NEI 13-02 FAQ Review and Industry Overall Integrated Plan Template for NRC Order EA-13-109

NRC Public Meeting

February 19, 2014

BWR OWNERS' GROUP

NUCLEAR ENERGY INSTITUTE

Agenda

- Meeting Objectives
- FAQ Reviews
  - FAQ List of Topics
  - HCVS-06: Assumptions
  - HCVS-07: Source Term From SFP
  - HCVS-08: Instrument Qualifications
- White Paper Topics
- Template Development Information and Key Dates
- Pilot Plant Project
- Template Elements
- Example Template
- Open Discussion
- Follow-up

Meeting Objectives

- Feedback of the following:
  - Presented FAQ Resolution on 3 topics presented
  - White Paper Topic
  - Revision of the OIP Template
    - Hatch
    - Generic
  - Affirmation of OIP Template Schedule

FAQ Reviews

FAQ Number	NEI 13-02 Section	Subject
HCVS-01	4.2.2, 4.2.3	HCVS Primary Controls and Alternate Controls and Monitoring Locations
HCVS-02	1.2.6	HCVS Dedicated Equipment
HCVS-03	1.2.5, 1.2.6, 4.2.3	HCVS Alternate Control Operating Mechanisms
HCVS-04	4.1.5	HCVS Release Point
HCVS-05	4.1.4, 4.1.6, 6.2	HCVS Control and 'Boundary Valves'
HCVS-06	Multiple	FLEX Assumptions/HCVS Generic Assumptions
HCVS-07	4.2.5	Consideration of Release from Spent Fuel Pool Anomalies
HCVS-08	4.2.2, 4.2.4	HCVS Instrument Qualifications
HCVS-09	Multiple	Use of Toolbox Actions for Personnel

FAQ Reviews

- HCVS-06: HCVS Assumptions
  - Document the FLEX related and Generic assumptions in a standard location and reference so that they can be reviewed once by the NRC and will not require extensive preparer or reviewer time for each submittal.
  - Refer to the C3 template for assumptions

FAQ Reviews

- HCVS-07: Spent Fuel Pool
  - NRC comment: Item requires further information and clarification.
    - Staff believes that if any HCVS equipment is located in an area that could be impacted by source term from either SFP or reactor severe accident, the governing source term should be the higher of the two.
  - There is no assumption or criteria in the EA-13-109 Order that relates to a “SFP accident”. The Order only mentions core damage and protection of Mk I & II containments, i.e., “reactor severe accident”. There is no mention of source term in the order.
  - Actions under Order EA-12-049 provides multiple mitigation actions to protect SFP cooling and Order EA-12-051 provides redundant instrumentation to plant decision makers to allow correct prioritization of any action needed for the SFP. Every site has to be in compliance with these Orders.
  - If action is required for HCVS in the SFP area then the environment in the vicinity and ingress/egress must be evaluated as identified in FAQ HCVS-01.

FAQ Reviews

- HCVS-08: HCVS Instrument Qualifications

  Q: What conditions have to be considered in the design and siting of HCVS Controls and monitoring equipment?

  - Order Element 1.2.4 states, “The HCVS shall be designed to be manually operated during sustained operations from a control panel located in the main control room or a remote but readily accessible location.”
  - Order Element 1.2.5 states, “The HCVS shall, in addition to meeting the requirements of 1.2.4, be capable of manual operation (e.g., reach-rod with hand wheel or manual operation of pneumatic supply valves from a shielded location), which is accessible to plant operators during sustained operations.”
  - Order Element 1.2.6 states, “The HCVS shall be capable of operating with dedicated and permanently installed equipment for at least 24 hours following the loss of normal power or loss of normal pneumatic supplies to air operated components during an extended loss of AC power.”

FAQ Reviews

- HCVS-08: HCVS Instrument Qualifications (Cont'd)

  Thermal Considerations: (See Order Elements 1.1.2 and 1.1.4):

  Main Control Room

  - Temperature and heat load that exist from operation of the HCVS system.
  - Temperature and heat load that exist due to proximity to the undercooled containment.
    - MCR Temperatures considered for Order EA-12-049 (FLEX) are reasonable to use since any changes as the result of a severe accident are not expected to impact the MCR due to Control Room location in a separate air space and FLEX ventilation methods applied to the MCR
  - Temperature and heat load that exists due to the ELAP condition (loss of ventilation).
    - Utilize toolbox actions and EA-12-049 (FLEX) mitigation strategies.
    - HCVS controls and instrumentation will be similar to other instrumentation and controls found in most MCRs. Unless the licensee uses controls and instrumentation in the HCVS system that are known to be susceptible to failure from elevated temperatures but within habitability limits, no evaluation of temperature effects needs to be performed for HCVS components located in the MCR.

