The Davis-Besse Close Call

Leadership ViTS Meeting
September 11, 2006

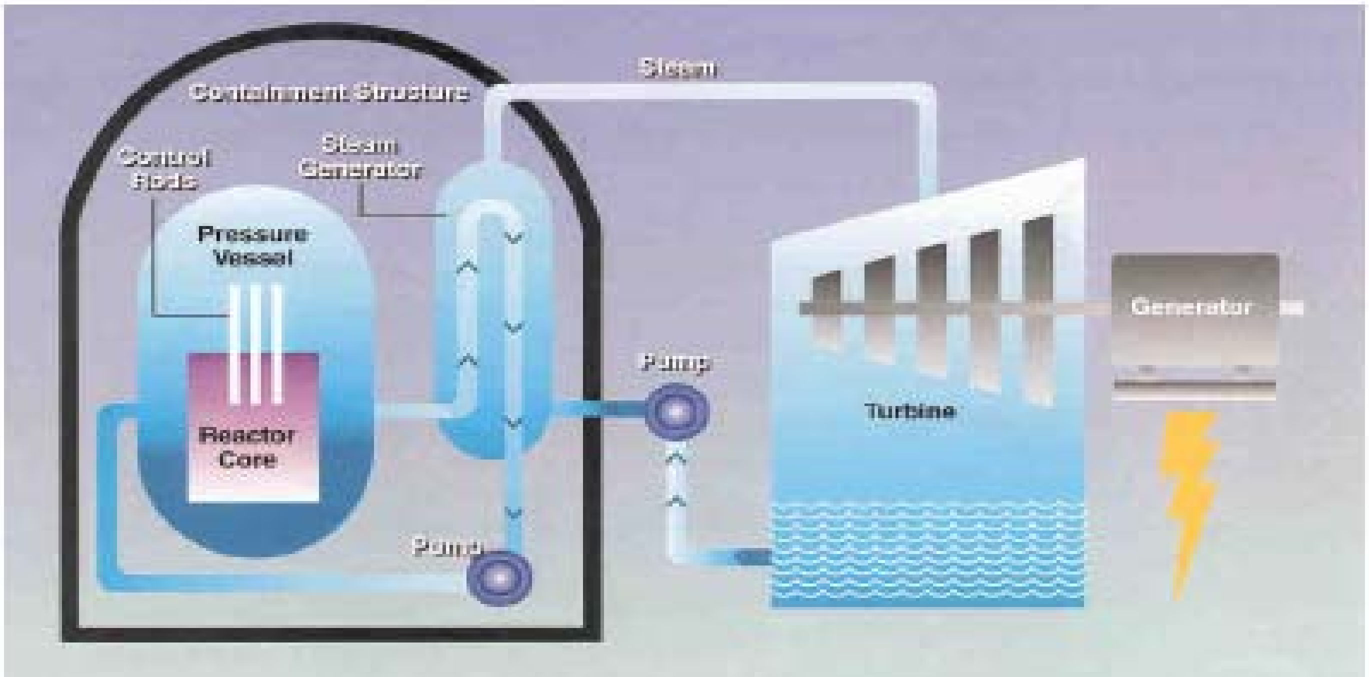
Bryan O'Connor, Chief
NASA Office of
Safety and Mission Assurance

Synopsis of the Davis-Besse Incident

- On February 16, 2002, Davis-Besse (Oak Harbor, Ohio) nuclear plant personnel were repairing cracks in the vessel head penetration (VHP) nozzles
- While being machined, the nozzles which were supposed to be imbedded tipped over
- Further inspection identified a large penetrated cavity of 20 to 30 square inches
- The cavity penetrated completely through the 6.63 inches of carbon steel to the thin stainless steel cladding liner
- The liner (3/8 inch) was all that was preventing a large loss of coolant accident with potential catastrophic consequences

