PDR Advance Copy

ABB
ASEA BROWN BOVERI

13 March, 2000
LD-2000-0018

RECEIVED
'00 MAR 16 A10:28
PUBLIC DOCUMENT
RECEIVED
'00 MAR 17 P2:10
PUBLIC DOCUMENT

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

SUBJECT: **ABB CENP GENERAL RESPONSE TO PUBLIC MEETING REGARDING CALDON, INC. ULTRASONIC FLOW MEASUREMENT REPRESENTATION OF CROSS-CORRELATION FLOWMETERS TECHNOLOGY**

References: 1) Letter, C. R. Hastings (Caldon) to USNRC Document Control Desk, "Information on Ultrasonic Flow Measurement Instrumentation", February 15, 2000

2) Letter I. C. Rickard (ABB CENP) to USNRC Document Control Desk, "Submittal of CENPD-397-P, Rev. 01 – Improved Flow Measurement Accuracy Using CROSSFLOW Ultrasonic Flow Measurement Technology", LD-2000-0002, January 6, 2000 {Contains Proprietary Information}

On March 8, 2000, the Nuclear Regulatory Commission (NRC) held a public meeting with Caldon, Inc. The purpose of the meeting was to provide Caldon an opportunity to discuss the state-of-the-art of ultrasonic flow measurement (UFM) technology, as a follow-up to Caldon's submittal made on February 15, 2000 (Reference 1). Caldon indicated in its submittal that certain factors may be relevant to NRC's ongoing review of cross-correlation technology. Although the Caldon letter did not specifically mention ABB C-E Nuclear Power, Inc. (ABB CENP), Advanced Measurement and Analysis Group, Inc. (AMAG) or the CROSSFLOW UFM System by name, the ongoing NRC review activities are associated with the ABB CENP topical report CENPD-397-P, Rev. 01, "Improved Flow Measurement Using CROSSFLOW Ultrasonic Flow Measurement Technology" (Reference 2). Following the public meeting, the NRC verbally requested that ABB CENP provide a general response to the issues raised at the meeting. This letter provides the requested response.

GENERAL COMMENTS:

The topics discussed by Caldon and its consultants that participated in the public meeting are well know to ABB CENP and AMAG and we believe are effectively addressed in Reference 2. Much of the information provided by Caldon gives a reasonable assessment of the state of the art as it existed a number of years ago. In reviewing the Caldon submittal, it is interesting to note that many papers were authored by either current AMAG employees or users of the cross-correlation and CROSSFLOW technology. However, there is a balance of significant, proprietary information missing from the presentation. This information includes cross-correlation technology knowledge

ABB C-E NUCLEAR POWER, INC.

P.O. Box 500
2000 Day Hill Rd.
Windsor, CT 06095-0500

Telephone (860) 285-9678
Fax (860) 285-3253

D F03

gained by Canadian General Electric in the early 1970's, continued research and development by Ontario Power Generation (formerly Ontario Hydro) through the 1980's and further development by AMAG since the early 1990's. AMAG was founded and is presently led by individuals who played key roles in development of cross-correlation technology for Ontario Power Generation and Canadian General Electric. AMAG has advanced the development and application of CROSSFLOW technology with financial support from the Canadian government, commercial contracts and its partnership with ABB CENP.

ABB CENP has also invested in the continued development of cross-correlation technology since its relationship with AMAG was initiated in the early 1990's. As a designer of light water reactor Nuclear Steam Supply Systems (NSSS) and provider of nuclear services and fuel world wide, ABB CENP has performed multiple and rigorous multi-disciplined expert reviews of the CROSSFLOW technology including hardware design, software, data acquisition, ultrasonics, thermal hydraulics and uncertainty analyses. ABB CENP promotes the CROSSFLOW solution to the nuclear industry because the product meets the high standards of quality, technical excellence and integrity that we insist upon as a reputable supplier to the nuclear industry.

