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Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: **Submittal Supporting Accelerated ABWR Review Schedule - Chapter 3 and 9 COL Action Items**

Dear Chet:

Enclosed are SSAR markups addressing ABWR DFSER COL Action Items 3.3.2-1, 3.5.1.2-1, 3.5.2-1, 3.10-1 and 9.3.5-1.

It should be noted that COL Action Item 9.3.5-1 was previously Confirmatory Item 9.3.5-1.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Gary Ehlert (GE)
Norman Fletcher (DOE)
Cal Tang (GE)

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are provided on all air intake and exhaust openings. These dampers are designed to withstand a negative 1.46 psi pressure.

3.3.2.3 Effect of Failure of Structures or Components Not Designed for Tornado Loads

All safety-related system and components are protected within tornado-resistant structures.

See Subsection 3.3.3.3 for COL license information ~~interface~~ requirement.

3.3.3 Interfaces

3.3.3.1 Site-Specific Design Basis Wind

The site-specific design basis wind shall not exceed the design basis wind given in Table 2.0-1 (See Subsection 2.2.1).

3.3.3.2 Site-Specific Design Basis Tornado

The site-specific design basis tornado shall not exceed the design basis tornado given in Table 2.0-1 (See Subsection 2.2.1).

3.3.3.3 Effect of non-Seismic Category I ~~Remainder of Plant~~ Structures, ~~Systems,~~ and Components not Designed for Tornado Loads

All remainder of plant structures, systems, and components not designed for tornado loads shall be analyzed for the site-specific loadings to ensure that their mode of failure will not effect the ability of the Seismic Category I ABWR Standard Plant structures, systems, and components to perform their intended safety functions. (See Subsection 3.3.2.3)

The COL applicant will ensure that the collapse of non-seismic category I structures, such as cooling towers or stacks outside the scope of the ABWR standard plant, will not endanger seismic category I structures and that site-dependent effects of blast loads will be less than those of design tornado pressures (see Subsection 3.3.2.3)

3.3.4 References

1. ANSI Standard A58.1, *Minimum Design Loads for Buildings and Other Structures*, Committee A. 58.1, American National Standards Institute.

2. ASCE Paper No. 3269, *Wind Forces on Structures*, Transactions of the American Society of Civil Engineers, Vol. 126, Part II.

3. Deleted

4. Bechtel Topical Report BC-TOP-3-A, Revision 3, *Tornado and Extreme Wind Design Criteria for Nuclear Power Plants.*

missle-consequence mitigation by structural walls and slabs. These walls and slabs are designed to withstand internal missile effects; the applicable seismic category and quality group classification are listed in Section 3.2. Penetration of the structural walls by internally generated missiles is not considered credible.

For local shields and barriers see the response to Question 410.9.

3.5.1.2 Internally Generated Missiles (Inside Containment)

Internal missiles are those resulting from plant equipment failures within the containment. Potential missile sources from both rotating equipment and pressurized components are considered.

3.5.1.2.1 Rotating Equipment

By an analysis similar to that in Subsection 3.5.1.1.1, it is concluded that no items of rotating equipment inside the containment have the capability of becoming potential missiles. All reactor internal pumps are incapable of achieving an overspeed condition and the motors and impellers are incapable of escaping the casing and the reactor vessel wall, respectively.

3.5.1.2.2 Pressurized Components

Identification of potential missiles and their consequences outside containment are specified in Subsection 3.5.1.1.2. The same conclusions are drawn for pressurized components inside of contaiment. For example, the ADS accumulators are moderate energy vessels and are therefore not considered a credible missile source. One additional item is fine motion control rod drives (FMCRD) under the reactor vessel. The FMCRD mechanisms are not credible missiles. The FMCRD housings are designed (Section 4.6) to prevent any significant nuclear transient in the event of a drive housing break.

3.5.1.2.3 Missile Barriers and Loadings

Credit is taken in some cases of rotating and pressurized components generating missiles for missile-consequence mitigation by structural walls and slabs. Penetration for the containment walls, floors and slabs by potential missiles is not considered credible. However, credible secondary missiles, e.g., concrete fragments, may be formed following impact of primary missiles. See Subsection 3.5.4.4 for COL license information requirements.

