

STATE OF VERMONT
PUBLIC SERVICE BOARD

Investigation into (1) whether ENVY Nuclear Vermont)
Yankee, LLC, and ENVY Nuclear Operations, Inc.,)
(collectively, “ENVY VY”), should be required to cease) Docket No. 7600
operations at the Vermont Yankee Nuclear Power Station, or)
take other ameliorative actions, pending completion of repairs) Sept. 8, 2010
to stop releases of radionuclides, radioactive materials, and,)
potentially, other non-radioactive materials into the environment;)
(2) whether good cause exists to modify or revoke the)
30 V.S.A. § 231 Certificate of Public Good issued to ENVY VY;)
and (3) whether any penalties should be imposed on ENVY VY for)
any identified violations of Vermont Statutes or Board orders related)
to the releases.)

**PREFILED TESTIMONY OF RAYMOND SHADIS
ON BEHALF OF NEW ENGLAND COALITION
REGARDING ENTERGY NUCLEAR OPERATIONS-VERMONT YANKEE
ROOT CAUSE EVALUATION REPORT, CR VTY-2010-00069**

Mr. Shadis reviews and evaluates Entergy Nuclear Vermont Yankee’s (“ENVY’s”) June 6, 2010 “Root Cause Evaluation Report” for the purpose of assisting the Vermont Public Service Board in determining the range of its authority with respect to investigation of the questions raised in the above caption for Docket 7600.

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1 Q-1 Please state your name and residence.

2 A-1 My name is Raymond Shadis. My place of residence is 47 Shadis Road, Edgecomb,
3 Maine.

4

5 Q-2 Please state your qualifications to provide testimony in this matter.

6 A-2 My relevant curriculum vitae have been provided as Exhibit NEC-RS-1 of my
7 Prefiled Testimony on Behalf of New England Coalition regarding Process Water
8 Releases at Entergy Nuclear Vermont Yankee Power Plant, July 2, 2010; also
9 supplemented in response to Q-2 of that testimony. I would add here that my work
10 experience, in particular with New England Coalition (“NEC”) from 1997 to the present,
11 has routinely required review, evaluation, and analysis of commercial nuclear power
12 licensee reports comparable to Entergy Nuclear Vermont Yankee’s (“ENVY”) Root
13 Cause Evaluation Report.

14

15

1 Q-3 Have you previously testified before the Vermont Public Service Board and has that
2 testimony been admitted into evidence?

3 A-3 Yes, I have testified and my testimony was admitted in Docket 6545 (Sale of
4 Vermont Yankee), Docket 7195 (Vermont Yankee Steam Dryer Investigation) and
5 Docket 7440 (Authority to Continue Operation of Vermont Yankee after March 21, 2012).

6
7 Q-4 What is the purpose of your testimony?

8 A-4 The purpose of my testimony is to review and evaluate Entergy Nuclear Vermont
9 Yankee's ("ENVY's") June 6, 2010 "Root Cause Evaluation Report" for the purpose of
10 assisting the Vermont Public Service Board in determining the range of its authority with
11 respect to investigation of the questions raised in the above caption for Docket 7600.

12
13 Q-5 Please outline your testimony.

14 A-5 I will describe how the Root Cause Evaluation Report (RCER) fails to properly
15 identify an actual root cause of the process water leaks that were first publicly reported
16 on January 7, 2010, and how it therefore fails to propose effective action to prevent leaks
17 of contaminated process water in the near-term or during the proposed extended period of
18 operation (until 2032). I will also explain that these failings, plus certain conclusions,
19 revelations or admissions contained in the report, warrant further investigation by the
20 Board and raise issues within the Board's statutory and jurisdictional purview.

21
22 Q-6 The RCER describes causes of the groundwater contamination found at site
23 sampling wells, including a partially blocked drainage tunnel, a compromised joint in the
24 drainage tunnel, and lastly, two holes in AOG piping caused by water, water vapor, or
25 steam impingement. Does this identify a root cause for the incident?

26 A-6 No, it does not. A "root cause" is not the foreseeable initiating event and I believe
27 ENVY knows this. A root cause must be some material, design or
28 inspection/maintenance failure. For example, the root cause of a bridge collapse is not
29 the failure of support joint plates or bolts or rivets, nor is it corrosion or stress. The root
30 cause, if it is in anyway foreseeable, is invariably a material or design failure. The root
31 cause of the bridge collapse could be that engineers specified support plates that were just

1 too thin for the job or that low grade bolts were supplied for a function that required a
2 high grade fastener. A root cause could be that the bridge was not properly inspected or
3 that it was poorly maintained.