NRC Lessons Learned Task Force Report September 30, 2002

The Davis-Besse Nuclear Power Plant



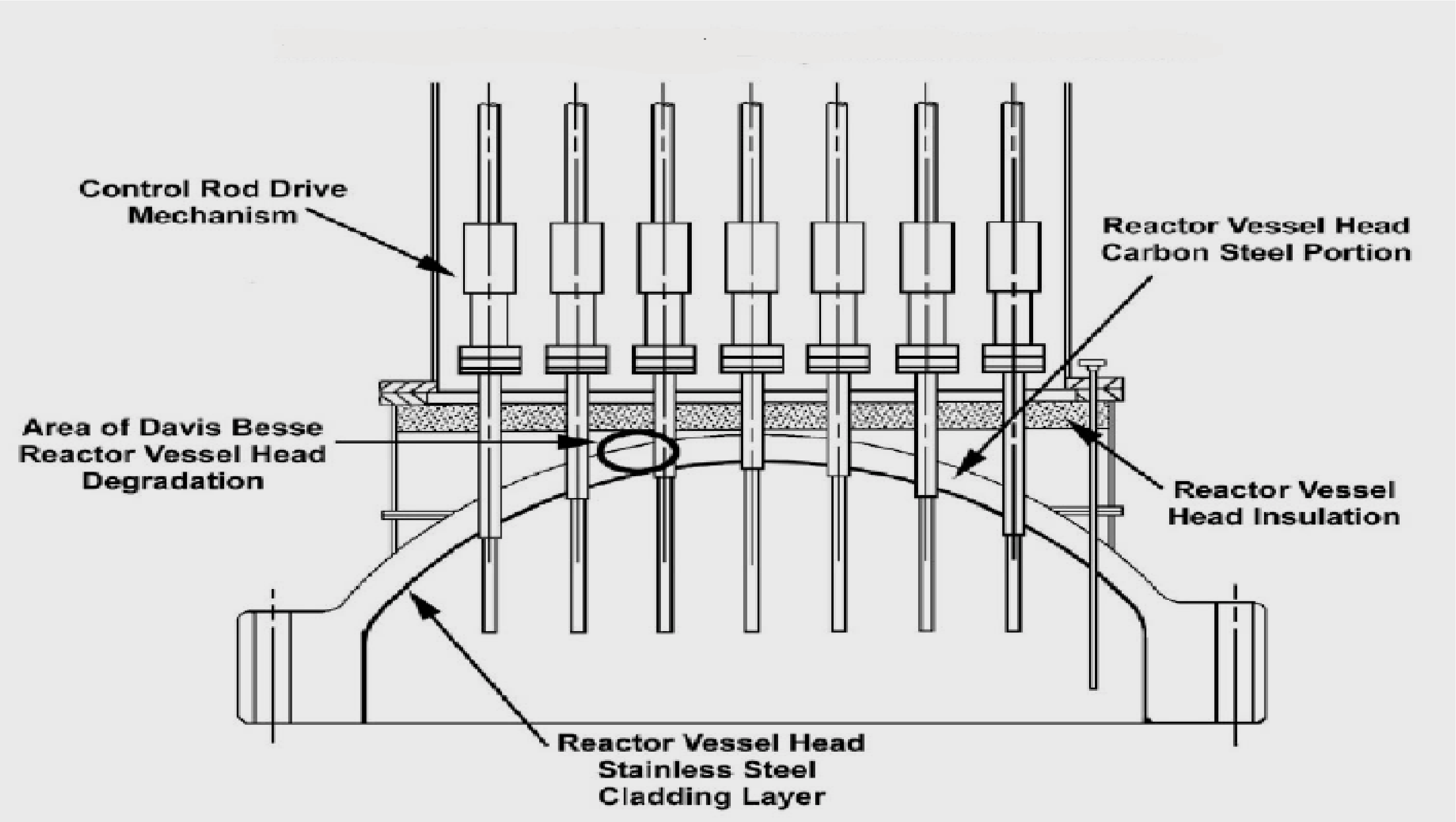
Pressurized Water Reactor

FIG 1: BASIC PLANT SYSTEMS

