PART 9900: 10 CFR GUIDANCE

DEFINITION OF LEAK-BEFORE-BREAK ANALYSIS AND ITS APPLICATION TO PLANT PIPING SYSTEMS

A. PURPOSE

To provide guidance on the definition of Leak-Before-Break (LBB) analysis and its application for the evaluation of nuclear power plant piping systems.

B. BACKGROUND

It has come to the attention of the staff through recent discussions with licensees, licensee submittals, and internal staff discussions that licensees may be performing analyses purported to be "LBB analyses" for purposes not approved by the NRC. LBB is an analysis procedure with a limited scope of applicability and requires NRC review and approval. This directive discusses the existing regulatory positions related to this issue and provides inspection guidance in this area.

C. DISCUSSION

The NRC undertook a plan to assess the applicability of LBB analyses to nuclear power plant piping systems with the establishment of the Piping Review Committee and the Pipe Break Task Group during the early 1980s. The work of the Pipe Break Task Group culminated in the publication of NUREG-1061, Vol. 3 in November 1984, which delineated the staff's assessment of LBB applicability. Subsequently, the NRC amended the scope of General Design Criteria 4 (GDC-4) of Appendix A to Title 10 Code of Federal Regulations Part 50 (10 CFR Part 50) to include the use of LBB analyses to allow the removal of pipe whip restraints, jet impingement barriers, and related equipment designed to address the dynamic effects of postulated ruptures in pressurized water reactor coolant system (RCS) piping (2). Further amendment of the rule extended LBB applicability to the high energy piping of all reactor types (3). This is stated in the current (1996) revision of 10 CFR Part 50 as follows:

However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be

excluded from the design basis when *analyses reviewed and approved by the Commission* [emphasis added] demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping.

Finally, a new draft Standard Review Plan (SRP) Section 3.6.3 was developed to include guidance on the evaluation of licensee submittals with respect to LBB analyses. The limitations on the application of LBB analyses are comprehensively addressed in references (1) through (3) below, as well as draft SRP Section 3.6.3.

As noted above, the NRC-accepted application of LBB analysis was tailored to the removal of components designed to mitigate the dynamic effects of high energy (pressure > 275 psi or temperature > 200°F) pipe ruptures. Those dynamic effects which could be excluded under the modifications of GDC-4 in references (2) and (3) included:

(a)	missile generation,
(b)	pipe whipping,
(c)	pipe break reaction forces,
(d)	jet impingement forces,
(e)	decompression waves within the ruptured pipe, and
(f)	dynamic or nonstatic pressurization of cavities, compartments, or subcompartments (not performing a containment function) as a result of the pipe rupture.

In general, the considerations listed above can be summarized as local effects of the postulated pipe break. These are as opposed to global effects such as gross containment pressurization, rises in area temperatures and/or humidity, radiation release, and fluid inventory loss. Reanalysis as a result of the use of LBB of the magnitude of these global effects and their influence on the design of emergency core cooling systems, containment boundaries, and/or the environmental qualification of electrical and mechanical components is not allowed by the regulations.

Therefore, if a licensee has received an SER from the Commission noting which sections of the facility's piping have been approved for the application of LBB analysis modifications such as the following may be undertaken:

(a)	The removal of pipe whip restraints and jet impingement shields.
(b)	The removal of snubbers on steam generators and reactor coolant pumps whose only design function is the mitigation of thrust loads associated with the pipe break.

(c)	Temporary or blowout shielding designed to protect the integrity of the reactor pressure vessel bioshield during design basis loss of coolant accident events may be replaced with permanent shielding.
(d)	The elimination of pressure and temperature conditions for the design of subcompartments associated with the break of a line (but only if the subcompartment itself does not provide a containment related function).
(e)	The installation of permanent refuelling pool seals.

D. CONCLUSION

If the inspector identifies a situation in which a licensee proposes to apply LBB analysis for any purpose, the inspector should:

1.	Verify that the licensee has received NRC review and approval for the LBB analysis for the piping system under consideration and possesses an NRC SER.
2.	Examine the modification which is being proposed to establish that the purpose for the application of LBB is appropriate given the information provided in this Inspection Guidance and references (1) through (4) below.
3.	If the inspector is unable to verify the appropriateness of the licensee's actions, the item should be sent via TIA to NRR for assessment and interpretation.

E. REFERENCES

The guidance provided in this directive was extracted from the following:

1.	NUREG-1061, Volume 3, Report of the U.S. Nuclear Regulatory Commission Piping Review Committee, Evaluation of the Potential for Pipe Breaks, November 1984.
2.	Federal Register Vol. 51, No. 70, April 11, 1986.
3.	Federal Register Vol. 52, No. 207, October 27, 1987.

4.	Draft Standard Review Plan (NUREG-0800) Section 3.6.3.

END