

FINAL LICENSE RENEWAL INTERIM STAFF GUIDANCE LR-ISG-2006-01:  
PLANT-SPECIFIC AGING MANAGEMENT PROGRAM FOR INACCESSIBLE AREAS OF  
BOILING WATER REACTOR MARK I STEEL CONTAINMENT DRYWELL SHELL

Introduction

Line Item II.B1.1-2 of NUREG-1801, Volume 2, Revision 1, includes a provision for aging management of the Mark I steel containment drywell shells. However, the line item requires additional detail to address the inaccessible areas of the Mark I steel containment drywell shells. Specifically, the line item does not provide guidance when the distance between the steel drywell shell and the surrounding concrete structure is too small for the successful performance of visual examination.

All Mark I containment drywells are free-standing steel construction, except for Brunswick, Units 1 and 2. The Brunswick Mark I containment consists of a reinforced concrete drywell and a reinforced concrete torus with a steel liner. A drywell shell is a free-standing steel structure with no concrete backing, whereas the steel liner of a drywell is a leak-tight membrane in direct contact with the concrete containment.

Historical Background

Information Notice (IN) 86-99, "Degradation of Steel Containments," dated December 8, 1986, described an event related to the degradation of the drywell shell at Oyster Creek Nuclear Generating Station. IN 86-99, Supplement 1, dated February 14, 1991, explained that the most likely cause of corrosion of the drywell shell in sand-pocket areas (near the bottom of the drywell) and in the spherical portion of the drywell at higher elevations, was the water in the gap between the drywell and the concrete shield. The source of water was noted as leakage through the seal between the drywell and the refueling cavity. The IN supplement noted that the stainless steel liners in the refueling cavity and equipment pool developed cracks along the perimeter of the liner plates where they were welded to embedded channels. The IN supplement also noted that ultrasonic testing (UT) discovered minor corrosion in the cylindrical portion of the drywell, and significant corrosion in the sand-bed region of the shell.

Discussion

Generic Letter (GL) 87-05, "Request for Additional Information-Assessment of Licensee Measures to Mitigate And/Or Identify Potential Degradation of Mark I Drywells," requested additional information regarding licensee actions to mitigate and/or identify potential degradation of boiling water reactor Mark I drywells. As a result, a number of licensees performed UT of their carbon steel drywell shells adjacent to the sand-bed region. In addition, many licensees established leakage monitoring programs for drain lines to identify leakage that may have resulted from refueling or spillage of water into the gap between the drywell and the surrounding concrete. UT performed as a result of GL 87-05 provided a set of data points to determine the drywell shell thickness that could be compared to the nominal fabrication thickness and the minimum thickness required to withstand the postulated loads. These UT measurements taken during the 1987-1988 time frame fall approximately near the mid-point of the current 40-year operating license period for most plants with Mark I steel containments.

The drywell shell is a passive, long-lived structure within the scope of license renewal that is subject to aging degradation. Pursuant to 10 CFR 54.21, the applicant must demonstrate that the effects of aging will be adequately managed so that the intended function will be maintained consistent with the current licensing basis for the period of extended operation. On the basis of license renewal application reviews and industry operating experience, the NRC staff determined that a plant-specific aging management program (AMP) is needed to address the potential loss of material due to corrosion in the inaccessible areas of the Mark I steel containment drywell shell for the period of extended operation.

#### Recommended Action

In addressing Line Item II.B1.1-2 of NUREG-1801, Volume 2, Revision 1, applicants for license renewal for plants with a Mark I steel containment should perform an aging management review of the inaccessible areas of its containment drywell shell and provide a plant-specific aging management program that addresses the potential loss of material due to corrosion for the period of extended operation.

In conducting the aging management review and developing the plant-specific aging management program for the drywell shell, the applicant should consider the following recommended actions based upon plant design and operating experience:

- (1) Develop a corrosion rate that can be reasonably inferred from past UT examinations or establish a corrosion rate using representative samples in similar operating conditions, materials, and environments. If degradation has occurred, provide a technical basis using the developed or established corrosion rate to demonstrate that the drywell shell will have sufficient wall thickness to perform its intended function through the period of extended operation.
- (2) Demonstrate that UT measurements performed in response to GL 87-05 did not show degradation inconsistent with the developed or established corrosion rate.
- (3) Where degradation has been identified in the accessible areas of the drywell, provide an evaluation that addresses the condition of the inaccessible areas for similar conditions, that is, the applicant should evaluate the acceptability of inaccessible areas when conditions exist in the adjacent accessible areas that could indicate the presence of or could result in degradation to such inaccessible areas.
- (4) To assure that there are no circumstances that would result in degradation of the drywell, demonstrate that moisture levels associated with accelerated corrosion rates do not exist in the exterior portion of the drywell shell, for example: (1) the sand pocket area drains and/or the refueling seal drains are monitored periodically; (2) the top of the sand pocket area is sealed to exclude water accumulation in the sand pocket area; and/or alarms are used to monitor regions for moisture/leakage.

- (5) If moisture has been detected or suspected<sup>1</sup> in the inaccessible area on the exterior of the drywell shell or the source of moisture cannot be determined subsequent to root cause analyses:
- (a) Include in the scope of license renewal any components that are identified as a source of moisture, if applicable, such as the refueling seal or cracks in the stainless steel liners of the refueling cavity pool walls, and perform an aging management review.
  - (b) Identify surface areas requiring examination by implementing augmented inspections for the period of extended operation in accordance with the American Society of Mechanical Engineers (ASME) Section XI IWE-1240 as identified in Table IWE-2500-1, Examination Category E-C.
  - (c) Use examination methods, that are in accordance with ASME Section XI IWE-2500, which specifies:
    - (i) surface areas accessible from both sides shall be visually examined using a VT-1 visual examination method,
    - (ii) surface areas accessible from one side only shall be examined for wall thinning using an ultrasonic thickness measurement method,
    - (iii) when ultrasonic thickness measurements are performed, one foot square grids shall be used, unless justified otherwise, and
    - (iv) ultrasonic measurements shall be used to determine the minimum wall thickness within each grid. The location of the minimum wall thickness shall be marked such that periodic reexamination of that location can be performed.
  - (d) Demonstrate through use of augmented inspections performed in accordance with ASME Section XI IWE that corrosion is not occurring, or that corrosion is progressing so slowly that the age-related degradation will not jeopardize the intended function of the drywell shell through the period of extended operation.
- (6) If the intended function of the drywell shell cannot be demonstrated for the period of extended operation (i.e., wall thickness is less than the minimum required thickness), identify actions that will be taken as part of the aging management program to ensure that the integrity of the drywell shell will be maintained through the period of extended operation.

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<sup>1</sup> The term “suspected” refers to surface areas likely to experience accelerated degradation and aging as described in IWE-1241(a) of Section XI of the ASME Code. Specifically, typical locations are those areas exposed to standing water, repeated wetting and drying, persistent leakage, and those with geometries that permit water accumulation, condensation, and microbiological attack.