FAQ Reviews

- HCVS-08: HCVS Instrument Qualifications - Thermal Considerations (Cont'd)

  Primary or Alternate Control location (if other than MCR temperature and heat load that exist for operation of the HCVS system.

  - If this location is NOT in the Reactor Building or other buildings where HCVS piping is located then the heat load impact is similar to the MCR when the location is in a separate air space.
  - Temperature and heat load that exist due to proximity to the undercooled containment.
  - Temperature and heat load that exists due to the ELAP condition (loss of ventilation).
    - If this location is NOT in the Reactor Building or next to the HCVS piping then the heat load impact is similar to the Control Room since it would be located in a separate air space

  HCVS controls and instrumentation located outside the MCR will be similar to other instrumentation and controls found in plant locations outside the MCR.

  - Unless the licensee uses controls and instrumentation in the HCVS system that are known to be susceptible to failure from elevated temperatures but within habitability limits, no evaluation of temperature effects needs to be performed for HCVS components located outside of the Reactor Building or other buildings where HCVS piping is located.

FAQ Reviews

- HCVS-08: HCVS Instrument Qualifications (Cont'd)

  Radiological Considerations: (See Order Elements 1.1.3)

  MCR radiological conditions that exist from operation of the HCVS system

  – Meet General Design Criteria (GDC) 19 or the Alternate Source Term (AST) analysis

  Primary or Alternate Control location (if other than Control Room) radiological conditions that exist for operation of the HCVS system.

  – This analysis may be bounded by the required dose considerations for Control Room design in General Design Criteria (GDC) 19 or the Alternate Source Term (AST) analysis if this location is outside the Reactor Building due to Reactor Building to Auxiliary Building Shielding design.
  – If the location is inside the Reactor Building, then it will need to be evaluated for radiological impact due to HCVS system operation under severe accident conditions.

  Order element 1.1.3 does discuss the requirement to consider the dose and radiological conditions caused by operation of the HCVS system but not failure of Mitigating Strategies related to Spent Fuel Pool Cooling.

FAQ Reviews

- HCVS-08: HCVS Instrument Qualifications (Cont'd)

  Time frame:

  - The instrumentation should be capable of operating in the thermal and radiological environment for at least 24 hours without significant operator action (see FAQ HCVS-02 for a discussion of significant operator action considerations for the first 24 hours of the sustained operational period).
  - Other provisions of NEI-13-02 such as the definition of "Sustained Operations" extend this time but do NOT preclude mitigating measures from FLEX or offsite support for reduction in thermal or radiological impacts (e.g. portable fans, AC power for ventilation, possible cooling water supplies to the area coolers if part of the FLEX mitigating measures.
  - The restriction on permanently installed equipment and operator actions only exists for the 24 hour period to ensure HCVS viability for at least a 24 hour mission time. See FAQ 2013-02 on Order Element 1.2.6 use of "dedicated equipment".

White Paper Topics

- HCVS-WP-01: HCVS Dedicated Power and Motive Force
  - Scope of operator actions for selected HCVS electrical and pneumatic supplies
- **HCVS-WP-02: HCVS Cyclic Operations Approach**
  - Accident sequence
  - Number of vent cycles
  - Radiological limitations from HCVS operation
- HCVS-WP-03: Hydrogen/CO Control Measures
  - Passive measures
  - Active measures
- HCVS-WP-04: FLEX/HCVS Interactions
  - Portable equipment use under severe accident and BDBEE conditions

Template Development Information and Key Dates

- Template Development
  - Pilot plant(s) identified – Hatch as MK I & NMP2 as MK II
  - Draft template by January 20, 2014 – Presented on Jan 15
  - Final Draft template March 15, 2014 – After Pilots
  - NEI 13-02 Revision to include template by April 15, 2014
- NRC-NEI Joint Template Meetings
  - January 15, 2014 – Complete (Draft Template & 3 FAQ)
  - January 29, 2014 – (Template Elements & FAQs)
  - February 19, 2014 (Pilot Plant Portion 1)
  - March 5, 2014 (Pilot Plant Portion 2)
  - March 26, 2014 (NRC Feedback on OIP Pilots/Workshop Prep)
- Industry Template Workshop, Tentative April 8

Template Elements

Template Goals:

- Use Hybrid 050/049 Template with Order and ISG (NEI 13-02) Cross Reference
- Directly align to the ISG
  - Describe the phased approach to implementation
  - Big picture schedule statement
  - Wetwell performance objectives
    - Discuss the section 1.1 objectives of attachment 2 in order
    - Discuss the requirements in sections 4.1, 4.2 and 6.1 and appendix's F and G of NEI 13-02
  - Drywell performance objectives
  - Quality standards
  - Programmatic requirements
- Linkage to ISE or SE

Template Elements

Proposed Template with Order and ISG (NEI 13-02) Cross Reference:

Introduction

Part 1: General Integrated Plan Elements and Assumptions

<u>Part 2:</u> Boundary Conditions for WW Vent with specifics about the compliance actions relative to the ISG and NEI 13-02 section 2

<u>Part 3:</u> Boundary Conditions for DW Vent with specifics about the compliance actions relative to the ISG and NEI 13-02 section 3

<u>Part 4:</u> Programmatic Controls, Training, Drills and Maintenance Elements

<u>Part 5:</u> Milestone table elements

<u>Attachment 1:</u> Portable Equipment

<u>Attachment 2:</u> Sequence of Events Timeline

<u>Attachment 3:</u> Conceptual Sketches

<u>Attachment 4:</u> Failure Evaluation Table

<u>Attachment 5:</u> References

<u>Attachment 6:</u> Changes/Updates to this OIP

<u>Attachment 7:</u> Open Items in HCVS OIP

Template Elements

Part 1: General Integrated Plan Elements and Assumptions

- **Key Site assumptions to implement NEI 13-02 strategies**
  - Grouping of Assumptions as FLEX, Generic and Site Specific.
  - Considering making an FAQ on FLEX assumptions and one on Generic to use as a reference in the template.

Template Elements

Part 2: Boundary Conditions for WW Vent with specifics about the compliance actions relative to the ISG and NEI 13-02 section 2

- **Severe Accident**
  - **First 24**
  - **Beyond 24 hours**
- **Support Equipment Functions**
  - **BDBEE Venting**
  - **Severe Accident Venting**

Template Elements

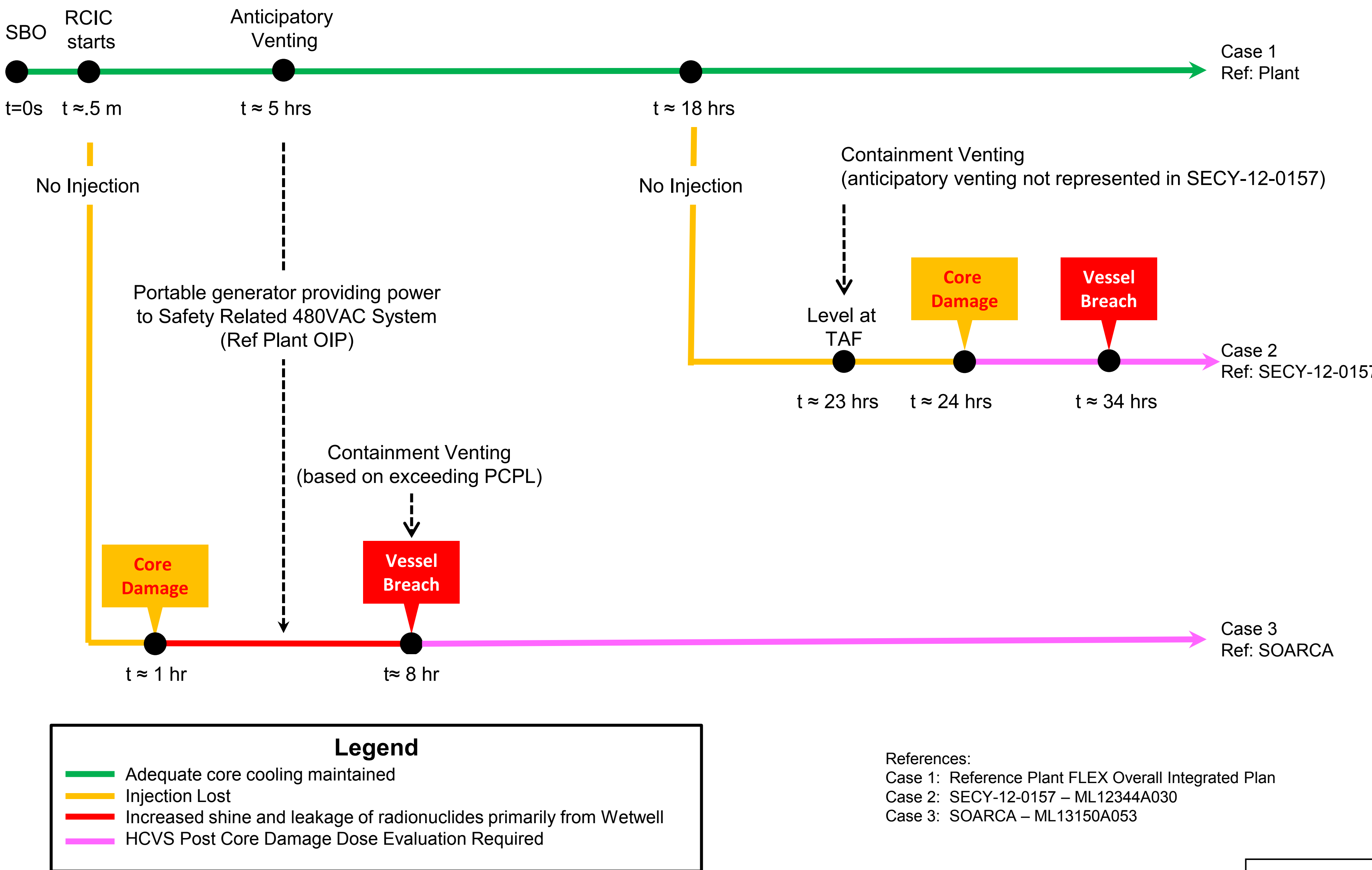
Part 4: Programmatic Controls, Training, Drills and Maintenance Elements

