PDR-016

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

August 13, 1982

Ms. Lynn Connor
P. O. Box 57
Cabin John, Md 20818

IN RESPONSE REFER
TO FOIA-82-324

Dear Ms. Connor:

This is in response to your letter dated July 21, 1982, in which you requested, pursuant to the Freedom of Information Act, two staff papers, which you identified in your letter.

The requested staff papers, SECY 81-582, and SECY 81-629 are being placed in the NRC Public Document Room, 1717 H Street, N.W., Washington, DC. You may obtain access to these documents by presenting a copy of this letter or by requesting folder FOIA-82-324 in your name.

This completes NRC's action on your request.

Sincerely,

J. M. Felton, Director
Division of Rules and Records
Office of Administration

October 7, 1981

SECY-81-582

For: The Commissioners

POLICY ISSUE
(Notation Vote)

From: William J. Dircks, Executive Director for Operations

Subject: TMI Action Plan II.F.2 (NUREG-0737); Additional Instrumentation for Detection of Inadequate Core Cooling

Purpose: To inform the Commission of the staff's current position on the placement of thermocouples to monitor core cooling conditions for BWRs and to provide a status report and recommendations concerning the implementation schedule for reactor vessel level instrumentation for PWRs.

Background: BWR Core Thermocouples

Regulatory Guide 1.97, revised in accord with the TMI Action Plan, states that thermocouples should be installed in BWRs to monitor the cooling conditions in the reactor core. The ACRS, in August 1981 letters reporting on the review of the Fermi and Susquehanna reactors, recommended that the location of such thermocouples be reevaluated. The staff agrees and describes its approach for doing that, below.

PWR Reactor Vessel Water Level System

Item II.F.2 of NUREG-0737 and the TMI Action Plan require implementation of reactor vessel level instrumentation in PWRs. The ACRS has expressed concern about the schedule required for implementation of this requirement being too tight. We have assessed the progress of industry in development and installation of these systems and recommend that the existing implementation date of January 1982 be replaced. The earliest practical date by which these systems could be installed, calibrated, and operable at all operating PWRs is the first refueling after January 1, 1983, for reasons discussed below.

Discussion: Status of BWR Core Thermocouples

The ACRS supported use of core thermocouples in BWRs in its letter of November 10, 1980 to the NRC Executive Director for Operations, but called attention to the need for further study to determine the appropriate vertical location of such thermocouples. In the August 11, 1981 ACRS letters (reporting on Fermi 2 and

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Susquehanna reviews) from ACRS Chairman J. C. Mark to NRC Chairman N. J. Palladino, the ACRS recommended that further study be given to placement of a small number of thermocouples in a more accessible location. Regulatory Guide 1.97 Revision 2, provides for inclusion of a minimum of four thermocouples in each BWR core quadrant but does not further specify the location of such thermocouples.

The staff did study the placement of thermocouples in BWRs in the process of formulating the requirements in Regulatory Guide 1.97. Our study included our own calculations and those of consultants in addition to a review of General Electric Company studies and recommendations on the subject. We concluded that inclusion of core thermocouples, one in each of several Local Power Range Monitor (LPRM) assemblies, would provide operationally useful data about core cooling when the ECCS core spray is degraded. We also concluded that the vertical location of the thermocouples in the LPRM assemblies was not critical and that the location in LPRM assemblies used by GE in its analyses was the most practical. Our evaluation is reported in the LaSalle SSER (NUREG-0519) and was called to the attention of ACRS in a memorandum from H. Denton to Chairman Mark (Enclosure 1) and in staff presentations during the ACRS review of Fermi 2. However, we have no reason to disagree with the ACRS conclusion that placement of the thermocouples at another location may prove to be more practical and just as useful for accident diagnosis. Therefore, in response to the ACRS recommendation for a reevaluation, we have prepared a letter for BWR applicants and licensees (Enclosure 2) requesting that they perform a study to confirm the most suitable location for thermocouples for their facility. We will encourage and expect to receive generic responses, perhaps for the various classes of BWRS. We do not expect this to affect the June 1983 implementation date of Regulatory Guide 1.97.

Although this approach will be responsive to the stated concern of the ACRS, it will not completely resolve all controversy surrounding these thermocouples. The BWR owners are expected to again appeal the need for the thermocouples to the ACRS in the near future.

