



GE ENERGY

Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon removal of Enclosures 1, the balance of this letter may be considered non-proprietary.

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MFN 06-122
May 5, 2006

U.S Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: TEPCO/GE UdFlow System Pre-Meeting Draft Presentation

Enclosure 1 contains the TEPCO/GE UdFlow System "Draft" presentation for an upcoming pre-meeting with the NRC.

Enclosure 1 contains proprietary information of the type that GE customarily maintains in confidence and withholds from public disclosure. The Enclosure 3 affidavit identifies that the designated information has been handled and classified as proprietary to GE. Along with the affidavit this information is suitable for review by the NRC. GE hereby requests that the designated information in Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17. Enclosure 2 is a non-proprietary version of Enclosure 1.

If you have any questions, please contact, Ed Schrull at (910) 675-5744 or myself.

Sincerely,

George Stramback
Manager, Regulatory Services

Project No. 710

D065

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Enclosures:

1. **TEPCO/GE UdFlow System for the Measurement of Nuclear Feedwater Flow Rate by Ultrasonic Doppler Technology - Proprietary**
2. **TEPCO/GE UdFlow System for the Measurement of Nuclear Feedwater Flow Rate by Ultrasonic Doppler Technology – Non-proprietary**
3. **Affidavit, George B. Stramback, dated May 5, 2006**

**cc: MC Honcharik (NRC)
LM Quintana (GE/Wilmington)
ED Schrull (GE/Wilmington)**

ENCLOSURE 1

MFN 06-122

TEPCO/GE UdFlow System for the Measurement of Nuclear Feedwater Flow Rate by Ultrasonic Doppler Technology

IMPORTANT NOTICE

GE Proprietary Information

PROPRIETARY INFORMATION NOTICE

This enclosure contains proprietary information of the General Electric Company (GE) and is furnished in confidence solely for the purpose(s) stated in the transmittal letter. No other use, direct or indirect, of the document or the information it contains is authorized. Furnishing this enclosure does not convey any license, express or implied, to use any patented invention or, except as specified above, any proprietary information of GE disclosed herein or any right to publish or make copies of the enclosure without prior written permission of GE. The header of each page in this enclosure carries the notation "GE Proprietary Information."

GE proprietary information is identified by a single underline inside double square brackets. The electronic version includes a red font inside the brackets. For black-grayscale printed copies, the red font and single underline appears similar to normal text. [[This sentence is an example.^{3}]] Slides in which the entire slide is proprietary are identified with double square brackets *before* the slide title only, the slide title in a red font, and the superscript notation included after the slide title. In each case, the superscript notation, e.g., {3}, refers to, in this example, Paragraph (3) of the enclosed affidavit, which provides the basis for the proprietary determination. Specific information that is not so marked is not GE proprietary.

ENCLOSURE 2

MFN 06-122

TEPCO/GE UdFlow System for the Measurement of Nuclear Feedwater Flow Rate by Ultrasonic Doppler Technology

Non-Proprietary Version

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1, which has the proprietary information removed. Portions of the enclosure that have been removed are indicated by an open and closed bracket as shown here [[]]

DRAFT

***TEPCO/GE UdFlow System for the
Measurement of Nuclear Feedwater Flow
Rate by Ultrasonic Doppler Technology***

May 11, 2006

**U.S. Nuclear Regulatory Commission Headquarters
Rockville, Maryland**



Tokyo Electric Power Company, Inc.

Research & Development Center

Thermal Hydraulics & Fluid Structure Dynamics Research Group



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Meeting Objectives

- **Introduce NRC to the TEPCO/GE UdFlow System**
- **Present the reasons for the development of the System**
- **Describe the System hardware**
- **Develop the science behind the System**
- **Discuss the System accuracy validation test results**
- **Detail the future activities and validation test plans**
- **Present LTR structure and content**
- **Solicit guidance from NRC**



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Introduction: The TEPCO / GE UdFlow System