Part 5: Milestone table elements

Attachments

- Attachment 1: Portable Equipment
- Attachment 2: Sequence of Events Timeline
  - Operator action constraints timeline is determined based on the following sequences:
    - Sequence 1 is a FLEX run with Venting in a BDBEE without core damage.
    - Sequence 2 is based on SECY-12-0157 results for a prolonged SBO (ELAP) with the delayed loss of RCIC
    - Sequence 3 is based on SOARCA results for an SBO (ELAP) with failure of RCIC to inject.

Representative BWR Venting Timelines



References:
Case 1: Reference Plant FLEX Overall Integrated Plan
Case 2: SECY-12-0157 – ML12344A030
Case 3: SOARCA – ML13150A053

Not to scale

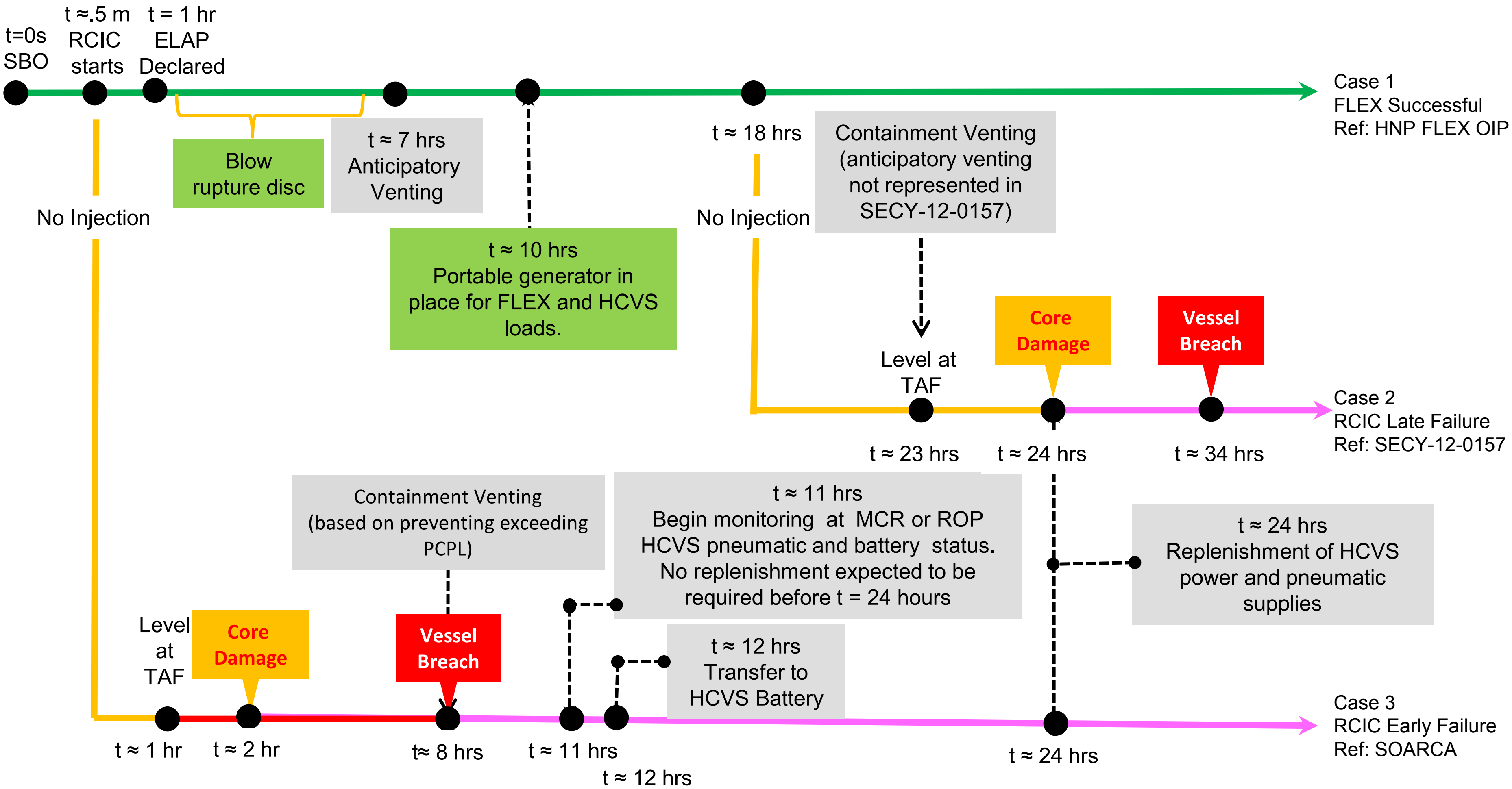
Hatch SA HCVS Pilot Template Elements

Review of Plant Hatch completion of items in revision C3 of the Severe Accident HCVS OIP Template

Hatch OIP Major Elements

- Adding Site Characteristics important to HCVS
  - Control Building and Rx Building Layout
  - Main Stack and vent pipe locations
- Time and Environmental Constraint Items
  - Rupture disc
  - HCVS Operation
  - Battery power actions
  - >24 Hour motive force

Hatch HCVS Venting Timelines



Legend

- Adequate core cooling maintained (green)
- Injection Lost (orange)
- Increased shine and leakage of radionuclides primarily from Wetwell (red)
- HCVS Post Core Damage Dose Evaluation Required (pink)
- HCVS Time evaluation required (grey)

References:
Case 1: HNP FLEX Overall Integrated Plan
Case 2: SECY-12-0157 – ML12344A030
Case 3: SOARCA – ML13150A053

Not to scale

Hatch OIP Major Elements

- 7.3 Hours, Initiate use of Hardened Containment Vent System (HCVS) per site procedures to maintain containment parameters below design limits and within the limits that allow continued use of RCIC - The reliable operation of HCVS will be met because HCVS meets the seismic requirements identified in NEI 13-02 and will be powered by DC buses with motive force supplied to HCVS valves from