Additional BWR Considerations on Reliable Hardened Vents

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Nuclear Regulatory Commission
January 17, 2011
Rockville, MD

Topics

Purpose of presentation
Venting capability
Definition of “reliable”
Preliminary BWROG design concepts
Preliminary timeline for RHV issue resolution
Surveys

Purpose of Presentation

Support accelerated NRC schedule for developing Order for Recommendation 5.1 (Reliable Hardened Vents) by providing BWROG input:

- Mission and preliminary design goals
- Preliminary timeline for implementation

Venting Capability

Current vents designed to mitigate loss of decay heat removal

Fukushima events have indicated that vent system changes can enhance venting for both

- Core damage prevention, and
- Post-core damage response (defense-in-depth)

Definition of “Reliable”

Reliable: Will perform its required function in the desired manner under the relevant conditions and on the occasions or during the time intervals when it is required so to perform. [Source: A.E. Green and A.J. Bourne, Reliability Technology, Wiley-Interscience, 1972.]

Command and control through procedure enhancement and implementation is as important as hardware in determining vent reliability

Agreement on this definition is key to implementing reasonable and effective changes to the venting system

Preliminary BWROG Design Concepts

BWROG preliminary design concepts include mission statements and possible design goals for Phases 1 and 2

- Phase 1 = Core damage prevention
- Phase 2 = Post-core damage response
- Performance-based
- Built on NRC proposed performance requirements (Dec 15)
- Integrated with industry FLEX approach
- Increased design consistency among US plants
- Address Mark I's and Mark II's

Phase 1 Mission Statement

BWRs with Mark I and Mark II containments should be capable of reliably venting containment:

- Across a spectrum of events, including
  - events similar to those at the Fukushima plants
  - prolonged station blackout
  - loss of decay heat removal
- When required by procedures
- For prevention of core damage and containment protection

Phase 1 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 1
The containment venting function should presume the occurrence of significant core damage and the presence of hydrogen.	Not a Phase 1 issue.
The vent should be capable of [*passive]* operation to limit pressure to the PCPL, and *[active]* operation to permit depressurization at any time, for example to enable low pressure coolant injection into the RPV.	The vent should be capable of **active and/or** passive operation to limit pressure to the PCPL, and active operation to permit depressurization at any time, for example to enable low pressure coolant injection into the RPV.

Phase 1 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 1
Operators should be able to vent containment from the wetwell and drywell using permanently installed equipment under prolonged SBO conditions.	Operators should be able to vent containment ~~**from the wetwell and drywell**~~ using **available** installed equipment under prolonged SBO conditions**.** Available equipment includes permanently installed equipment and the alignment and control of portable equipment from an accessible operating location (i.e., not compromised by the effects of temperature or radiation).

Phase 1 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 1
[Venting system should be equipped with a filter to preserve the containment function as a barrier to fission products at all times and facilitate venting decision making.]	Venting system should maintain current suppression pool scrubbing capability and not preclude potential augmentation in Phase 2. For conditions requiring venting, plant EOPs provide the necessary guidance for venting decision-making

Phase 1 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 1
Venting system should avoid the use of common systems between units and not interfere with the operation of other safety and non-safety equipment.	Venting systems should **minimize** the use of common systems between units and shall not interfere with the operation of other safety and non-safety equipment. Any use of common vent paths between units is designed for venting of all units simultaneously The discharge of flow does not interfere with the operation of equipment that is needed for subsequent accident response

Phase 2 Mission Statement

BWRs with Mark I and Mark II containments should be capable of reliably venting containment and managing radiological release:

- After severe core damage
- For a spectrum of events, including
  - events similar to those at the Fukushima plants
  - prolonged station blackout
  - loss of decay heat removal
- When required by procedures
- This builds upon the Phase 1 mission

Phase 2 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 2
The containment venting function should presume the occurrence of significant core damage and the presence of hydrogen.	The vent should be capable of carrying out its Phase 2 mission, including operation and containment isolation, under conditions of : • Prolonged station blackout (loss of AC power), • Containment pressure up to the PCPL, • Significant core damage, core-concrete interaction, high radiation levels, hydrogen and other combustible gases, and elevated accident temperatures.
The vent should be capable of *[passive]* operation to limit pressure to the PCPL, and *[active]* operation to permit depressurization at any time, for example to enable low pressure coolant injection into the RPV.	Addressed in Phase 1.

Phase 2 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 2
Operators should be able to vent containment from the wetwell and drywell using permanently installed equipment under prolonged SBO conditions.	Operators should be able to vent containment ~~**from the wetwell and drywell**~~ using **available** installed equipment under prolonged SBO conditions**, building on the Phase 1 FLEX approach.** Available equipment includes permanently installed equipment and the alignment and control of portable equipment from an accessible operating location (i.e., not compromised by the effects of temperature, radionuclides, combustible gas).

Phase 2 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 2
[Venting system should be equipped with a filter to preserve the containment function as a barrier to fission products at all times and facilitate venting decision making.]	Venting system should **provide a method** to preserve the containment function as a barrier to fission products at all times and facilitate venting decision-making. For conditions requiring venting, plant SAMGs shall provide the necessary guidance for venting decision-making. Continued evaluation is needed.

Phase 2 Preliminary Design Goals

NRC Proposed Performance Requirement	BWROG Phase 2
Venting system should avoid the use of common systems between units and not interfere with the operation of other safety and non-safety equipment.	Venting systems should **minimize** the use of common systems between units and shall not interfere with the operation of other safety and non-safety equipment. Any use of common vent paths between units is designed for venting of all units simultaneously The constituents of flow do not interfere with the operation of equipment in any unit that is needed for subsequent accident response.

Preliminary Timeline for BWR Implementation: Short Term

Regular BWROG Containment Performance Strategies Subcommittee meetings to review implementation plans and issues of mutual interest

Regular BWROG meetings with NRC to present current status of fleet planning / evaluations / implementation of Phase 1 and Phase 2

Jan/Feb 2012:	BWROG begins developing white paper on radionuclide scrubbing
March 9, 2012:	NRC issues orders, including RHV
March 2012:	BWROG begins developing implementation plans for RHV for the fleet and 90-day Order response template
March 29, 2012:	Utility 20-day response, if appropriate
May 2012:	Meeting with NRC to present preliminary BWROG RHV 90-day Order response plans and views on radionuclide scrubbing
June 7, 2012:	90-day response
Summer 2012:	SECY to Commission on filtering

Preliminary Timeline for BWR Implementation: Long Term

Regular BWROG Containment Performance Strategies Subcommittee meetings to review implementation plans and issues of mutual interest

Regular BWROG meetings with NRC to present current status of fleet planning / evaluations / implementation of Phase 1 and Phase 2

Mark I and Mark II plants: Completion of Phase 1 changes intended to be consistent with overall FLEX implementation

Date for completion of Phase 2 changes TBD

Surveys

Previous survey results

- Mark I's have functioning wetwell vents
- Actual plant vent configurations vary in size and routing

Planned survey on

- Reliable design features for Phase 1
- Design concepts for Phase 2
  - Accessibility considerations
  - Possible need for radionuclide scrubbing