SAFETY GUIDE 11

INSTRUMENT LINES PENETRATING PRIMARY REACTOR CONTAINMENT

A. Introduction

General Design Criteria 55 and 56 require that each line that penetrates primary reactor containment and is part of the reactor coolant pressure boundary or that is connected directly to the containment atmosphere have one automatic valve inside and one automatic valve outside containment "unless it can be demonstrated that the design is acceptable on some other defined basis." This guide describes a suitable basis which may be used to implement General Design Criteria 55 and 56 for demonstrating the acceptability of a particular group of these lines, namely, instrument lines.

B. Discussion

Valving provided for each instrument line penetrating or connected to primary reactor containment must reflect the importance of two safety functions: (1) the function the line performs and (2) the need to maintain containment leaktight integrity. The probability of achieving the first function is enhanced by inclusion of fewer valves (e.g., one rather than two), whereas that of the second function is enhanced by additional valves.

In the event of a rupture of any component in the instrument line outside primary containment, it is important to assure that the integrity and functional performance of secondary containment and its associated filtration systems are maintained. It is also desirable to keep the rate and extent of coolant loss from the ruptured component within the capability of reactor coolant makeup system. The probability of such a rupture is considered to be sufficiently high that the calculated offsite exposures that might result from such a single failure during normal operation should be substantially below the guidelines of 10 CFR 100.

The rate of coolant loss from an instrument line rupture outside containment can be reduced by including flow restrictions, such as orifices, in the instrument line. The flow restrictions should be sized to reduce this rate of coolant loss to the extent practical without adversely affecting the capability of the connected instruments to perform their functions. In particular, it must be assured that the response time of the instruments does not become unacceptably long because of such flow restrictions and that the flow restrictions will not become plugged. It is also desirable that flow restrictions in the instrument line be located as close as practical to where the instrument line connects to the reactor coolant system.

If the conditions of the two preceding paragraphs are satisfied, an acceptable capability for isolating instrument lines penetrating or connected to primary reactor containment can be provided by a single isolation valve capable of automatic operation (no dependence on operator actions) or capable of remote operation by the operator in the control room or another appropriate location. A self actuated excess flow check valve is acceptable as an automatically operated valve if it has the other features needed for this service. It is desirable that the isolation valve be located outside containment for greater accessibility. For power operated valves, which may provide a safety function in either the open or closed position, on balance, greater safety will be afforded by designing this valve to remain "as-is" (usually open) if power is lost.

Elimination of the isolation valve inside containment makes it important that there be a high degree of assurance that the piping from the containment up to and including the outside valve retain its integrity during normal reactor operation and under accident conditions. This assurance can be provided by locating the valve as close to containment as practical, by adopting a conservative approach in the design of this section of piping, by suitable quality assurance provisions, and by suitable visual inservice inspections. Performing inservice inspections should not increase the probability of damaging the instrument lines. In addition, provisions may be needed to protect against accidental damage of lines and to assure that failures of one line will not induce failure of any other line by pipe whip, missiles, or some other mechanism.

Sufficient experience with valves of a similar type should be available to assure a high probability that the valve will not close when the instrument line is intact and its safety function is required, but that it will close if the instrument line is ruptured downstream. In the event of a rupture downstream of the valve, the valve should close automatically or be capable of being closed during normal reactor operation and under accident conditions. In addition, the valve should reopen automatically or be capable of being reopened readily under the conditions that prevail when reopening is appropriate. It should not be necessary to break a line to reopen a closed valve.

It is desirable to have valve status (opened or closed indicated in the control room because without such an indication, a valve may be closed and the effectiveness of the instrument impaired for long periods of time. For remotely operable valves, the operator needs sufficient information regarding the status of the valve and the condition of the line so that he can take proper, timely actions.

Lines connected to instruments that are part of the protection system are extensions of that system and should satisfy the requirements for redundancy, independence, and testability for the protection system, to assure that the protective function will be accomplished.

Lines connected only to instruments that are not part of the protection system need not meet the requirements of the protection system. For these lines, the assurance that isolation can be effected when required is of greater importance to safety than the capability of the connected instrument function; therefore, more extensive valving is acceptable.