installed accumulators and portable nitrogen storage bottles. Critical HCVS controls and instruments associated with containment will be DC powered and operated from the MCR or a Remote Operating Station on each unit. The DC power for HCVS will be available as long as the HCVS is required. Station batteries will provide power for greater than 12 hours, HCVS battery capacity will be available to extend past 24 hours. In addition, when available Phase 2 FLEX Diesel Generator (DG) can provide power before battery life is exhausted. Thus initiation of the HCVS from the MCR or the Remote Operating Station within 7.3 hours is acceptable because the actions can be performed any time after declaration of an ELAP until the venting is needed at 12 hours for BDBEE venting. This action can also be performed for SA HCVS operation which occur at a time further removed from an ELAP declaration as shown in Attachment 2.

Hatch OIP Major Elements

- At >24 Hours, temporary generators will be installed and connected to the pigtail to power up battery chargers using a portable DG to supply power to HCVS critical components/instruments - Time critical after 26 hours. Current battery durations are calculated to last greater than GG hours (Reference X). DG will be staged beginning at approximately 8-10 hour time frame (Reference 4). Within Two (2) hours of deployment the DG will be in service. Thus the DGs will be available to be placed in service at any point after 24 hours as required to supply power to HCVS critical components/instruments. The connections, location of the DG and access for refueling will be located in an area that is accessible to operators in the Control Building or in the yard area because the HCVS vent pipe is underground once it leaves the Reactor Building.

Hatch OIP Major Elements

- Vent characteristics
  - Boundary valve use and cross flow
  - Remote operating station use
  - FLEX type actions
  - Electric power details
- Milestone schedule

