U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Bilateral Exchange: Use of Containment Accident Pressure in Determining Available NPSH

Michele Evans
Director, Division of Component Integrity

Robert Taylor
Chief, Steam Generator Integrity & Chemical Engineering Branch

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Outline

- Net Positive Suction Head (NPSH)
- Use of Containment Accident Pressure
- Advisory Committee on Reactor Safeguards (ACRS) Position
- NRC Status – Future Actions

Net Positive Suction Head

- Adequate NPSH ensures adequate pump suction conditions

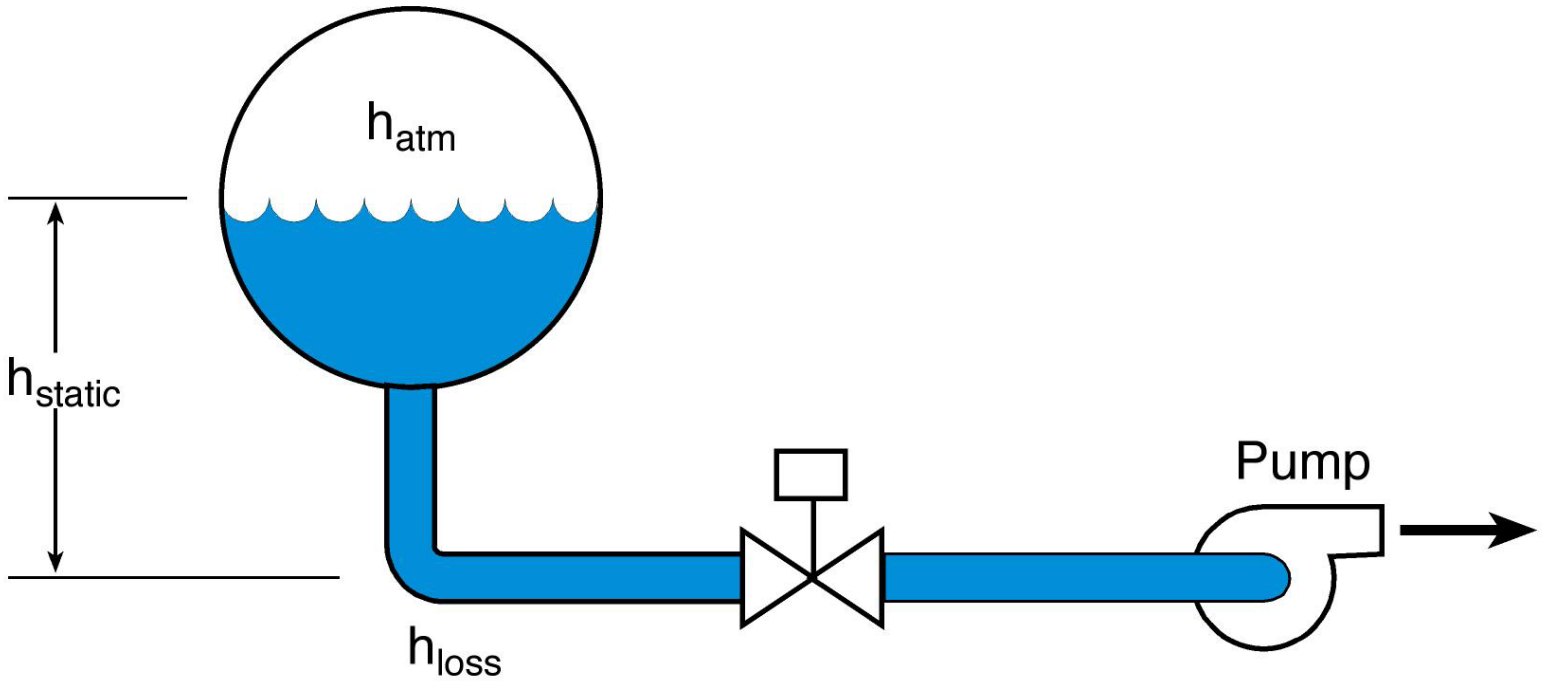
- Avoid Pump Cavitation
  - Cavitation causes mechanical damage (erosion, excessive vibration), decrease in pump flow rate, decrease in pump discharge pressure

- Two types of NPSH
  - Available (NPSHA): function of system design
  - Required (NPSHR): function of pump design

- NPSH margin = NPSHA - NPSHR

Available NPSH

$$\text{Available NPSH} = h_{atm} + h_{static} - h_{loss} - h_{vp}$$



Use of Containment Accident Pressure

- NPSH Margin:
  Available NPSH – Required NPSH $\geq$ *0*

- If NPSH margin < 0 without containment accident pressure, containment accident pressure is considered

Acceptability of Containment Accident Pressure Use - Technical Justification

- Containment Integrity
  - Leakage rate testing, visual and instrument inspections, valve position TS requirements, plant procedures
- Conservative Calculations
- Robust pump design and construction
  - Testing shows pumps can operate for some time (hours) with cavitation
- BWR emergency operating procedures contain guidance for pump cavitation
- Low risk

ACRS Position

- Advisory Committee on Reactor Safeguards (ACRS) disagrees with the NRC staff allowing credit for containment accident pressure for NPSH margin
  - Defense in depth not satisfied
  - ACRS wants a plant specific probabilistic risk analysis (PRA) for every application of containment accident pressure
  - A small amount for a short duration would be acceptable

NRC Staff Draft Guidance

- Staff has developed guidance for use of containment accident pressure:
  - ADAMS Accession No. ML100550869
  - Addresses pump cavitation phenomena
  - Guidelines for uncertainty and margin included in calculation procedures as requested by ACRS
  - ACRS agrees with guidance (March 19, 2010 ACRS letter to NRC Executive Director for Operations)

Status

- Use of containment accident pressure when calculating available NPSH:
  - 19 BWRs
  - 8 PWRs
- Compliance with GSI-191 recommendations for many PWRs necessitate use of containment accident pressure to demonstrate no flashing across the sump screens
- Current reviews involving use of containment accident pressure are on hold pending resolution of differences with the ACRS

Future Actions

- Complete work on staff guidance for use of containment accident pressure by meeting with the BWROG and PWROG to obtain industry data for uncertainty values and other pump data
- Complete work on Commission paper recommending options to the Commission to resolve differences with ACRS
- With Commission approval, complete the Browns Ferry and Monticello EPU reviews
- Revise staff regulatory guidance in response to staff Commission paper

Discussion Topics/ Questions

- Do Japanese nuclear plants use containment accident pressure in determining the available NPSH of ECCS and containment spray pumps
  - If so, what is the justification for this?
- Do both PWRs and BWRs use containment accident pressure in determining available NPSH?
- Is use of containment accident pressure for NPSH margin included in PRA studies?
  - If so, what is the effect on risk?
- Are there guidance documents on use of containment accident pressure at Japanese plants?
- How is defense in depth treated for Japanese reactors?
  - Requirements? Design goal? Regulatory philosophy?

Acronyms

- ACRS – Advisory Committee on Reactor Safeguards
- EDO – Executive Director for Operations
- EPU – Extended Power Uprate
- GSI – Generic Safety Issue
- PRA – Probabilistic Risk Analysis
- PWR – Pressurized Water Reactor
- BWR – Boiling Water Reactor
- TS – Technical Specifications
- NPSH – Net Positive Suction Head