NRC Lessons Learned Task Force Report September 30, 2002

Reactor Pressure Vessel Head Showing the Location of the Degradation Cavity

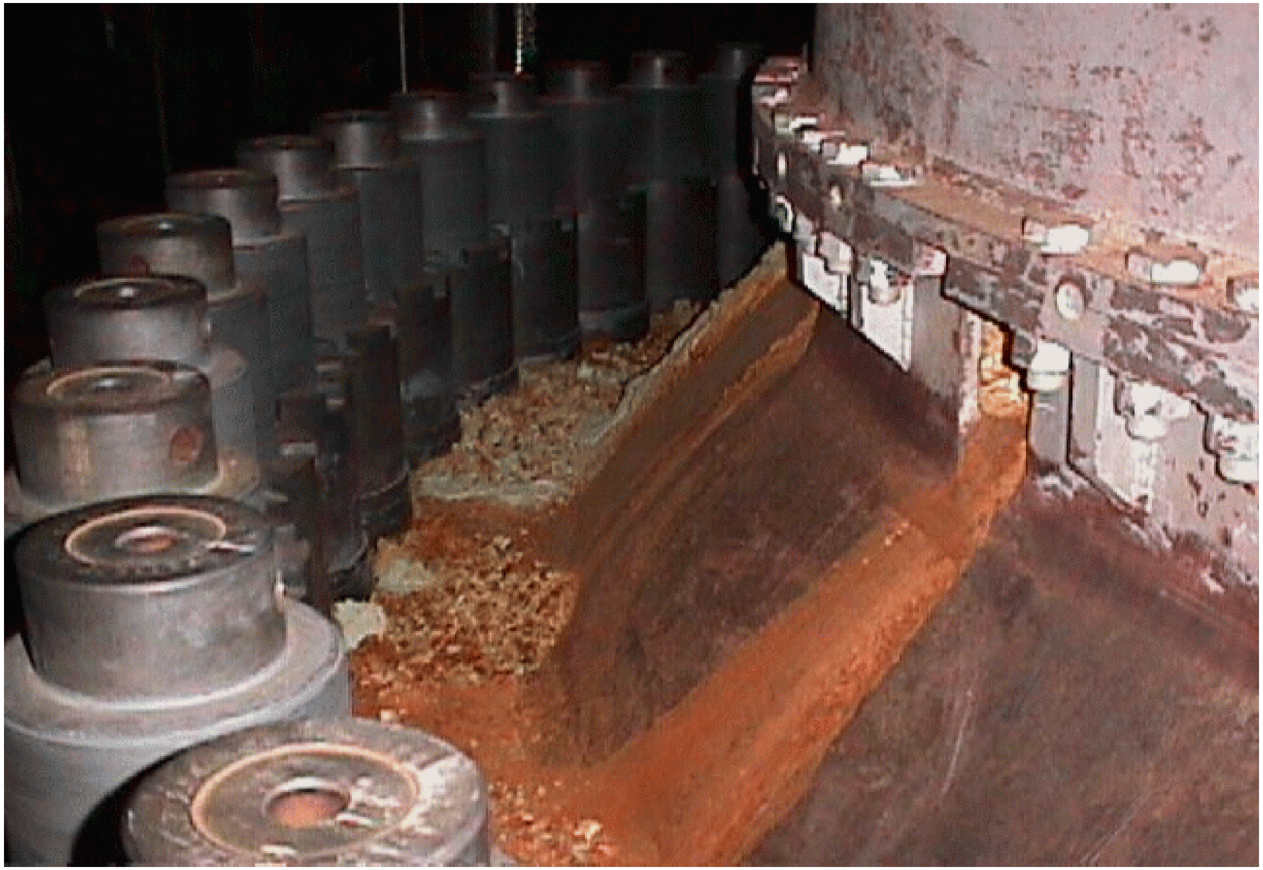
Figure 2-2 SCHEMATIC VIEW OF TYPICAL B&W RPV HEAD