Status of Reactor Vessel Water Level Measurement Systems for PWRs

The purpose of a reactor water level measurement system is to provide the reactor operator with instrumentation to directly monitor water level in the reactor vessel and thereby the adequacy of core cooling so that he

may implement actions to correct or avoid conditions of inadequate core cooling. Instrumentation presently available in PWRs does not provide an unambiguous indication of availability of cooling capacity for the core. At this time, additional instrumentation proposed by applicants and licensees includes three types of water level measurement (Enclosure 3): (a) Westinghouse Reactor Vessel Level Instrumentation System (RVLIS), (b) Combustion Engineering Heated Junction Thermocouple (HJTC) system, and (c) National Nuclear Corporation (NNC)/EPRI Neutron Detector system. In addition, a modified differential pressure (dp) system which includes hot leg dp measurement to the top of the candy cane is under study by some B&W reactor applicants and licensees. It is expected that the details of such a system will be submitted for review soon by B&W or one of the B&W reactor owners.

Westinghouse dp System

The Westinghouse RVLIS utilizes two sets of three dp cells. These cells measure the pressure drop from the bottom of the reactor vessel to the top of the vessel, and from the hot legs to the top of the vessel. This dp measuring system utilizes cells of differing ranges to monitor different flow behaviors with and without pump operation. The dp signal is processed and converted into the reactor water level. When the reactor coolant pumps are not operating, the RVLIS reading will be indicated on the narrow range scale ranging from zero to the height of the vessel. This reading represents the equivalent collapsed liquid level in the vessel. When the reactor coolant pumps are operating, the RVLIS reading will be indicated on the wide range scale. With the pumps running the RVLIS reading is an indication of the void fraction of the vessel water and steam mixture. Upper range RVLIS is used for head venting operations during long term recovery.

The Westinghouse summary report, "Westinghouse RVLIS for Monitoring Inadequate Core Cooling (ICC) (7300 System), (UHI Plant), and (Microprocessor System)" was submitted in December 1980 and is under staff review. The review includes results from a test program being performed at the Semiscale facility in Idaho. Our review and the test program are consistent with the original plan (Enclosure 4) but are approximately one month behind at this time. We expect to complete our generic evaluation, except for the analysis of the final performance test, by the end of 1981.

The Westinghouse dp system has been selected by licensees for use in eighteen reactors. We are told that twelve of these reactors will have the system installed prior to the current January 1, 1982 deadline in NUREG-0737. The systems for Zion Units 1 and 2 are already installed. Most of the operating license applicants who have selected the Westinghouse system expect to complete installation prior to power operation (Summer 1, McGuire 1 and Diablo Canyon). Licensees have requested that installation be delayed until the first refueling outage for Sequoyah Units 1 and 2, North Anna 1 and 2, and Salem 2.

The staff concludes that those plants which have committed to install the Westinghouse dp system are substantially in compliance with the NUREG-0737 provided that major technical problems are not encountered in proof tests of the system that affect its generic approval. One problem attributed to an atypicality in the Semiscale test model has been encountered and is expected to be resolved by a final performance test to be performed in mid-November. Evaluation of this additional test will delay the generic SER until January 1982. In addition, a LOCA survivability test to evaluate the instrument performance after it has been subjected to large break blowdown conditions will be performed in February 1982. However, this test is confirmatory in nature since the objective is to assure a correct interpretation of the instrument readout after such an event, and not necessarily to require continued operability as a design basis. The results of the large break LOCA survivability tests and conclusions on the post-LOCA interpretation of level instrumentation will be reported in conjunction with our review of calibration test data obtained from plant specific reviews.

In summary, installation of Westinghouse dp systems are expected to be completed on schedules ranging from the present to the first refueling after January 1, 1982. We believe that our generic review of the system will be substantially complete by the end of 1981 and that approval of plant specific installations for incorporation into plant operating procedures can be completed on schedules ranging from mid-1982 to mid-1983, depending on the submittal schedules for final system descriptions and calibration data from individual plants.