C. Regulatory Position

To implement General Design Criteria 55 and 56 for instrument lines penetrating or connected to primary reactor containment:

1. *Sensing lines for instruments that are part of the protection system:*
   a. Should satisfy the requirements for redundancy, independence, and testability of the protection system.
   b. Should be sized or orificed to assure that in the event of a postulated failure of the piping or of any component (including the postulated rupture of any valve body) in the line outside primary reactor containment during normal reactor operation, (1) the leakage is reduced to the maximum extent practical consistent with other safety requirements, (2) the rate and extent of coolant loss are within the capability of the reactor coolant makeup system, (3) the integrity and functional performance of secondary containment, if provided, and associated safety systems (e.g., filters, standby gas treatment system) will be maintained, and (4) the potential offsite exposure will be substantially below the guidelines of 10 CFR 100.
   c. Should be provided with an isolation valve capable of automatic operation [1] or remote operation from the control room or from another appropriate location, and located in the line outside the containment as close to the containment as practical. There should be a high degree of assurance that this valve (1) will not close accidentally during normal reactor operation, (2) will close or be closed if the instrument line integrity outside containment is lost during normal reactor operation or under accident conditions, and (3) will reopen or can be reopened under the conditions that would prevail when valve reopening is appropriate. Power-operated valves should remain as-is upon loss of power. The status (opened or closed) of all such isolation valves should be indicated in the control room. If a remotely operable valve is provided, sufficient information should be available in the control room or other appropriate location

[1] A self-actuated excess flow check valve is acceptable as an automatically operated valve provided it has all other features specified in the guide.

to assure timely and proper actions by the operator.

d. Should be conservatively designed up to and including the isolation valve and of a quality at least equivalent to the containment. These portions of the lines should be located and protected so as to minimize the likelihood of their being damaged accidentally. They should be protected or separated to prevent failure of one line from inducing failure of any other line. Provisions should be included to permit periodic visual inservice inspection, particularly of those portions of the lines outside containment up to and including the isolation valve.

e. Should not be so restricted by components in the lines, such as valves and orifices, that the response time of the connected instrumentation will be increased to an unacceptable degree.

2. *Sensing lines for instruments that are not part of the protection system:*

   a. Should meet the provisions of 1.b., 1.c., 1.d., and 1.e., above, or

   b. Should be provided with one automatic isolation valve inside and one automatic valve outside containment. The valve outside should be located as close to containment as practical.

SUPPLEMENT TO SAFETY GUIDE 11

INSTRUMENT LINES PENETRATING PRIMARY REACTOR CONTAINMENT BACKFITTING CONSIDERATIONS

D. Introduction

Safety Guide 11 describes the regulatory position concerning instrument lines penetrating primary reactor containment for present and future reactors. The purpose of this supplement is to provide guidance to applicants and licensees concerning possible backfitting with regard to these instrument lines. This supplement does not represent a requirement for backfitting; such requirements will be formulated on an individual case basis pursuant to § 50.109, "Backfitting," of CFR Part 50.

E. Regulatory Position

1. Plants for which a notice of hearing on application for construction permit was published on or after January 5, 1970, should conform to the regulatory position in the safety guide.
2. Plants for which a notice of hearing on application for construction permit was published between January 5, 1967, and December 30, 1969, should meet the following criteria as soon as practicable:
   a. Each instrument line connected to the reactor coolant pressure boundary and penetrating containment should be sized or include an orifice such that if a postulated failure of the piping or of any component (including the postulated rupture of any valve body) in the line outside primary reactor containment occurs during normal reactor operation:
      (1) the leakage is reduced to the maximum extent practical consistent with other safety requirements,
      (2) the rate and extent of coolant loss are within the capability of the reactor coolant makeup system,
      (3) the integrity and functional performance of secondary containment, if provided, and associated safety systems (e.g., filters, standby gas treatment system) will be maintained, and
      (4) the potential offsite exposure will be substantially below the guidelines of 10 CFR Part 100.
   b. For each instrument line penetrating containment, including those connected to the containment atmosphere, some method of verifying during operation the status (open or closed) of each isolation valve should be provided.
3. Licensees of plants for which a notice of hearing on application for construction permit was published on or before December 30, 1966, should furnish to the regulatory staff a suitable analysis of the effects on the secondary containment, if provided, and associated safety systems of a postulated failure of the piping or of any component in an instrument line outside primary reactor containment. With respect to plants for which the integrity and functional performance of the secondary containment building and associated safety systems cannot be maintained under these postulated conditions, the licensee should provide protection equivalent to that described in regulatory position 2.a.(3) above as soon as practicable consistent with the reactor shutdown schedule.