Hatch OIP Major Elements

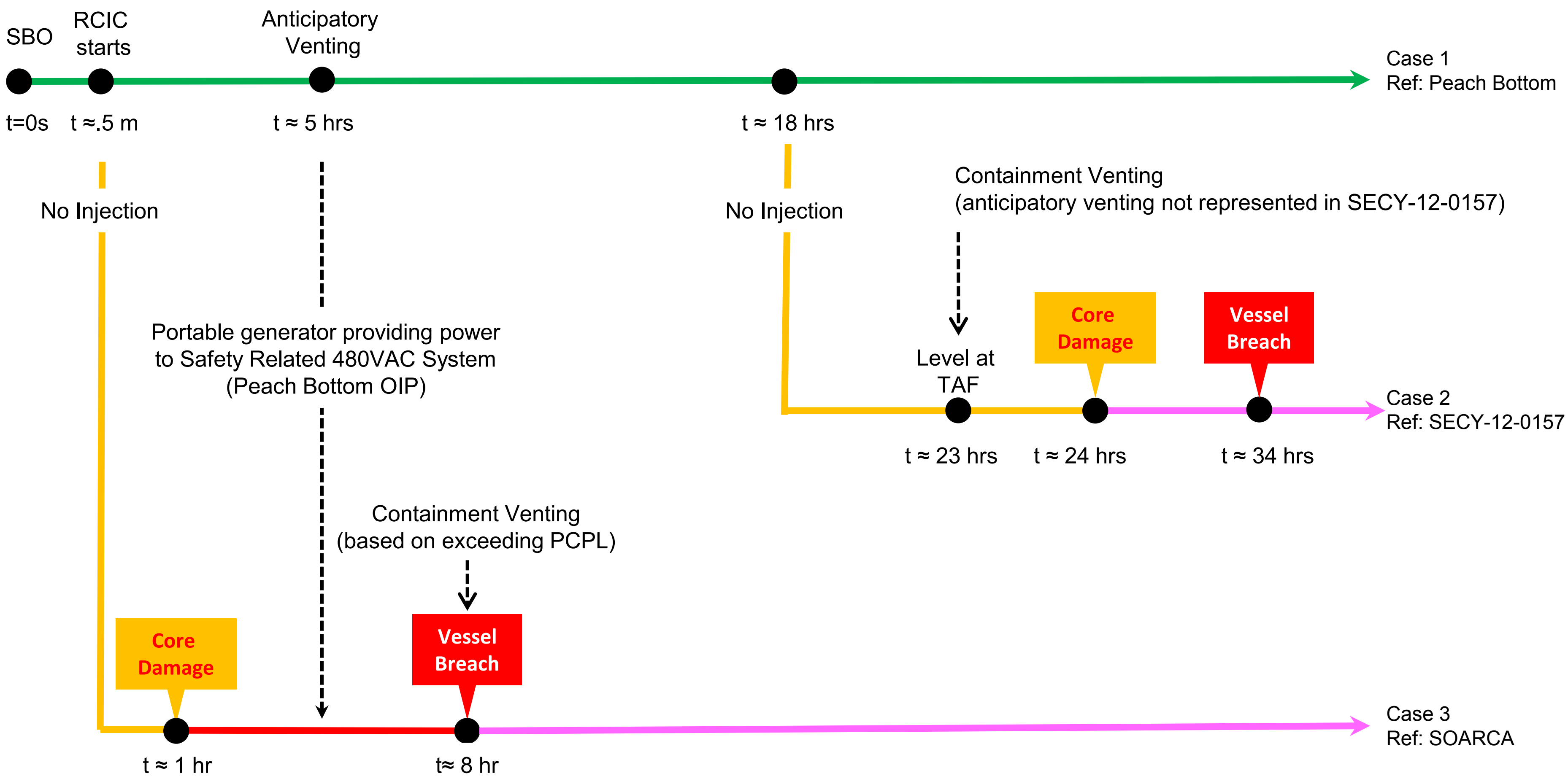
- Portable equipment use
  - Without core damage
  - With core damage
- Example Drawings
  - Electrical
  - Mechanical
  - Plant Layout

Example Template

HCVS-WP-02: Approach

- Objectives:
  - Minimize analysis required
  - Maintain simplicity
  - Maintain BWR fleet consistency
- Sequence per Diagram
- HCVS Cycling Evaluation
- Generic Radiological Analysis
  - Scaled approach based upon capability to perform actions based on the results from bounding curve
    - Vent line dose curves (generated based on 1465 release fractions and timing) use simplified assumptions for "base" curve – 7 day curve
    - Sensitivity cases performed to evaluate reasonableness
    - Operator actions for portable equipment can be evaluated based upon MAAP-informed timing of GAP release and ex-vessel. Evaluated impacts will be driven primarily from containment shine and the location of the HCVS piping
  - Optional Site Analysis utilizing 1465 and site characteristics

Representative BWR Venting Timelines



Legend

- Adequate core cooling maintained
- Injection Lost
- Increased shine and leakage of radionuclides primarily from Wetwell
- Radiological release via Wetwell Vent

