toughness requirements in accordance with the ASME Boiler and Pressure Vessel Code, Section III, the criteria of 10CFR50, Appendix G, and the supplementary guidelines of Reg. Guide 1.99, Rev. 2.

For Pilgrim pressure-temperature restrictions, two locations in the reactor vessel are limiting. The closure region controls at lower pressures and the beltline controls at higher pressures.

The nil-ductility transition (NDT) temperature is defined as the temperature below which ferritic steel breaks in a brittle rather than ductile manner. Radiation exposure from fast neutrons (>1 Mev) above about 10^{17} nvt may shift the NDT temperature of the vessel metal above the initial value. Impact tests from the first material surveillance capsule removed at 4.17 EFPY indicated a maximum RT_{ndt} shift of 55 degrees F for the weld specimens.

Neutron flux wires and samples of vessel material are installed in the reactor vessel adjacent to the vessel wall at the core midplane level. The wires and samples will be periodically removed and tested to experimentally verify the values used for Figures 3.6-1, 3.6-2, and 3.6-3. The withdrawal schedule of Table 4.6-3 has been established as required by 10CFR50, Appendix H.

The RT_{ndt} of the closure region is +10 degrees F. The initial RT_{ndt} for the beltline weld and base metal are -48 degrees F and 0 degrees F, respectively. These RT_{ndt} temperatures are based upon unirradiated test data, adjusted for specimen orientation in accordance with USNRC Branch Technical Position MTEB 5-2.

The closure and bottom head regions are not exposed to neutron fluence (> 1 Mev) over the vessel life sufficient to cause a shift in RT_{ndt}. The pressure-temperature limitations (Figures 3.6-1, 3.6-2, and 3.6-3) of the closure and bottom head regions will therefore remain constant throughout vessel life. Only the beltline region of the reactor vessel will experience a shift in RT_{ndt} with a resultant increase in pressure-temperature limits.

The curves apply to 100% bolt preload condition but are conservative for lesser bolt preload conditions.

A. Thermal and Pressurization Limitations (Cont)

For critical core operation when the water level is within the normal range for power operation and the pressure is less than 20% of the preservice system hydrostatic test pressure (313 psi), the minimum permissible temperature of the highly stressed regions of the closure flange is RT_{ndt} + 60 degrees F = 70 degrees F; thus, a cutoff limit of 70 degrees F was chosen as shown on Figure 3.6-3 and as required by 10CFR50 Appendix G, paragraph IV. A.3. This same cutoff is conservatively included in the limits for hydrostatic and leak tests and for non-critical operation, as shown on Figures 3.6-1 and 3.6-2, respectively, in order to be consistent with the limits for critical operation.

The closure region is more limiting than the feedwater nozzle with respect to both stress intensity and RT_{ndt}. Therefore, the pressure-temperature limits of the closure are controlling.

The minimum bolt-up temperature is the minimum allowable nil ductility transition temperature (RT_{ndt}) at pressures below the 20% of pre-operational system hydrostatic test pressure that bolt pre-load stress can be applied to the reactor vessel closure region. It is defined as the initial RT_{ndt} of the higher stressed component of the reactor vessel that includes the vessel head, head flange and shell adjacent to the vessel flange. The maximum RT_{ndt} is + 10 degrees F. For conservatism a minimum bolt-up temperature of 55 degrees F is chosen because this temperature provides sufficient margin between the lowest service temperature at 20% of the pre-operational hydrostatic test pressure prior to pressurization.

The adjusted reference temperature shift is based on Regulatory Guide 1.99, Revision 2, dated May 1988; the analytical results of General Electric Report MDE 277-1285, Revision 1, dated January 21, 1985, regarding projected neutron fluence; and Structural Integrity Associates (SIA) report SIR-00-108 dated September 11, 2000, for RT_{ndt} versus fluence as a function of temperature and pressure.

B. Coolant Chemistry

The reactor vessel coolant chemistry requirements are discussed in Subsection 4.2 of the FSAR.

A radioactivity concentration of 20 μ Ci/ml total iodine can be reached if there is significant fuel failure or if there is a failure or a prolonged shutdown of the cleanup demineralizer. Calculations performed by the AEC staff for this activity level results in a radiological dose at the site boundary of 8 rem to the thyroid from a postulated rupture of a main steam line assuming a 5 second valve closing time and a coolant inventory release of 3 x 10^4 lbs.

A reactor sample will be used to assure that the limit of Specification 3.6.B.1 is not exceeded.