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USE OF ULTRASONIC FLOW MEASUREMENT TO DETERMINE REACTOR POWER

- PURPOSE OF THIS PRESENTATION
  - To inform the ET and the LT of the status of the staff's review of the application of ultrasonic flow meters (UFMs) in determining reactor power
- MEASURE FOR SUCCESS OF THIS PRESENTATION
  - ET and LT are aware of staff activities
  - ET and LT are advised of potential need for regulatory action to address deficiencies in the application of UFMs

PRESENTERS: Warren Lyon

Presentation Date: June 8, 2006

A-93

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BACKGROUND

- ✓ UFMs uses: Feedwater flow measurement for MURs and power recovery
- ✓ Appendix K to 10 CFR 50.46 changed to allow decrease in 2% uncertainty assumption for reactor power used in LOCA analyses
- ✓ Importance is tied to compliance with the licensed thermal power upon which accident and transient analyses are conducted
- ✓ Currently, 2 UFM devices have approved topical reports
  - Caldon - Check and CheckPlus
  - Westinghouse/AMAG - Crossflow

CROSSFLOW UFM HISTORY

- 1999 Generic Crossflow UFM topical report approved. Licensees beging requesting MURs
- January 2003 - Byron/Braidwood operating above rated thermal power (RTP). Region III requests NRR assistance on review of allegation related to Crossflow application at Byron/Braidwood.
- July 2003 - Ft. Calhoun submits first MUR LAR based on Crossflow
- August 2003 - Byron/Braidwood reduce power, staff begins assessment of basis for operating above RTP. Power recovery application of Crossflow UFM.
- January 2004 - NRC approves Ft. Calhoun MUR LAR
- February 2004 - NRC establishes task group to review UFMs
- May 2004 - Ft. Calhoun licensed RTP returned to pre-MUR level
- July 2004 - NRC task group identifies issues and recommends actions.
- January 2005, Calvert Cliffs and March 2005, Ft. Calhoun submit MUR LARs based on Crossflow
- August 2005 - Westinghouse, Calvert Cliffs, & Ft. Calhoun provided issues related to Crossflow

CROSSFLOW UFM HISTORY (con't)

- September 2005 - New issue identified with Crossflow use at Calvert Cliffs. Swirl in feedwater flow adversely affects Crossflow measurement.
- October 2005 - Staff places Calvert Cliffs and Ft. Calhoun MUR reviews on hold
- October 2005 to January 2006 - Calvert Cliffs, Ft. Calhoun, W/AMAG, Owners Group, & NRC continue interactions on issue resolution. NRC observes tracer testing at Calvert Cliffs.
- February 2006 - NRR staff completes theoretical assessment of Crossflow uncertainty claim. Additional RAIs provided to W/AMAG
- March 2006 - NRC & W/AMAG meet to discuss RAI responses
- April 2006 - NRC provides detailed RAIs on issues that must be resolved for use of Crossflow. NRR issues User's Need memo to RES to peer review theoretical assessment. W/AMAG describe model being developed that confirms original bases. Staff informs W/AMAG of schedule for and issues to be resolved for completion of reviews.
- May 2006 - RES provides response to NRR User's Need memo. RES substantiated NRR position that Crossflow does not obtain sufficient information to support uncertainty analyses.
- June 2006 - W/AMAG provide additional information on theoretical and empirical bases for Crossflow uncertainty claim.

OVERVIEW

- ✓ Caldon Check and CheckPlus UFMs are acceptable

- ✓ Westinghouse/Advanced Measurement and Analysis Group (W/AMAG) review is ongoing. Anticipated staff finding is unacceptable. RES supports NRR position on capability of Crossflow UFM.

- ✓ Use of external UFMs for power recovery under 10 CFR 50.59 has not been shown to be acceptable

PLANT-SPECIFIC STATUS - RECENT MUR LARs

✓ Seabrook (Caldon) UFM is acceptable (ML061360034, May 22, 2006)

✓ Calvert Cliffs (W/AMAG) is on hold - an amended LAR is anticipated

✓ Ft. Calhoun (W/AMAG) is on hold pending generic review completion

ACCEPTANCE CRITERIA

- Traceability - relating a measurement to a standard
  - Standard maintained by a national laboratory - National Institute of Standards and Technology (NIST)
  - Each step between measurement and standard - clearly defined and no unverified assumptions
  - Unbroken path between measurement and standard
  - Total measurement uncertainty reflects aggregate uncertainties of each step
- Applicability - provide accurate information over range of use
  - Sound basis (theoretical understanding or equivalent)
  - Calibration is constant or change is fully understood, predictable, and verifiable