3.5.1.2.4 Evaluation of Potential Gravitational Missiles Inside Containment

Gravitational missiles inside the containment have been considered as follows:

Seismic Category I systems, components, and structures are not potential gravitational missile sources.

Non-Seismic Category I items and systems inside containment are considered as Follows:

(1) Cable Tray

All cable trays for both Class 1E and non-Class 1E circuits are seismically supported whether or not a hazard potential is evident.

(2) Conduit and Non-Safety Pipe

Non-Class 1E conduit is seismically supported if it is identified as a potential hazard to safety-related equipment. All Nuclear Island non-safety related piping that is identified as a potential hazard is seismically analyzed per Subsection 3.7.3.13.

(3) Equipment for Maintenance

All other prior to equipment, such as hoists, that is required during maintenance will either be removed ~~during~~ operation, moved to a location where it is not a potential hazard to safety-related equipment, or seismically restrained to prevent it from becoming a missile. See Subsection 3.5.4.7 for COL license information.

3.5.1.3 Turbine Missiles

See Subsection 3.5.1.1.1.3.

generated from other natural phenomena. The design basis tornado for the ABWR Standard Plant is the maximum tornado windspeed corresponding to a probability of 10E-7 per year (300 mph). The other characteristics of this tornado, summerized in Subsection 3.3.2.1. The design basis tornado missiles are per SRP 3.5.1.4, Spectrum I.

Using the design basis tornado and missile spectrum as defined above with the design of the Seismic Category I buildings, compliance with all of the positions of Regulatory Guide 1.117, "Tornado Design Classification," Positions C.1 and C.2 is assured.

The SGTS charcoal absorber beds are housed in the tornado resistant reactor building and therefore are protected from the design basis tornado missiles. The offgas system charcoal absorber beds are located deep within the turbine building and it is considered very unlikely that these beds could be ruptured as a result of a design basis tornado missile. These features assure compliance with Position C.3 of Regulatory Guide 1.117.

An evaluation of all non safety-related structures, systems, and components (not housed in a tornado structure) whose failure due to a design basis tornado missile that could adversely impact the safety function of safety-related systems and components will be provided to the NRC by the applicant referencing the ABWR design. See Subsection 3.5.4.2 for COL license information requirements.

3.5.1.5 Site Proximity Missiles Except Aircraft

External missiles other than those generated by tornados are not considered as a design basis (i.e. $\leq 10^{-7}$ per year).

3.5.1.6 Aircraft Hazards

Aircraft hazards are not a design basis event for the Nuclear Island (i.e. $\leq 10^{-7}$ per year). See Subsection 3.5.4.3 for COL license information requirements.

3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles

The sources of external missiles which could affect the safety of the plant are identified in Subsection 3.5.1. Certain items in the plant are required to safely shut down the reactor and maintain it in a safe condition assuming an additional single failure. These items, whether they be structures, systems, or components, must therefore all be protected from externally generated missiles.

These items are the safety-related items listed in Table 3.2-1. Appropriate safety classes and equipment locations are given in this table. All of the safety-related systems listed are located in buildings which are designed as tornado resistant. Since the tornado missiles are the design basis missiles, the systems, structures, and components listed are considered to be adequately protected. Provisions are made to protect the charcoal delay tanks against tornado missiles.

See Subsections 3.5.4.1 and 3.5.4.8 for COL license information requirements.

3.5.3 Barrier Design Procedures

The procedures by which structures and barriers are designed to resist the missiles described in Subsection 3.5.1 are presented in this section. The following procedures are in accordance with Section 3.5.3 of NUREG-0800 (Standard Review Plan).

3.5.3.1 Local Damage Prediction

The prediction of local damage in the impact area depends on the basic material of construction of the structure or barrier (i.e., concrete or steel). The corresponding procedures are presented separately. Composite barriers are not utilized in the ABWR Standard Plant for missile protection.

valent static load concentrated at the impact area is determined. The structural response to this load, in conjunction with other appropriate design loads, is evaluated using an analysis procedure similar to that in Reference 6 for rigid missiles, and the procedure in Reference 7 for deformable missiles.

3.5.4 Interfaces

3.5.4.1 Protection of Ultimate Heat Sink

Compliance with Regulatory Guide 1.27 as related to the ultimate heat sink and connecting conduits being capable of withstanding the effects of externally generated missiles shall be demonstrated (See Subsection 3.5.2).