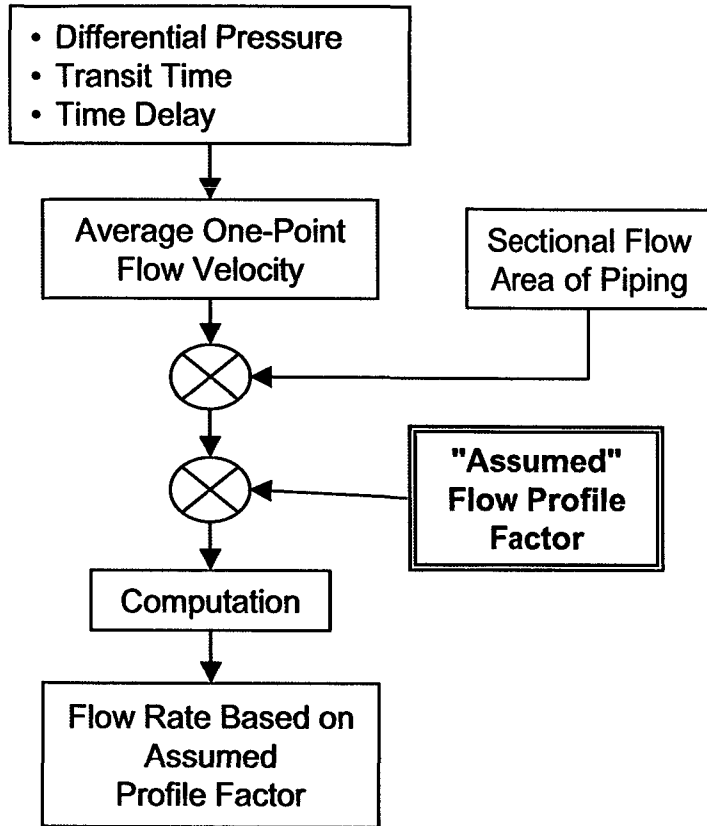
- Feedwater pipe inner surfaces (piping and venturis) become rougher over time, which causes increased inaccuracy in the flow rate measurement.
- Existing ultrasonic flow meters assume a velocity flow profile to calculate feedwater flow rate. The assumed flow profile changes with pipe age.
- TEPCO Research & Development (R&D) has developed an Ultrasonic flow meter [[]].
- TEPCO R&D is collaborating with GE to evaluate, design, test, license, and manufacture this flow meter (the “TEPCO/GE UdFlow System”) [[]].
- [[]]
- GE will be submitting a Licensing Topical Report (LTR) for NRC approval to apply the TEPCO/GE UdFlow System to Measurement Uncertainty Recapture (MUR) power uprates.



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Existing Flow Meters

Flow Meter Algorithm

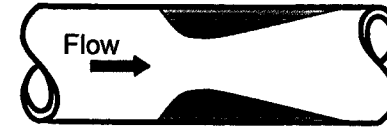


**Flow Rate Based on
"Assumed" Flow Profile**

Existing Flow Meters

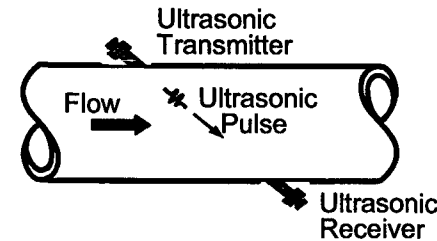
Parameter

- Venturi



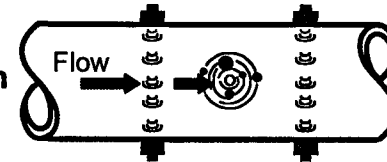
Differential Pressure

- Time of Flight



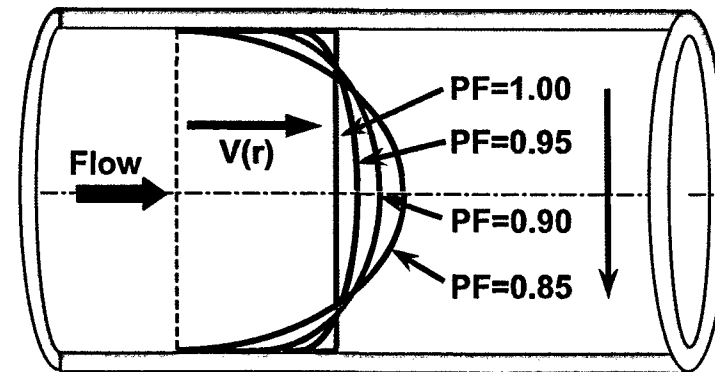
Transit Time

- Cross Correlation



Time Delay

- Flow Profile Factors (PF) are determined by velocity profiles.
- Velocity profile is a function of Reynolds Number and pipe inner surface roughness.