4 In an example closer to home, the Entergy Vermont Yankee Root Cause Analysis
5 Report [Initial] CR-VTY-2004-2015 “Electrical Fault/Fire”, 07-16-04 and Entergy
6 Vermont Yankee Root Cause Analysis Report [Final] CR- 04-2015 “Electrical
7 Fault/Fire”, 04-26-2005, identified a number of contributing causes for an electrical short
8 circuit and transformer [oil] fire; both physical failure and human error, a failed surge
9 arrestor, inspection failure, failure to heed industry experience, a displaced flange that
10 allowed oil to leak, a dislodged metal sheet from an isophase bus duct expansion joint
11 and so on.

12 None of these made the cut as a ‘root cause.’

13 ENVY rightly traced the incident to its root and (except for glossing over the
14 contribution of uprate-related modifications increasing bus duct airflow and except for
15 waffling on bus duct maintenance failure) assigned responsibility to (1) a fabrication
16 deficiency (which somehow slipped through quality control) and (2) no preventative
17 maintenance on [electrical] surge arrestors.

18 The Electrical Fault/Fire report contained no less than 18 attachments of primary
19 source supporting technical material. The RCER contains half that and much of it merely
20 narrative. Clearly ENVY gave much more attention to getting the technical/factual
21 aspects of the Electrical Fault/Fire report right than it has given to this RCER.

22 In the matter of the AOG system leaks, it appears that ENVY stops the train of
23 causation at a claim that pipes were breached by interior mechanical erosion; presumably
24 under conditions unique to the VY AOG system, but nonetheless conditions that should
25 have been anticipated. In short, a hole in a pipe is not a root cause. The root cause must
26 be some material, design or inspection/maintenance failure, and ENVY has not identified
27 which of these was the actual root cause of this incident. The Board should demand that
28 a proper root cause analysis be done.

29
30
31

1 Q-7 Why is this important?

2 A-7 This is important because a truncated root cause analysis invariably results in a
3 truncated, misshapen and otherwise useless extent of condition review. The question that
4 goes less than fully answered is: what other locations, systems, and components has this
5 particular root case affected? Without understanding and correcting the root cause and
6 without a thorough understanding of the extent of condition, the chances of determining
7 appropriate actions to head off a similar and potentially worse occurrence are slim.

8

9 Q-8 Do you see any benefits to the Board or to the licensee in taking Entergy's approach
10 to determining root cause?

11 A-8 I can see no benefit to the Board in terms of materially assisting its investigation.
12 The licensee saves time and money if it can confine the investigation to a single
13 occurrence in a single location, which is what this shorthand twist on root cause analysis
14 appears aimed to accomplish.

15 In simple terms, I read the Entergy script this way: water or vapor hydraulically
16 mines its way through pipe (root cause); pipe leaks; partially dammed drain backs
17 contaminated water up to concrete joint defect; contaminated water migrates to test well -
18 end-of-sequence. Then Entergy proposes a fix: plug leaking pipe to stop source; clean
19 and patch drain; pump to draw clean water in and ever less contaminated water out. Case
20 closed.

21 A root cause determination that extends beyond listing a chain of physical events
22 would almost certainly implicate human error in one or more departments, for example,
23 engineering, inspection, maintenance, etc. The next step would be to determine extent of
24 condition examining all other similar structures systems and components where this error
25 may have applied.

26 Webster's New World Dictionary of the American Language (1976, William
27 Collins + World Publishing) has that analysis is a "separating or breaking up of any
28 whole into its parts, esp. with an examination of these parts to find out their nature,
29 proportion, function, interrelationship, etc." whereas evaluation is to find the value or
30 amount of...*SYN*, see ESTIMATE".

1 I believe it is telling that in the matter of the 2004 transformer fire, where the
2 scope of corrective action was to some degree self limiting by the unique nature of the
3 failed components, ENVY chose to style its investigation and report as a root cause
4 *analysis*, but in the matter of leaking and degraded underground piping, where many
5 systems and components are buried, underground, or difficult-to-access, Entergy has
6 offered a less probing and less detailed *evaluation*.

7 Without a thorough extent of condition review based on a probing root cause
8 *analysis*, the Board cannot have any assurance that appropriate measures have been put in
9 place to assure that additional, and potentially more severe, leaks will not take place and
10 negatively affect groundwater and drinking water resources, the natural environment,
11 plant reliability, decommissioning costs, and the orderly development of the area.

12
13 Q-9 Do you dispute ENVY's claim that the pipe failures were caused by internal
14 mechanical erosion with no contribution to the failure from corrosion?

15 A-9 Yes, for several reasons. ENVY has based its claim in part on the physical
16 configuration of the affected pipe areas; these two holes being located in areas where
17 uniform flow is disturbed by changes in the direction and internal contours of the pipe.
18 Permit me to list my reasons for disputing these claims:

19 A. It is counter-intuitive to ignore that fact that near identical configurations
20 and materials must exist through the miles of small bore piping at Vermont Yankee,
21 much of it more highly energized than the AOG pipes at issue, yet no leaks of similar
22 cause have been reported.