3.5.4.2 Missiles Generated by Natural Phenomena from Remainder of Plant Structures, Systems and Components

The remainder of plant structures, systems, and components shall be analytically checked to ensure that during a site-specific tornado they will not generate missiles exceeding the missiles considered under Subsection 3.5.1.4.

3.5.4.3 Site Proximity Missiles and Aircraft Hazards.

Analyses shall be provided that demonstrate that the probability of site proximity missiles (including aircraft) impacting the ABWR Standard Plant and causing consequences greater than 10CFR Part 100 exposure guidelines is $\leq 10^{-7}$ per year (See Subsection 3.5.1.6).

3.5.4.4 Secondary Missiles Inside Containment

Protection against the secondary missiles inside containment described in Subsection 3.5.1.2.3 shall be demonstrated.

3.5.4.5 Impact of Failure of Non Safety-Related Structures, Systems, and Components Due to a Design Basis Tornado

An evaluation of all non safety-related structures, systems, and components (not housed in a tornado structure) whose failure due to a design basis tornado missile that could adversely impact the safety function of a safety-related systems and components will be provided to the NRC by the applicant referencing the ABWR design. (See Subsection 3.5.1.4).

3.5.4.6 Turbine System Maintenance Program

A turbine system maintenance program including probability calculations of turbine missile generation meeting the minimum requirement for the probability of missile generation shall be provided to the NRC (See Subsection 3.5.1.1.3).

INSERT NEXT PAGE

3.5.5 References

1. C. V. Moore, *The Design of Barricades for Hazardous Pressure Systems*, Nuclear Engineering and Design, Vol. 5, 1967.

2. F. J. Moody, *Prediction of Blowdown Thrust and Jet Forces*, ASME Publication 69-HT-31, August 1969.

3. A. Amirikan, *Design of Protective Structures*, Bureau of Yards and Docks, Publication No. NAVDOCKS P-51, Department of the Navy, Washington, D.C., August 1960.

4. A. E. Stephenson, Full-Scale Tornado-Missile Impact Tests, EPRI NP-440, July 1977, prepared for Electric Power Research Institute by Sandia Laboratories.

5. W. B. Cottrell and A. W. Savolainen, *U. S. Reactor Containment Technology*, ORNL-NSIC-5, Vol. 1, chapter 6, Oak Ridge National Laboratory.

6. R. A. Williamson and R. R. Alvy, *Impact Effect of Fragments Striking Structural Elements*, Holmes and Narver, Inc., Revised November 1973.

7. J. D. Riera, *On the Stress Analysis of Structures Subjected to Aircraft Impact Forces*, Nuclear Engineering and Design, North Holland Publishing Co., Vol. 8, 1968.

8. Deleted

INSERT

COL 3.5.1.2-1

3.5.4.7 Maintenance Equipment Missile Prevention Inside Containment

The COL applicant will provide procedures to ensure that all equipment inside containment, such as hoists, that is required during maintenance will either be removed prior to operation, moved to a location where it is not a potential hazard to safety-related equipment, or seismically restrained to prevent it from becoming a missile. (See Subsection 3.5.1.2.4(3))

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3.5.4.8 Failure of Structures, Systems and Components Outside ABWR Standard Plant Scope

Any failure of structures, systems and components outside ABWR standard Plant scope which may result in external missile generation shall not prevent safety-related structures, systems and components from performing their intended safety function. The COL applicant will provide an evaluation of the adequacy of these designs for external missile protection for NRC review. (See Subsection 3.5.2) by dynamic analysis using appropriate response spectra.

(b) Floor Response Spectra

(i) Floor response spectra used are those generated for the supporting floor. In case supports are attached to the walls or to two different locations, the upper bound envelope spectra obtained by superimposing are used.

(ii) In many cases, to facilitate the design, several floor response spectra are combined by an upper bound envelope obtained by superimposing.

3.10.3.2.3 Local Instrument Supports

For field-mounted Seismic Category I instruments, the following is applicable:

(1) The mounting structures for the instruments have a fundamental frequency above the excitation frequency of the RRS.

(2) The stress level in the mounting structure does not exceed the material allowable stress when the mounting structure is subjected to the maximum acceleration level for its location.