Plant Ages

↓
Inner Surface
Becomes
Rougher

↓
PF Changes
(Lower)

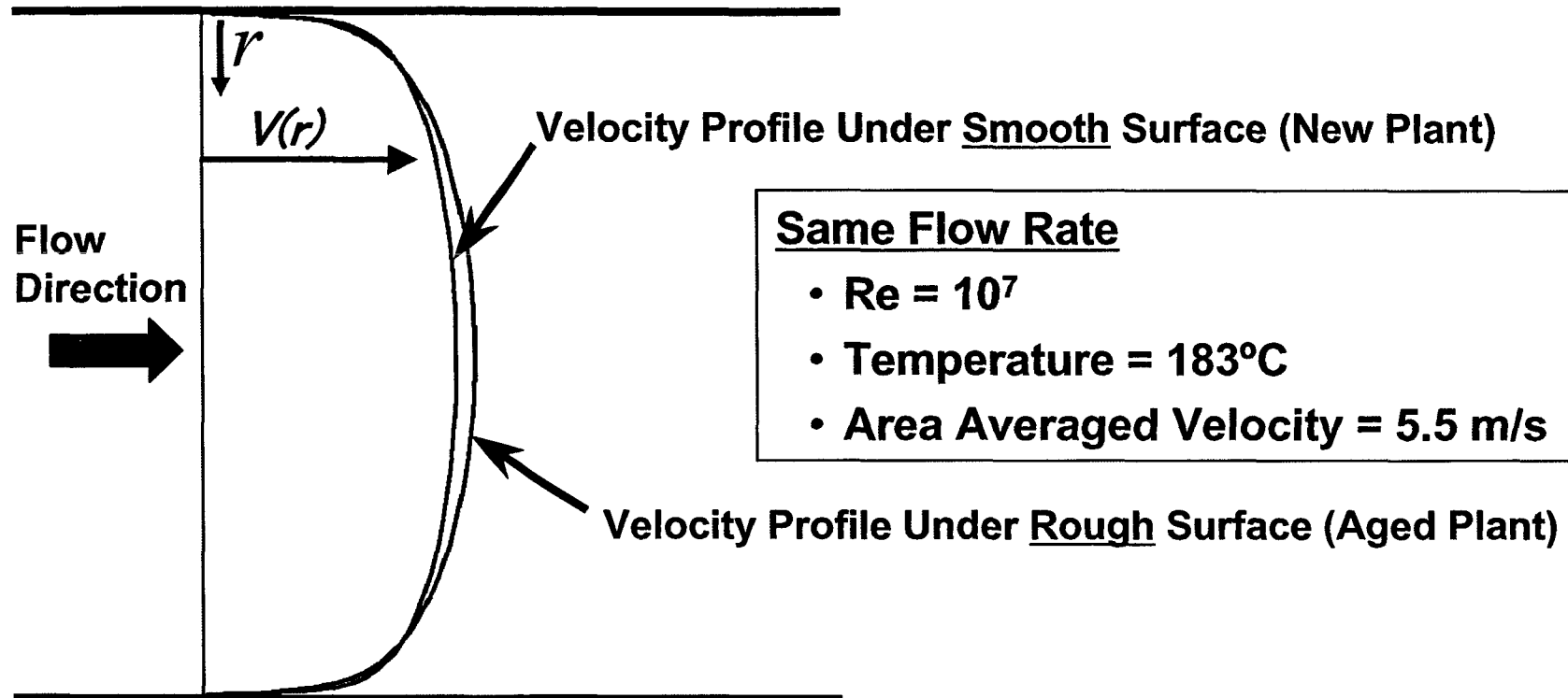


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Profile Factor Effect on Existing Flow Meters



- Different velocity profiles (New Plant and Aged Plant) for the same flow rate, require different profile factors for accurate flow meter measurement
- Impossible to simulate actual (changing) plant conditions during flow meter factory testing of existing flow meters
 - Surface roughness (corrosion)
 - Reynolds Number
 - Pipe configurations (flow disturbance, biased flow)



