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June 4, 1992

Docket Nos. 50-348
50-364

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Joseph M. Farley Nuclear Plant
Request for Additional Information Concerning the
Steam Generator Alternate Plugging Criteria

Gentlemen:

By letter dated May 20, 1992, the NRC Staff requested additional information concerning the steam generator alternate plugging criteria. Attached are responses to both of the Staff's questions.

It is anticipated that these responses will be incorporated in Revision 3 of WCAP-12871. However, Revision 3 will not be printed until additional NRC Staff requests for information are received and resolved.

If there are any questions, please advise.

Respectfully submitted,

J. D. Woodard

JDW/REM:map 2550

Attachment

cc: Mr. S. D. Ebneter
Mr. S. T. Hoffman
Mr. G. F. Maxwell

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ATTACHMENT

1. NRC REQUEST

When evaluating the radiological consequences of a postulated main steam line break, the Nuclear Regulatory Commission staff analyzes for two cases of iodine spiking. First, a pre-existing iodine spike is assumed to have occurred (pre-accident iodine spike case) with reactor coolant iodine concentrations as specified in the Technical Specifications. Second, an analysis is performed assuming an event-initiated iodine spike. Both cases are described in NUREG-0800, Standard Review Plan 15.1.5, Appendix A.

Please provide an analysis of the radiological consequences of a main steam line break considering iodine spiking as specified in SRP 15.1.5, Appendix A. In performing the analysis, consider the maximum expected (55 gallon per minute) primary-to-secondary leak rate that might result assuming a main steam line break. The analysis should assume offsite power is both available and not available.

SNC RESPONSE

The current Farley licensing basis did not include an iodine spike for the main steam line break analysis. Consequently, the leakage analysis in support of the alternate plugging criteria did not include an iodine spike. Inclusion of the iodine spike has resulted in a reduction in the allowable leak rate for a steam line break from 55 gpm to 5.7 gpm. The supporting analysis is provided below.

Allowable Leak Rate for Accident Conditions

A calculation has been completed to determine the maximum permissible steam generator (SG) primary-to-secondary leak rate during a steam line break for the Farley Unit 1 and 2 SGs. The calculation considered accident initiated and pre-accident iodine spikes. The accident initiated iodine spike resulted in the limiting leak rate. Based on a 30 rem thyroid dose at the site boundary, a leak rate of 5.9 gpm was determined to be the upper limit for the total allowable primary-to-secondary leakage in all loops. The SGs in the intact loops are assumed to have primary-to-secondary leakage of 150 gpd each (approximately 0.1 gpm), which is the maximum value defined by the proposed technical specification. Thus, the allowable leak rate for the SG in the faulted loop is 5.7 gpm. Although the leakage in any of the SGs may be distributed among tubesheet and tube support plate (TSP) locations, the calculation that was performed conservatively assumed that the leakage is all at TSP locations (above the mixture level).

Thirty rem was selected as the dose acceptance criteria for the accident initiated iodine spike case based on the guidance of Standard Review Plan (NUREG-0800) Section 15.1.5, Appendix A. The SRP further states that the acceptance criteria for a steam generator tube rupture (SGTR) with a pre-accident iodine spike is the 10 CFR 100 guideline. In this case, 150 rem was considered to be appropriately within the 300 rem guideline of 10 CFR 100 and, thus, was selected as the dose acceptance criteria. Only the release of iodines and the resulting two hour site boundary thyroid dose were considered in the leak rate determination. Noble gases were considered; however, whole body doses due to noble gas immersion have been determined in other evaluations to be considerably less limiting than the corresponding thyroid doses.

The salient assumptions used in the evaluation follow.

Initial primary coolant iodine activity:

Accident initiated iodine spike: 1 μCi/gm of dose equivalent I-131

Pre-accident iodine spike: 60 μCi/gm of dose equivalent I-131

Accident initiated spike iodine appearance rate:

500 X the appearance rate that corresponds to a 1 μCi/gm equilibrium primary coolant activity level

The appearance rate (Curies/sec) for each iodine nuclide is as follows:

I-131: 1.34
I-132: 2.53
I-133: 3.05
I-134: 3.9
I-135: 2.87

Failed fuel, percent of core:	0, applicable with or without offsite power
Initial secondary coolant activity:	0.1 μCi/gm of dose equivalent I-131 (Tech Spec LCO)
Availability of offsite power:	Not available, results in bounding case since fuel failure is not predicted with or without reactor coolant pump operation and steam dump to the condensers is not available
Turbine condenser:	Not available, all activity released directly to the environment