NRC Lessons Learned Task Force Report September 30, 2002

Boric Acid Deposits Observed on the Reactor Pressure Vessel Head in 2000

Figure 2-5 BORIC ACID DEPOSITS ON RPV HEAD FLANGE

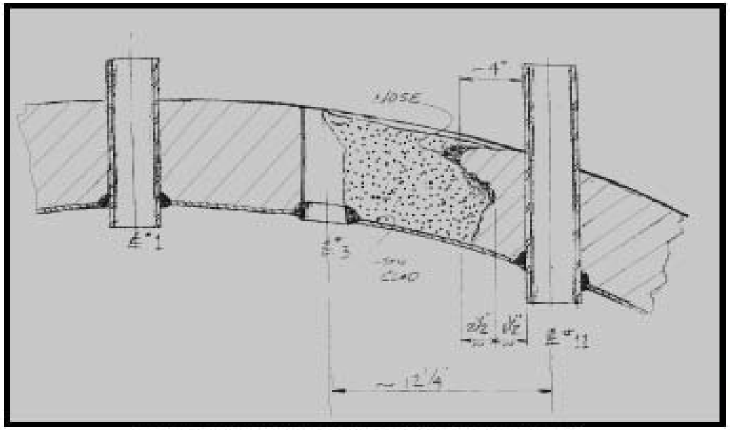


Refueling Outage 12 (2000)

NRC Lessons Learned Task Force Report September 30, 2002

Sketch and Pictures Showing the Extent of the Degradation Cavity When Found

Figure 2-4
DBNPS VHP NOZZLE NO.3 DEGRADATION CAVITY



Degradation Between Nozzle#3 and Nozzle#11.
The Sketch Provided by the Licensee

Nozzle #3 Area Cut Away From Reactor Head

Close-Up View of Cavity

17

Rubberized Impression of Cavity

NRC Lessons Learned Task Force Report September 30, 2002

Proximate Cause of the Davis-Besse Penetration Cavity

- Pressurized Water Reactors (PWRs) use boron to help moderate the nuclear reaction
- Boron, a thermal neutron absorber, is dissolved in the Reactor Coolant System as boric acid
- Boric acid deposits had been slowly accumulating on the pressure vessel head
- The cavity was formed and grew as a result of the associated corrosion that occurred
- The cavity was not easily observable because of the covering of the vessel head
- The cavity had been growing undetected for approximately 10 years

Conclusions from the NRC Report and Lesson Learned for NASA

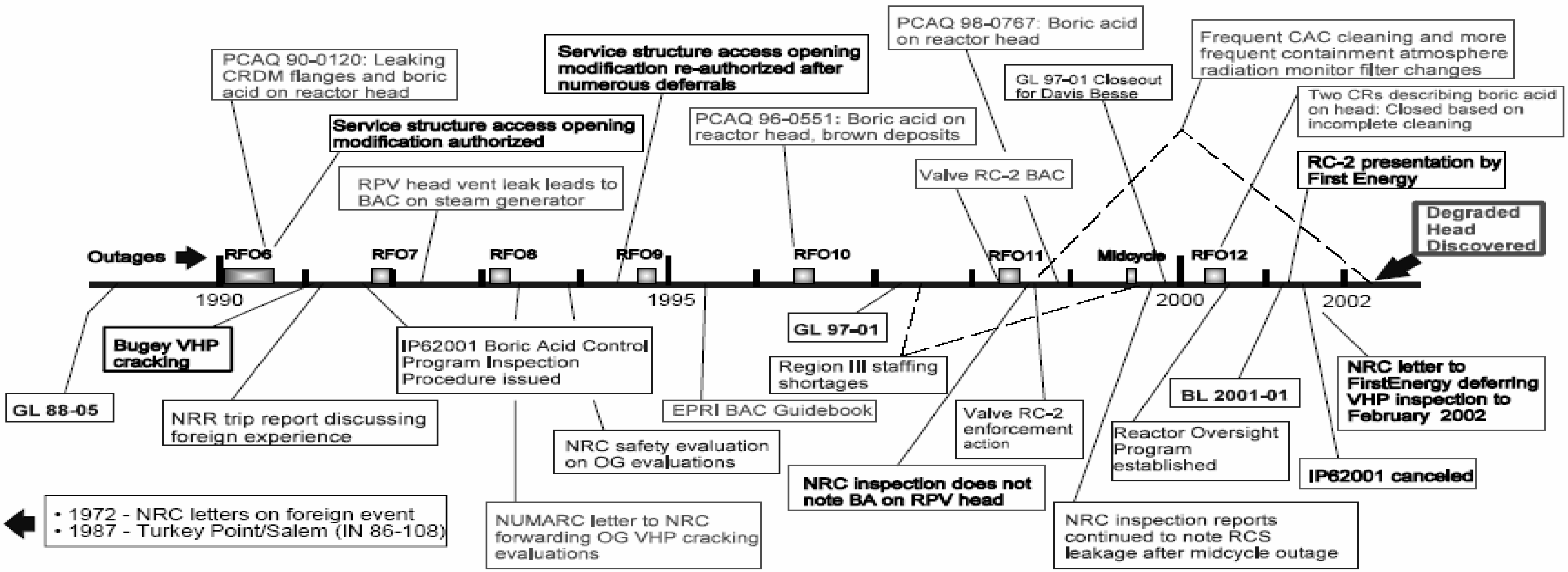
- NRC and industry had recognized the potential for boric acid-induced degradation for 10 years
- The consensus was that vessel head penetration was not an immediate safety concern
- NRC and industry personnel failed to take into account the risk implications from past boric acid-induced degradation events