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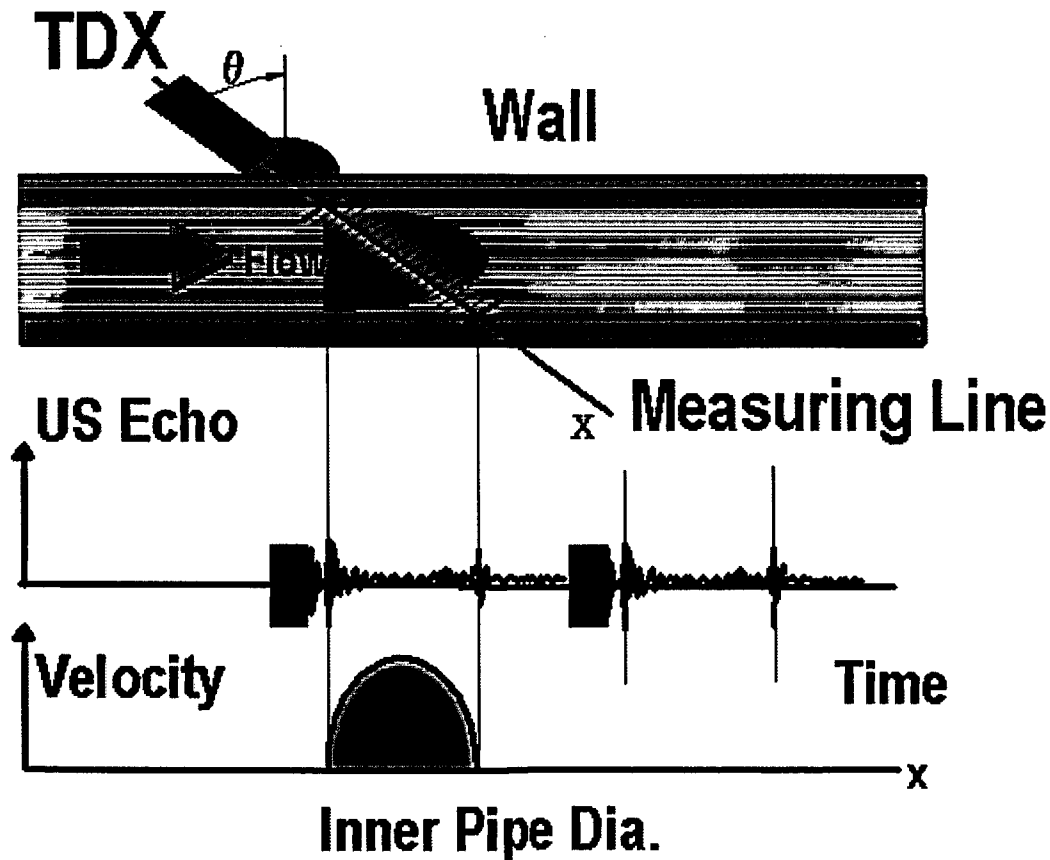
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TEPCO/GE UdFlow System Science