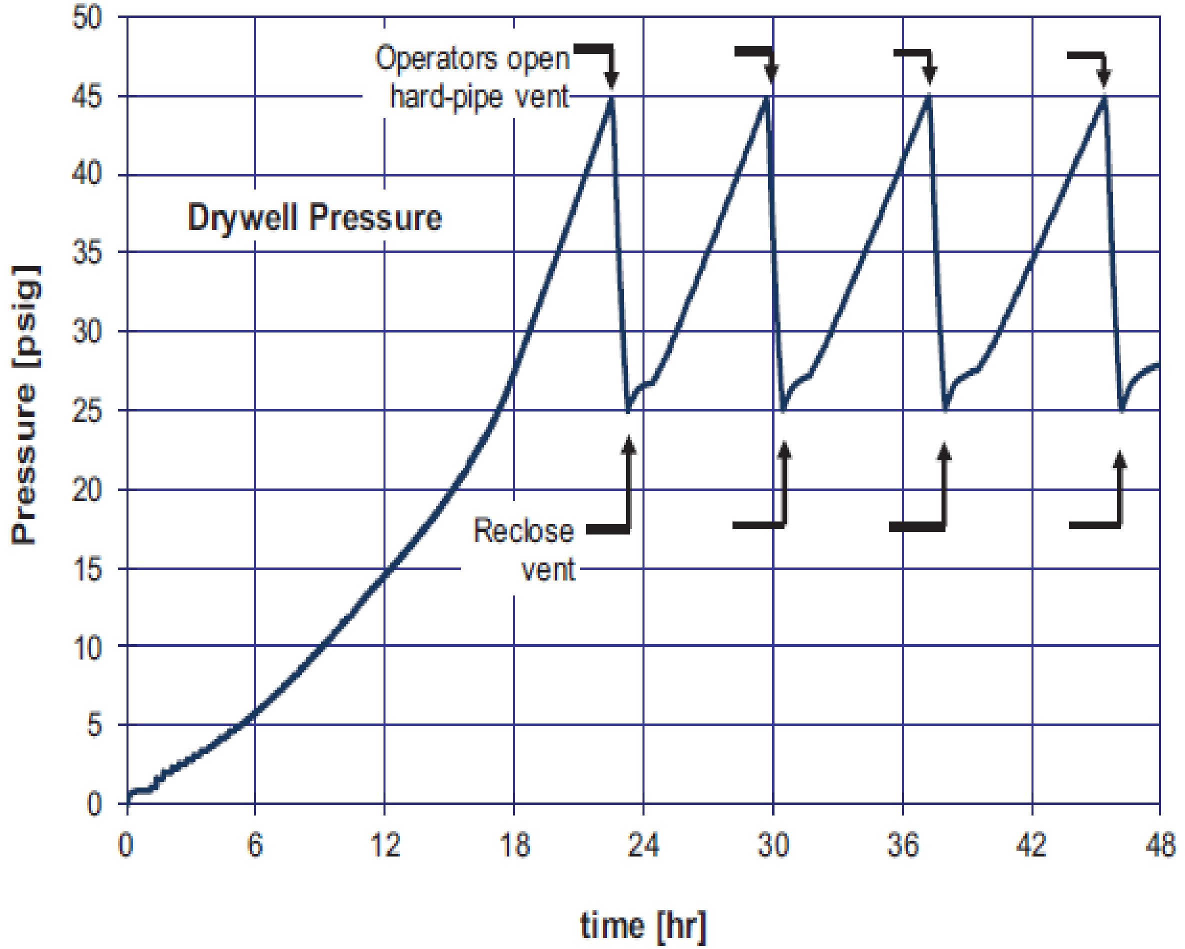
References:
Case 1: Peach Bottom Overall Integrated Plan – ML13059A305
Case 2: SECY-12-0157 – ML12344A030
Case 3: SOARCA – ML13150A053

Not to scale

Estimated Cycles for HCVS

- Case 1 – could represent a **single** cycle demand unless implementation of EA-12-049 calls for specific control of the vent path
- SOARCA analysis investigated vent cycling for a mitigated long term station blackout (ELAP)
  - Successful transfer to portable pump for injection at 4 hours when RCIC assumed to be lost
  - Wetwell vent opened at 45 psig and closed at 25 psig
  - **Single** cycle within first 24 hour period

SOARCA Vent Cycling



Vent Cycling in Severe Accident

- SECY-12-0157
  - Vent cycling discussed in scenario descriptions but no details provided
- EPRI Technical Report 1026539
  - Vent cycled between 60-40 psig
  - Drywell flooding and vent cycling – 12 cycles within 24 hours
  - Drywell sprays and vent cycling – 8 cycles within 24 hours
- BWROG Tabletop
  - Vent cycled between – Various
  - Wetwell vent cycling – <5 cycles within 24 hours

Summary

- In a simplistic view, the number of Wetwell vent cycles within the first 24 hours could be established based on the previous slide.
  - **Thus a generic number of 8 cycles is reasonable**
- Consequently, the number of Drywell and Wetwell vent cycles within the first 24 hours could be established based on the previous slide.
  - **Thus a generic number of 12 cycles is reasonable**
- The number of cycles is very dependent on the strategy and scenario selected for the evaluation.
- Multiple Vent cycling is not a requirement in response to EA-13-109 and the actual benefits have not yet been fully established as part of the filtering strategies rulemaking.