Lesson Learned for NASA:
Pay attention to developing degradation events that can lead to catastrophic failures

BACKUP

The Time Line of Events Shows That This Type of Deposit Had Been Noted and Documented for over 10 Years

Figure 3-1 Time Line Relating Significant Items of Interest



IN (Information Notice) 86-108, "Degradation of Reactor Coolant System Pressure Boundary Resulting from Boric Acid Corrosion"
GL (Generic Letter) 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Coolant Pressure Boundary Components in PWR Plants"
GL 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations"
BL (Bulletin) 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"

PCAQs (Potential Condition Adverse to Quality) and CRs (Condition Reports) are issued by the licensee.

BA - Boric Acid
BAC - Boric acid corrosion
CAC- Containment air cooler
CRDM - Control rod drive mechanism
EPRI - Electric Power Research Institute
NRR - Office of Nuclear Reactor Regulation
NUMARC - Nuclear Management and Resource Council
OG - Owners Group
RCS - Reactor coolant system
RFO- Refueling outage
RPV - Reactor pressure vessel
VHP - Vessel head penetration

NRC Lessons Learned Task Force Report September 30, 2002

INPO Warning Flags

- Overconfidence
  - The “numbers” are good and the nuclear staff is living off past successes
- Isolationism
  - There are few interactions with other utilities, INPO, and other industry groups
  - Benchmarking is seldom done or is limited to “tourism” without implementation
  - As a result, the plant is behind the industry and doesn’t know it
- Inadequacies in Managing Relationships
  - Mindset toward NRC/INPO is defensiveness or “do the minimum”- no bank account
  - Employees are not involved, not listened to, and raising problems is not valued

INPO Warning Flags

- Weakness in Operations and Engineering
  - Operations standards, formality, and discipline are lacking
  - Plant operational focus is overshadowed by other issues, initiatives, or special projects
  - Engineering is weak (loss of talent) or lacks alignment with operational priorities
  - Design basis is not a priority and design margins erode over time
- Production Priorities
  - Important equipment problems linger, and repairs are postponed while the plant stays on line
  - Nuclear safety is "assumed but not emphasized in staff interactions and site communications

INPO Warning Flags

- Inadequacies in Managing Changes
  - Organizational changes, staff reductions, retirement programs, or relocations are initiated before fully considering impact--recruiting or training is not used to compensate
  - Processes and procedures don't support strong performance after management changes
- Inadequate Analysis of Plant Events
  - Event significance is unrecognized or underplayed and reaction to events is not aggressive
  - Organizational causes of events are not explored

INPO Warning Flags

- Weakness of Nuclear Leaders
  - Managers are defensive, lack team skills, or are weak communicators
  - Managers lack integrated plant knowledge or operational experience
  - Senior managers are not involved in operations and do not exercise accountability or follow-up
- Lack of Self-Criticalness
  - Oversight organizations lack an unbiased outside view or deliver only good news
  - Self-assessment processes do not find problems or do not address them