- Pulsed Ultrasonic Echography
- Instantaneous Doppler Shift Frequency

$$x = cT / 2$$

$$v = cf_D / 2f_0$$

x - Distance Traveled

v - Flow Velocity

c - Sound Velocity

f_D - Doppler Frequency

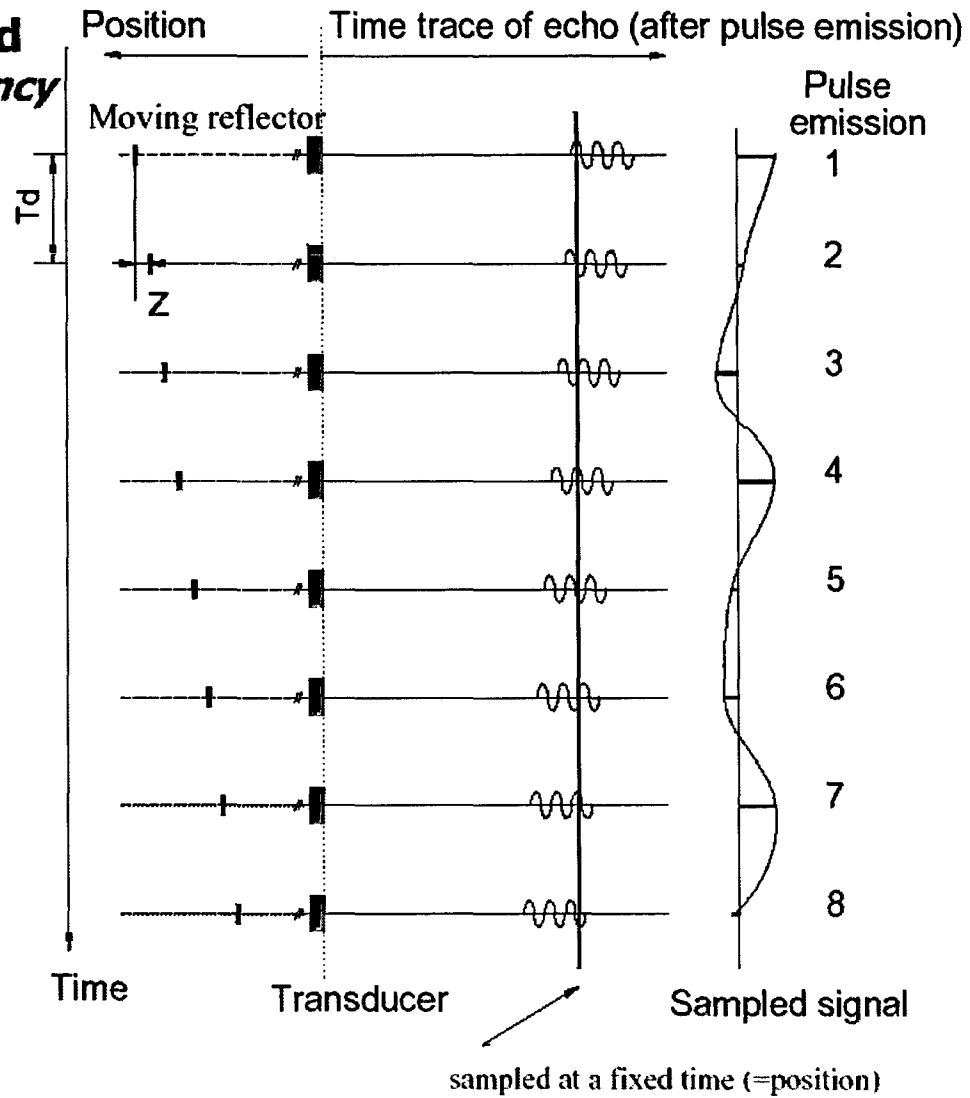
T - Time Between Pulses

f_0 - Basic Frequency



TEPCO/GE UdFlow System Science

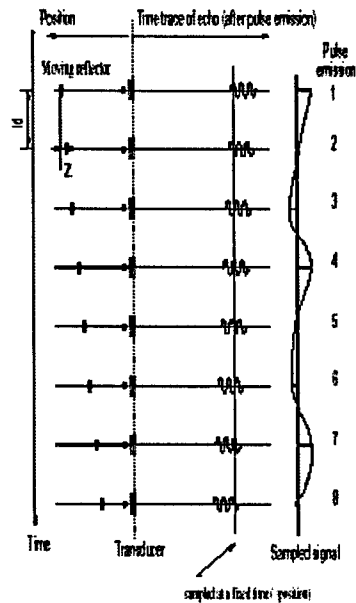
Ultrasonic Doppler Method *Detection of Doppler frequency*



TEPCO/GE UdFlow System Science

Ultrasonic Doppler Method

Detection of Doppler frequency



$$\phi = f_0 T_d$$

$$d\phi/dt = f_0 dT_d/dt$$

$$T_d = 2z/c$$

$$dT_d/dt = (2/c) dz/dt = 2v/c$$

$$d\phi/dt = 2vf_0/c = f_D$$



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TEPCO/GE UdFlow System Science

Ultrasonic Doppler Method

Measurement limitation

- From Nyquist sampling theorem

$$f_{D \max} < f_{\text{prf}}/2 \Rightarrow V_{\max} < c f_{\text{prf}}/4f_0$$

- Maximum depth

$$P_{\max} = c/2f_{\text{prf}}$$

- Measurement constraint

$$V_{\max} P_{\max} < c^2/8f_0$$



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TEPCO/GE UdFlow System Science

Ultrasonic Doppler Method

Characteristics and specifications

- Spatial resolution
 $dx = cT_c/2$
- Velocity resolution
 $dV = c/(2f_0T_{\text{meas}})$
- Maximum depth
 $P_{\text{max}} = c/(2f_{\text{prf}})$
- Maximum velocity
 $V_{\text{max}} = cf_{\text{prf}}/(4f_0)$



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Validation Tests – NIST, Nmi, Nmi - J

- **“Proof-of-Principle” testing was conducted at:**
 - **NIST – U.S. National Institute of Standards and Technology**
 - **Nmi – Nederlands Meetinstituut**
 - **Nmi-J – Japan National Institute of Advanced Industrial Science and Technology**

- **[[**

-

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Validation Tests - CENAM

- **“Statistically significant” testing was conducted at CENAM, Centro Nacional de Metrología, in January 2006.**
- [[
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Validation Tests - Specifics

| Facility | Liquid | Flow Condition | Pressure | Reynolds Number | Temperature |
|----------|--------|-------------------------|-------------------------|-----------------|-------------|
| NIST | Water | Stable, Well-controlled | Atmospheric (pump head) | 4.0E5 to 2.7E6 | Ambient |
| Nmi-J | Water | Stable, Well-controlled | Atmospheric (pump head) | 1.0E6 to 2.0E6 | Ambient |
| Nmi | Water | Stable, Well-controlled | Atmospheric (pump head) | 8.5E4 to 1.8E5 | Ambient |
| [[| | | | |]] |