Based on the meeting with the NRC Staff on March 8, 2000, it is understandable why the public and transit time specialists would have limited practical application knowledge of a cross-correlation based ultrasonic flow measurement system. However, disclosing this type of information to the public would require ABB CENP and AMAG to share the intellectual property that gives cross-correlation a clear technical and commercial advantage over transit time technologies. Although cross-correlation technology have been understood for years, the required data processing necessary to perform the statistical averaging in an accurate, timely and cost-effective manner was not commercially viable until the past decade. Today's enhanced computing power together with AMAG's advancements in ultrasonic cross-correlation application and sophisticated acoustical design, have allowed AMAG and ABB CENP to significantly evolve, validate and verify the technology. We believe it is the technology for the present and for the future and that the many potential applications and opportunities across many industries are yet to be identified and realized.

SPECIFIC COMMENTS:

ABB CENP is confident that the information already provided in the base topical report and in responses to the NRC Request for Additional Information (RAI) addresses all issues of interest to the NRC Staff as part of its comprehensive review effort. However, we would like to respond publicly to selected issues raised during the March 8, 2000 meeting to assist the public in understanding the current state of cross-correlation technology.

- Theoretical Basis of Cross-Correlation Technology

  The theory of flow measurement in a pipe using ultrasonic cross-correlation technology for single-phase flow originated in the 1970's as an empirical relationship. It was further developed into a theoretical relationship and verified by AMAG in the

1990's. This issue is addressed in the topical report, Sections 2 and 4, and again in the RAI's and Supplementary Record documents.

- Effect of Upstream Disturbance on Flow Measurement

  All flow measurement devices, including venturis, clamp-on transit time, chordal multi-path transit time, cross-correlation etc., are affected by upstream disturbance. To provide accurate flow measurement, the effect of this upstream disturbance must be accounted for and established via installation criteria that have to be met to achieve the specified accuracy. For example, the specific flow meter has to be installed at a certain distance downstream of the disturbance. This issue is addressed in the topical report, Section 5.6.

- Influence of Acoustical Noise

  The influence of acoustical noise on cross-correlation feedwater flow measurements has been investigated in detail by Canadian General Electric, Ontario Power Generation and AMAG starting in the 1970's. During the last five years, AMAG has performed a comprehensive analysis of this effect. This resulted in a new system design and methodology that has reduced the effect of acoustical noise to a minimum to achieve the specified accuracy. This issue is addressed in the topical report, Section 3.

- Percentage of Flow Stream Measured with Cross-Correlation Technology

  The CROSSFLOW ultrasonic beam interacts with the turbulence in the flow over the whole pipe diameter. The distribution of this effect varies depending on the design and methodology used to extract the required information related to flow measurement. CROSSFLOW monitors all eddies that are required for the determination of accurate feedwater flow. This is addressed in the topical report, Section 2.3, and in the RAI document.

- Accuracy of Clamp-on Ultrasonic Flowmeters

  During the March 8 presentation, Dr. George Mattingly, from the National Institute of Standards and Technology (NIST), stated that none of the five ultrasonic flow meters that NIST had tested had an accuracy of less than 1%.

  This conclusion is based on making an instantaneous comparison of the flow measurements by the CROSSFLOW system with the weigh tank results. As discussed in the topical report, Section 3.2.4.6, CROSSFLOW was designed to accurately measure flow as an average of a number of readings, which is appropriate in feedwater flow applications.

  An ABB CENP and AMAG analysis of the NIST weigh tank test results (obtained from NIST) demonstrates that the CROSSFLOW flow measurement accuracy is consistent with the accuracy specified in the topical report.

SUMMARY/CONCLUSIONS

ABB CENP and AMAG have carefully reviewed the non-proprietary portion of Caldon's submittal (Reference 1) as well as the transcripts and handouts from the March 8, 2000 public meeting. Our review has not uncovered any new technical issues that would prevent the NRC from issuing an SER for CENPD-397-P, Rev. 01. We believe the appropriate technical information to support our conclusion is provided in Reference 2 and the associated RAI responses.

If you have any remaining questions concerning this matter, please do not hesitate to call me or Chuck Molnar of my staff at (860) 285-5205 if we may be of further assistance.

Very truly yours,

ABB C-E NUCLEAR POWER, INC.

Ian C. Rickard, Director
Nuclear Licensing

xc: J. A. Calvo (NRC)
J. S. Cushing (NRC)
J. E. Donoghue (NRC)
E. C. Marinos (NRC)