Combustion Engi..eering HJTC System

The HJTC system measures reactor coolant liquid inventory with discrete HJTC sensors located at different levels within a separator tube ranging from the top of the core to the reactor vessel head. The basic principle of system operation is the detection of a temperature difference between adjacent heated and unheated thermocouples. In a fluid with relatively good heat transfer properties (e.g., water), the temperature difference between the adjacent thermocouples is very small. In a fluid with relatively poor heat transfer properties (e.g., steam), the temperature difference between the thermocouples is large. The separator tube provides for a steam-water interface at the collapsed liquid level and thermocouples at discrete axial levels within the tube indicate the presence of water at the measurement level.

The description of the Combustion Engineering (CE) HJTC system has been documented by individual users and is currently under staff review. We have been in communication with CE and with the CE Owners' Group in an effort to conduct the review generically. The review of the initial submittal on the docket for San Onofre Units 2 and 3 (Amendment 23, February 1981, Docket Numbers 50-361/362) is one to two months behind the review schedule originally projected (Enclosure 4). However, functional performance test data on the system have not yet been submitted even though the tests have been run and the vendor claims good results. Performance tests on the production probe should be complete by the end of the year. On this basis, we estimate that generic approval of the system can be completed near the end of the first quarter of 1982.

The installation of a HJTC system requires modification of incore instrument flange assemblies, containment penetration assemblies, and mineral insulated cabling. For San Onofre, which is the lead plant using the HJTC system, the required plant modifications can not be completed prior to mid-1982, even though the HJTC probe assembly can be delivered during the first quarter, 1982 (Enclosure 5). Southern California Edison has requested that the installation of the system be delayed until the first quarter, 1983, during its first refueling shutdown.

Those plants that have selected the HJTC system (there are eight in total and several ordered the system as early as one year ago) cannot physically complete installation before the latter part of 1982, even though the probe assemblies may be available early in the year. Therefore, plants committed to the CE system are not able to meet the current NUREG-0737 implementation schedule. We believe that all plants committed to this system will be able to complete installation on a schedule consistent with San Onofre, i.e., first refueling after January 1, 1983. Staff review of individual installations and calibration data and approval for incorporation into emergency procedures will probably extend to mid-1984, depending on individual submittal schedules.

NNC/EPRI Neutron Detection System

The principle used is the detection of photoneutrons from the reactor coolant system. The ratio of the count rates from two sets of detectors (one set above and the other below the reactor vessel) provides an indication of reactor water level.

This system was proposed by Alabama Power Company for interim use and developmental testing on Farley Units 1 and 2. Documentation of early experience with the system was provided in July 1981 and is currently under staff review. We have requested that additional information be provided by October 1. The system is still in the research and development stage and we are not optimistic that it will gain our approval. The licensee projects that the system could become operable by mid-1983. If the prospects for this system are not more favorable by early 1982, we will urge the licensee to select another system.

Vessel Level Systems to be Proposed

A vessel level system based on differential pressure measurements is currently being evaluated by B&W and B&W Owners. We estimate that 1½ to 2 years would be required to complete the design evaluation, procurement, and installation of such a system after completion of preliminary design. Progress by licensees and OL applicants with B&W reactors has been uniformly poor. The staff will not license a B&W reactor that does not show reasonable progress in this area. We have taken a consistent position with TMI-1 for approval of restart.

In view of the good progress being made by others, we believe it is justified to require that B&W owners have their systems installed and operable before restart following the first refueling outage after January 1, 1983. However, somewhat later dates may be acceptable, as described in the Recommendation, below.

Recommendation: It is recommended that the Commission allow the staff to delay the implementation schedule for PWR applicants and licensees for installation of the vessel level measurement system. In the next two weeks, NRR will describe an approach for renegotiating practical implementation schedules for NUREG-0737 requirements for all operating reactors. If the Commission endorses that approach, then this requirement for vessel level indicators in PWRs would be decided on a case by case basis. The decision for each plant would be made in conjunction with decisions on the other TMI work remaining to be done on that plant and in full view of the equipment procurement and installation constraints described above. As a general matter, we would expect the result to be that most of the level measurement systems would be installed before startup following the first refueling after January 1, 1983.

William J. Dircks
Executive Director for Operations

Enclosures:
1. Memo for Chairman Mark fm H. Denton, "Installation of Core Thermocouples in LaSalle."
2. Draft ltr to BWR Applicants & Licensees.
3. Information Report for Commissioners from W. J. Dircks, SECY-80-529.
4. Staff Review Schedule for NUREG-0737 Section II.F.2.
5. Figure 8-1 Earliest Possible ICC Installation Schedule - Songs 2.