Steam released to the environment (0 to 2 hours):

from 2 SGs in intact loops -	479,000 lb (plus p/s leakage)
from faulted loop -	91,000 lb (plus p/s leakage) (the entire initial SG water mass, does not include auxiliary feedwater addition)

Iodine partition coefficients:

SGs in intact loops -	1.0 for p/s leakage since leakage is assumed to be above the mixture level (conservative for leaks at the tube sheet)
	0.1 for steam release

SG in faulted loop -	1.0 due to dry SG (for both p/s leakage and steam release - leaks can be at any location) (FSAR assumes 0.1)
Atmospheric dispersion factor:	0 to 2 hours at the site boundary, 6.5 E-4 sec/cu-m

Thyroid dose conversion factors (rem/curie): Regulatory Guide 1.109

The radioactivity released to the environment due to a main steam line break can be separated into two distinct releases: the release of the initial iodine activity contained in the secondary coolant and the release of primary coolant iodine activity that is transferred by tube leakage. Based on the assumptions stated previously, the release of the iodine activity initially contained in the secondary coolant (3 SGs) results in a site boundary thyroid dose of approximately 2 rem. This is independent of both the leak location and iodine spiking assumptions.

The dose contribution due to primary-to-secondary leakage from both the faulted loop SG and the two intact loop SGs, regardless of the leak location, is as follows:

accident initiated iodine spike - 4.7 rem/gpm,
pre-accident iodine spike - 21.5 rem/gpm.

The total allowable leak rate is as follows:

accident initiated iodine spike (30 rem limit) - 5.9 gpm,
pre-accident iodine spike (150 rem limit) - 6.9 gpm.

The allowable leak rate for the SG in the faulted loop is as follows:

accident initiated iodine spike - 5.7 gpm,
pre-accident iodine spike - 6.7 gpm.

Based on these results, the accident initiated spike results in the limiting leak rate.

Because of the potential for SG tube uncovery, treatment of leakage is different depending on the location of the leak. Following a reactor trip, the mixture level in the SG can drop below the apex of the tube bundle. For the SGs in the intact loops, leakage that occurs in the tube sheet region is assumed to remain covered by water and mix with the secondary coolant (partition coefficient associated with steaming is 0.1). Leakage that occurs at a support plate is assumed to transfer directly to the environment without mixing or partitioning since the leakage site is assumed to be above the mixture level. Although less than approximately four feet of the bundle is expected to be above the mixture level, any support plate leak is assumed to remain uncovered for the duration of the accident recovery. The SG in the faulted loop is assumed to steam dry (no mixture level). Hence, leakage to this SG is also assumed to transfer directly to the environment regardless of the location of the leak.

The accidents that are affected by primary-to-secondary leakage are those that include, in the activity release and offsite dose calculation, modeling of leakage and secondary steam release to the environment. The reasons that the steam line break is limiting are: 1) the steam line break primary-to-secondary leak rate in the faulted loop is assumed to be many times greater than the operating leak rate because of the sustained increase in differential pressure, and 2) leakage to the faulted steam generator is assumed to be released directly to the environment, i.e., no mixing with the secondary coolant or partitioning of activity is assumed, since the steam generator in the faulted loop is subject to dryout. Depending on the elevation of the degradation (at the tubesheet region versus at a TSP), for other accidents in which there is a secondary side steam release, the secondary sides of all SGs are assumed to be intact, hence, an increase in the primary-to-secondary leak rate is not predicted because there is not a sustained increase in the primary-to-secondary differential pressure. Also, there may be justification for mixing or iodine partitioning in the SGs following t potential initial uncovery of the top of the tube bundle after the reactor trip. These factors significantly reduce the release of iodine to the environment for accidents other than steam line break.

As noted above, mixing and iodine partitioning are dependent upon the elevation of the degradation. For non-SLB accidents in which there is a secondary side steam release, there is justification for mixing and partitioning if the primary-to-secondary leakage is at the tubesheet region (below the SG water level). If the degradation is at a TSP, such that reactor coolant could bypass the secondary coolant and directly enter the steam space, the radioactivity release path is assumed to be directly to the environment, just as it is for the SG in the faulted loop following an SLB.

2. NRC REQUEST

If fuel failures are expected to occur during a main steam line break accident, provide an analysis of the radiological consequences considering the maximum primary-to-secondary leak rate.

SNC RESPONSE

Fuel failure is not predicted for a steam line break.