23 B. ENVY's claim is unsupported by any evidence, and they have not even
24 claimed to have performed a detailed examination of the affected areas and subsequent
25 analysis to determine whether corrosion may have been evident.

26 In discovery responses to NEC, for example, ENVY claims to have secured no
27 images other than the few mid-range photo snap shots provided in discovery, meaning
28 that no analytical level images were taken of the affected area. There are no such images
29 included in the RCER.

1 In discovery responses to NEC, ENVY claims not to have taken samples from the
2 affected pipe area for close bench examination or laboratory analysis. There is no record
3 of such sampling in the RCER.

4 In discovery responses to NEC, ENVY claims ignorance of several factors that
5 would be considered vital to determining the physical evolution of a pipe leak, including
6 chemistry and pH balance of the pipe contents, a range of internal pressure including
7 operating pressure, velocity of pipe contents etc. There is no record of consideration of
8 these factors in the RCER.

9 C. NRC annually issues several publications to licensees (information
10 notices, bulletins, and letters) advising of rising technical issues or accumulated plant
11 operating experience. In more than thirty years of reading these publications – including
12 NRC inspection Reports, NRC task force and staff reports, nuclear industry trade
13 publications, and attending NRC Regulatory Information Conferences – I have seen a
14 good bit of attention paid to external pipe corrosion and internal pipe flow accelerated
15 corrosion, but virtually nothing with regard to purely mechanical erosion in low energy
16 piping such as the affected sections of AOG piping. There is no mention of any similar
17 advisories, inspection reports, bulletins, etc. confirming that the phenomenon described
18 by ENVY is of industry or regulator concern.

19 D. In cases involving high-energy piping where flow accelerated corrosion
20 (FAC) or erosion-corrosion effects are in dispute, experts disagree as to the relative
21 contribution to pipe thinning from flow and from corrosion. In fact, Rudolf H. Hausler,
22 PhD, one of the nation’s foremost experts on FAC, stated in written testimony before the
23 NRC Atomic Safety and Licensing Board that flow in nuclear plant high energy piping
24 contributes to FAC only by removing corrosion and that it is incapable under plant
25 conditions of actually removing metal. He stated:

26
27 Since there is clearly a transition from “fluid flow accelerating the
28 chemical reactions” to “flow actually destroying metal” the question
29 becomes where such transition will occur and whether velocities which
30 effect such transitions could indeed occur in nuclear piping installation.

31 The answer is no, not in general but perhaps in rare occasions as
32 mentioned by Dr. Horowitz ³. Such velocities do not generally occur in
33 nuclear facility piping. If they were occurring then the damage would be
34 much more rapid, days rather than years to failure as are actually found.

1
2 Rudolf H. Hausler, PhD, MEMORANDUM, December 3, 2008, Discussion of the ASLB
3 Decision with regards to Contention 4 2008/12/17-New England Coalition's Motion for
4 Reconsideration /Licensing Board's Partial Initial Decision. ADAMS-ML09016035
5

6 In sum, I can find no technical basis in the RCER, in industry experience, or in
7 science to support the notion that the leaks resulted from the phenomenon described by
8 ENVY in the RCER.

9 To the extent that ENVY's remedial and preventive actions flow from this "root
10 cause" they are inappropriate and will not adequately address concerns regarding the
11 hazards to reliability, the Vermont environment, groundwater and drinking water
12 resources, and orderly development of the region from continued operation of the
13 Entergy Nuclear Vermont Yankee generating station.
14

15 Q-10 Do you have further comments regarding the RCER?

16 A-10 Yes. I believe that the RCER is deeply flawed in many respects; cluttered with
17 superfluous detail and unsupported conclusive statements and offering altogether too
18 little by way of documentation. For example, examination of the other suspect
19 components, such as the condensate storage tank, is described but ENVY refuses to
20 provide documentation.

21 Further, ENVY claims that certain sampling wells are in place to comport with
22 NPDES and other state permits, but refuses to discuss how the wells interface with permit
23 conditions, thus side-stepping the question of how onsite water sampling conditions may
24 be within the authority of the Board.

25 It appears that ENVY is being highly and inappropriately selective and less than
26 forthcoming on all areas of inquiry where Board authority may attach.

27 I would like to incorporate here by reference my earlier Prefiled Testimony on
28 Behalf of New England Coalition regarding Process Water Releases at Entergy Nuclear
29 Vermont Yankee Power Plant, July 2, 2010, which addressed the quality of Entergy's
30 examination of, and response to, the groundwater contamination publicly reported in
31 January 2010.

32 I respectfully offer that my testimony at this phase of the proceeding, coupled
33 with the testimony of the other parties, and critical review of the RCER provides

1 sufficient basis to proceed with a full investigation on the subjects outlined in the caption
2 for Docket 7600. I look forward to testifying in detail on those subjects following full
3 discovery.

4

5 Q-11 Does this complete your testimony?

6 A-11 Yes.