3.10.3.2.4 Instrument Tubing Support

The following bases are used in the seismic and other RBV dynamic loads design and analysis of Seismic Category I instrument tubing supports:

(1) The supports are qualified by the response spectrum method;

(2) Dynamic load restraint measures and analysis for the supports are based on combined limiting values for static load, span length, and computed dynamic response; and

(3) The Seismic Category I instrument tubing systems are supported so that the allowable stress permitted by Section III of ASME Boiler and Pressure Vessel Code are not exceeded when the tubing is subjected to the loads specified in Subsection 3.9.2 for Class 2 and 3 piping.

3.10.4 Operating License Review (Tests and Analyses Results)

See Subsection 3.10.5.2 for COL license information requirements.

3.10.5 COL License Information

3.10.5.1 Equipment Qualification Records

INSERT 3.10.5.1

COL 3.10-1 (See pg. 3.9-45)

The equipment qualification records including the reports (see Subsections 3.10.2.1.4 and 3.10.2.2.3) shall be maintained in a permanent file and shall be readily available for audit.

3.10.5.2 Dynamic Qualification Report

A dynamic qualification report (DQR) shall be prepared identifying all Seismic Category I instrumentation and electrical parts and equipment therein and their supports. The DQR shall contain the following: (1) A table or file for each system that is identified in Table 3.2-1 to be safety-related or having Seismic Category I equipment shall be included in the DQR containing the MPL item number and name, the qualification method and the input motion for all Seismic Category I equipment and the supporting structure in the system, and the corresponding qualification summary table or vendor's qualification report. (2) The mode of safety-related operation (i.e., active, manual active or passive) of the instrumentation and equipment along with the manufacturer identification and model numbers shall also be tabulated in the DQR. The operational mode identifies the instrumentation or equipment (a) that performs the safety-related functions automatically, (b) that is used by the operators to perform the safety-related functions manually, or (c) whose failure can prevent the satisfactory accomplishment of one or more safety-related functions. (See Subsection 3.10.4).

INSERT 3.10.5.1
COL applicants will provide plant specific seismic and dynamic parameters for the equipment qualification program in accordance with Subsection 3.10.

3.9.7 COL License Information

3.9.7.1 Reactor Internals Vibration Analysis, Measurement and Inspection Program

The first COL applicant will provide, at the time of application, the results of the vibration assessment program for the ABWR prototype internals. These results will include the following information specified in Regulatory Guide 1.20.

R. G. 1.20	Subject
C.2.1	Vibration Analysis Program
C.2.2	Vibration Measurement Program
C.2.3	Inspection Program
C.2.4	Documentation of Results

NRC review and approval of the above information on the first COL applicant's docket will complete the vibration assessment program requirements for prototype reactor internals.

In addition to the information tabulated above, the first COL applicant will provide the information on the schedules in accordance with the applicable portions of position C.3 of Regulatory Guide 1.20 for non-prototype internals.

Subsequent COL applicants need only provide the information on the schedules in accordance with the applicable portions of position C.3 of Regulatory Guide 1.20 for non-prototype internals. (See Subsection 3.9.2.4).

3.9.7.2 ASME Class 2 or 3 or Quality Group D Components with 60 Year Design Life

COL applicants will identify ASME Class 2 or 3 or Quality Group D components that are subjected to cyclic loadings, including operating vibration loads and thermal transients effects, of a magnitude and/or duration so severe the 60 year design life can not be assured by required Code calculations and, if similar designs have not already been evaluated, either provide an appropriate analysis to demonstrate the required design life or provide designs to mitigate the magnitude or duration of the cyclic loads. (See Subsection 3.9.3.1.)