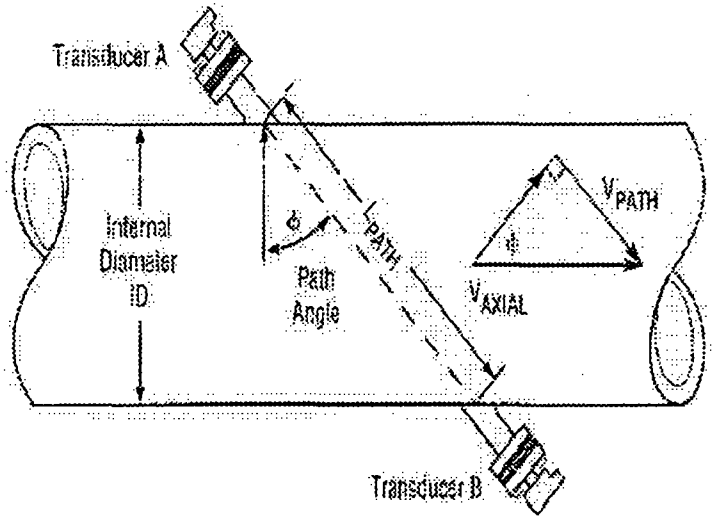
ACCEPTANCE CRITERIA ASSESSMENT

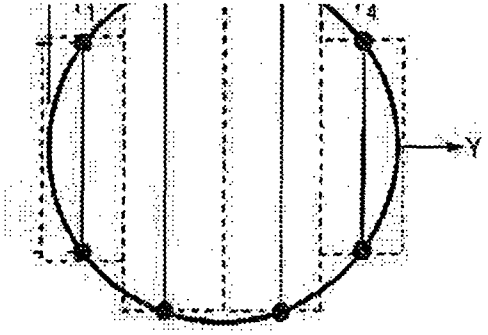
✓ Caldon Check and Checkplus meet all criteria

✓ W/AMAG Crossflow has not been shown to meet criteria, but staff has not completed review of all submitted information

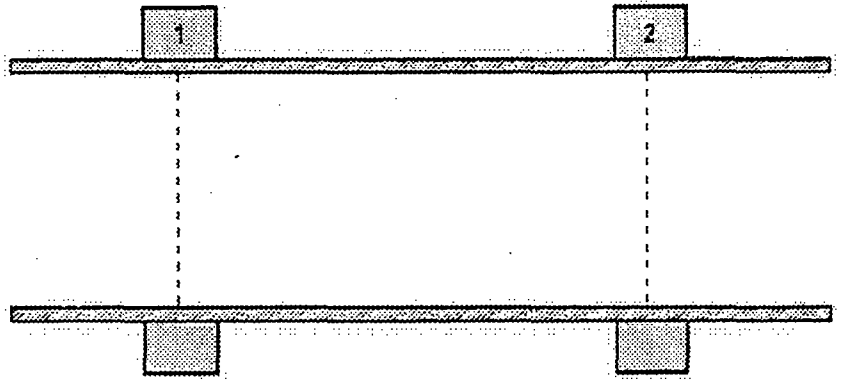
Ultrasonic Flow Meter Comparison

Caldon Check & CheckPlus





W/AMAG Crossflow



W/AMAG CROSSFLOW REGULATORY IMPACT

Potentially effected measurement uncertainty recapture power uprates:

Plant	% Uprate	MWt Increase
Salem 1&2	1.4	48 x 2 = 96
Hope Creek	1.4	46
SONGS 2&3	1.42	48 x 2 = 96
STP 1&2	1.4	53 x 2 = 106

Plant	% Uprate	MWt Increase
Pilgrim	1.5	30
Hatch 1&2	1.4	48 x 2 = 96
Kewaunee	1.4	23
Palisades	1.4	35.4

- Total MWt increase from Use of Crossflow based MURs = 528 MWt
- This equates to about 185 MWe
- Regulatory impact from the use of Crossflow for power recovery has not been fully assessed

W/AMAG CROSSFLOW CONCLUSIONS

- ✓ Theoretical, analytical, and understanding basis is weak
- ✓ Empirical data basis is weak
- ✓ Meter self-assessment does not appear viable
- ✓ An unbroken path from calibration used during meter operation to reference standards has not been achieved
- ✓ NRC-approved topic report is no longer valid
- ✓ NRC review is nearing completion although work remains
- ✓ Regulatory action may be required to address the use of Crossflow and other external UFMs for MURs and power recovery applications