HCVS-WP-02: BACKGROUND

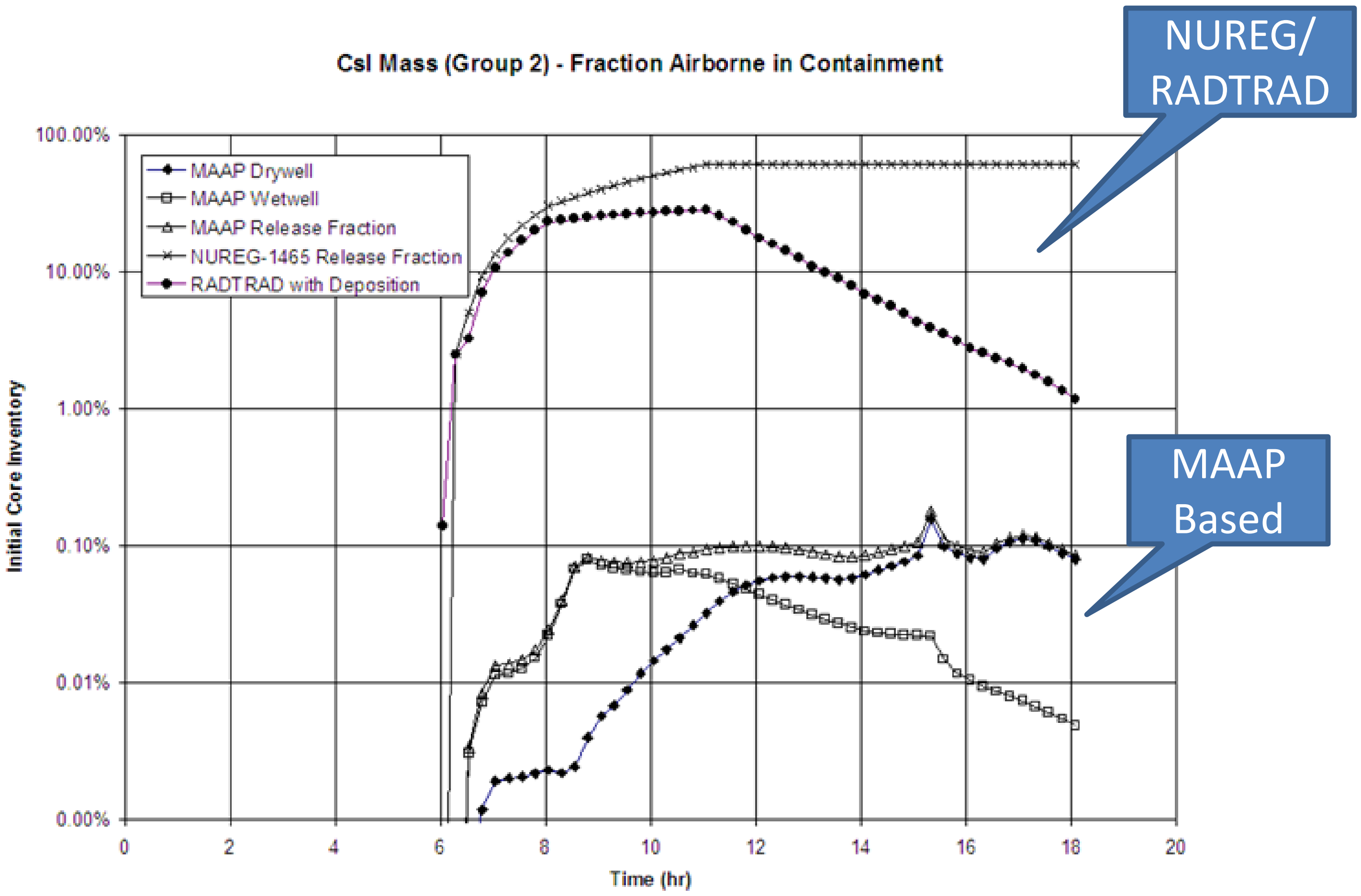
- Appendix G of NEI 13-02 provides a general description of approach to calculate source term based on RTM-96 and NUREG-1465.
- Number of variables that potentially impact calculation:
  - Timing of event
  - Size of core, containment, and vent pipe
  - Decay
  - Core fraction release during phases
  - Decontamination factor (changes with pool temp & pH, location of discharge)
  - Time of swapover from WW to DW
  - Deposition in containment
  - Deposition in piping
  - Suppression pool bypass (Mark II containments)
  - SRV Function

Generic Radiological Analysis

- MAAP runs to calculate fission product distribution
  - Test case assumed 4 hour operation of RCIC
  - Core damage at approximately 6 hours
  - Vessel breach at 15 hours
- RADTRAD results using NUREG-1465 with limited pool scrubbing and deposition
- NUREG-1465 releases
  - Plot shifted by 6 hours to account for 4 hours of RCIC operation

As expected, NUREG-1465 appears to be bounding

MAAP vs NUREG-1465



Sample Deposition Using Simplistic Model with NO Credit for Pool Scrubbing or Containment Deposition