3.9.7.3 Pump and Valve Inservice Testing Program

COL applicants will provide a plan for the detailed pump and valve inservice testing and inspection program. This plan will

(1) Include baseline pre-service testing to support the periodic in-service testing of the components required by technical specifications. Provisions are included to disassemble and inspect the pump, check valves, and MOVs within the Code and safety-related classification as necessary, depending on test results. (See Subsections 3.9.6, 3.9.6.1, 3.9.6.2.1 and 3.9.6.2.2)

(2) Provide a study to determine the optimal frequency for valve stroking during inservice testing. (See Subsection 3.9.6.2.2)

(3) Address the concerns and issues identified in Generic Letter 89-10; specifically the method of assessment of the loads, the method of sizing the actuators, and the setting of the torque and limit switches. (See Subsection 3.9.6.2.2)

INSERT 3.9.7.3 a

COL 3.10-1 (See pg. 3.10-8)

3.9.7.4 Audit of Design Specification and Design Reports

COL applicants will make available to the NRC staff design specification and design reports required by ASME Code for vessels, pumps, valves and piping systems for the purpose of audit. (See Subsection 3.9.3.1)

3.9.8 References

1. *BWR Fuel Channel Mechanical Design and Deflection*, NEDE-21354-P, September 1976.

2. *BWR/6 Fuel Assembly Evaluation of Combined Safe Shutdown Earthquake (SSE) and Loss-of-Coolant Accident (LOCA) Loadings*, NEDE-21175-P, November 1976.

3. NEDE-24057-P (Class III) and NEDE-24057 (Class I) Assessment of Reactor Internals Vibration in BWR/4 and BWR/5 Plants.

INSERT 3.9.7.3 a
COL applicants will provide plant specific environmental parameters for the equipment qualification program in accordance with Subsection 3.9.3.2.

Barriers have been considered to assure SLCS protection from pipe break (Section 3.6).

It should be noted that the SLCS is not required to provide a safety function during any postulated pipe break events. This system is only required under an extremely low probability event, where all of the control rods are assumed to be inoperable while the reactor is at normal full power operation. Therefore, the protection provided is considered over and above that required to meet the intent of ASB 3-1 and MEB 3-1.

This system is used in special plant capability demonstration events cited in Appendix A of Chapter 15; specifically, Events 54 and 56, which are extremely low probability nondesign basis postulated incidents. The analyses given there are to demonstrate additional plant safety considerations far beyond reasonable and conservative assumptions.

9.3.5.4 Testing and Inspection Requirements

Operational testing of the SLCS is performed in at least two parts to avoid inadvertently injecting boron into the reactor.

With the valves to the reactor and from the storage tank closed, and the valves to and from the test tank opened, condensate water in the test tank can be recirculated by locally starting either pump.

During a refueling or maintenance outage, the injection portion of the system can be functionally tested by valving the suction line to the test tank and actuating the system from the control room. System operation is indicated in the control room.

After functional tests, all the valves must be returned to their normal positions as indicated in Figure 9.3-1.

After closing a local locked-open valve to the reactor, leakage through the injection valves can be detected by opening valves at a test connection in the line between the drywell check valves. Position indicator lights in the control room indicate that the local valve is closed for test or open and ready for operation. Leakage from the reactor through the first check valve can be detected by opening the same test connection in the line between the check valves when the reactor is pressurized.

The test tank contains condensate water for approximately 3 minutes of pump operation. Condensate water from the makeup system or the condensate storage system is available for refilling or flushing the system.

Should the boron solution ever be injected into the reactor, either intentionally or inadvertently, then after making certain that the normal reactivity controls will keep the reactor subcritical, the boron is removed from the reactor coolant system by flushing for gross dilution followed by operating the reactor cleanup system. There is practically no effect on reactor operations when the boron concentration has been reduced below approximately 50 ppm.

The concentration of the sodium pentaborate in the solution tank is determined periodically by chemical analysis.

Electrical supplies and relief valves are also subjected to periodic testing.

The SLCS preoperational test is described in Subsection 14.2.12.

9.3.5.5 Instrumentation Requirements

The instrumentation and control system for the SLCS is designed to allow the injection of liquid poison into the reactor and the maintenance of the liquid poison solution well above the saturation temperature. A further discussion of the SLCS instrumentation may be found in Section 7.4.

See Subsection 9.3.11.1 for COL license information pertaining to SLCS storage tank discharge valve reliability.

COL 9.3.5-1
(previously CI 9.3.5-1)

9.3.11 COL License Information

9.3.11.1 Storage Tank Discharge Valve Reliability

The COL applicant will confirm that the SLCS storage tank discharge valves will have adequate reliability requirements and that the valves be incorporated into the Operational Reliability Assurance Program. (See Subsection 9.3.5.4)