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Flow Profile Measurement – Nuclear FW Conditions

Test Specification

Thermal-Hydraulic Conditions Similar to Actual BWR Plant

Type of Liquid: Water

Flow Condition: Stable, Controlled

Pressure: 7.6 MPa

Reynolds Number: 1.6×10^7

Temperature: 216 °C

Flow Rate: 3200 t/h

Feedwater Piping

Inner Diameter: 500 mm

Wall Thickness: 28 mm

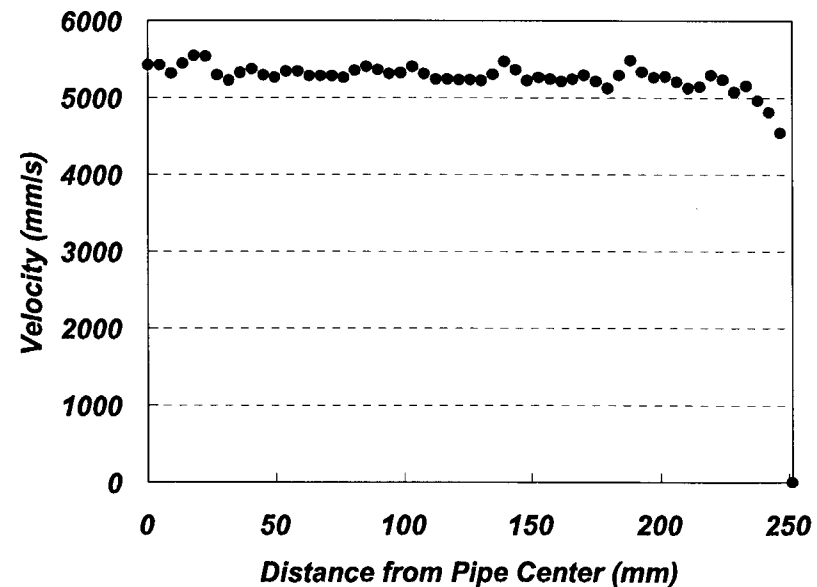
Material: Carbon Steel

Results

- A velocity profile was obtained using a single transducer.
- II

II

Velocity Profile Across the Pipe Cross-Section



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Conclusion

- **A new type of ultrasonic Doppler flow meter has been developed that can**
[[]]
- [[]]
]]
- **By improving feedwater flow rate measurement accuracy, an operating nuclear power plant can apply to NRC for an increase in power output.**
- **To allow the application of this flow meter to an operating nuclear power plant, GE requests US NRC review and approval of GE's LTR, [[]]**



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ENCLOSURE 3

MFN 06-122

Affidavit

General Electric Company

AFFIDAVIT

I, **George B. Stramback**, state as follows:

- (1) I am Manager, Regulatory Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.
- (2) The information sought to be withheld is contained in Enclosure 1 to GE letter MFN 06-122, *TEPCO/GE UdFlow System Pre-Meeting Draft Presentation*, dated May 5, 2006. GE proprietary information is identified by a single underline inside double square brackets. For black-grayscale printed copies, the red font and single underline appears similar to normal text. [[This sentence is an example. ^{3}]] Slides in which the entire slide is proprietary are identified with double square brackets *before* the slide title only, the slide title in a red font, and the superscript notation included after the slide title. In each case, the superscript notation, e.g., {3}, refers to, in this example, Paragraph (3) of the enclosed affidavit, which provides the basis for the proprietary determination.
- (3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).
- (4) Some examples of categories of information which fit into the definition of proprietary information are:
 - a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;
 - b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

- c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;
- d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., (4)b., and (4)d., above.

- (5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.
- (6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.
- (7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.
- (8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed design, testing and application basis criteria and results for feedwater flow instrumentation application to both PWR and BWR nuclear power plants. The development of this feedwater flow instrumentation was achieved at a significant cost to GE, on the order of tens of thousand dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

- (9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

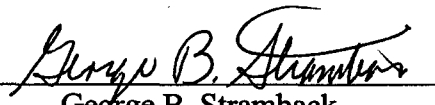
The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 5th day of May 2006.


George B. Stramback
General Electric Company