Commissioners' comments should be provided directly to the Office of the Secretary by c.o.b. Thursday, October 22, 1981.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT October 15, 1981, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE 1

NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE 1

JUL 14 1981

MEMORANDUM FOR: J. Carson Mark, Chairman, ACRS

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: INSTALLATION OF CORE THERMOCOUPLES IN LaSALLE

In your letter of April 16 to Chairman Hendrie regarding LaSalle County Station Units 1 and 2, the Committee recommended that a study of the feasibility of the use of core outlet or core subassembly thermocouples be completed prior to reaching a decision on the requirement for the LaSalle plant.

This is to call to your attention Section 18, item (3) of the LaSalle SER Supplement No. 1, NUREG-0519, where we described the staff's study. In addition, our report in response to the Committee's recommendation is included in Section 22, Item II.F.2, of the same document. The staff concluded that the use of incore thermocouples in BWRs to provide diverse indication of water level and to monitor core cooling is feasible. We are requiring LaSalle and all other BWR's to incorporate thermocouples into the ICC monitoring system prior to June 1983 in accordance with Regulatory Guide 1.97.

In a related matter, your letter of June 9 to Mr. Dircks requested an early meeting of the staff with ACRS to discuss issues relating to Section II.F.2 of NUREG-0737. We expect to have that meeting in September. If the Committee has questions concerning our LaSalle report or our intent with other BWRs in this area, the staff will be prepared to discuss them at that meeting.

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

ENCLOSURE 2

D R A F T

ENCLOSURE 2

LETTER TO BWR APPLICANTS AND LICENSEES

As you know, the staff has stated its intention to condition operating licenses for BWRs to require inclusion of thermocouples in the core. Our evaluation of the placement of the core thermocouples is discussed in the LaSalle SSER (NUREG-0519) which concluded that location of one thermocouple in each of several LPRM assemblies (four per core quadrant) was a feasible and acceptable approach. Based on the GE BWR Owners' Group appeal of this requirement in the August 6 ACRS review meeting on Fermi 2, the ACRS recommended that further study be given to placement of a small number of thermocouples in a more accessible location. We request that you perform such a study and confirm that the LPRM assemblies are the most suitable location or propose an alternate location and/or number of thermocouples to monitor inadequate core cooling. If an alternative is proposed, provide an evaluation of the advantages and disadvantages of the recommended installation in terms of relative effectiveness to monitor the approach and existence of inadequate core cooling and in terms of the installation and maintenance costs in dollars and occupational doses, including how these costs may be a function of the required installation date now specified as June 1983 in Regulatory Guide 1.97.

ENCLOSURE 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 4, 1980 — SECY-80-529 — ENCLOSURE 3

INFORMATION REPORT

FOR: The Commissioners

FROM: William J. Dircks, Executive Director for Operations

SUBJECT: TMI ACTION PLAN - II.F.2; ADDITIONAL INSTRUMENTATION FOR MEASUREMENT OF COOLANT LEVEL IN REACTOR VESSEL

PURPOSE: To provide the Commission with an information paper on the status of the technology for measuring reactor vessel water level.

BACKGROUND: During the October 28, 1980 Commission meeting regarding clarification of TMI Action Plan requirements, the staff informed the Commission that it would provide an information paper that would discuss the status of the technology for measuring reactor vessel water level and provide a basis for its recommended implementation schedule. The attached document is provided in response to that commitment.

DISCUSSION: The status of Instrumentation for Detection of Inadequate Core Cooling (ICC) was discussed at the LOFT/UTILITY Technology Transfer Meeting (LOFT Meeting) on October 16 and 17, 1980 at Idaho Falls, Idaho. Presentations were made by NRC (NRR and RES), INEL, ORNL, Westinghouse, CE, EPRI and DAVCO covering the NRC requirements and research program, the state of the art and current industry programs. A discussion following the session was conducted among the utilities, instrument suppliers, reactor vendors, and NRC. The main concerns discussed at this meeting were:

- Requirements of the TMI Action Plan Task II.F.2
- Status of Current Industry Planning
- NRC research coordination
- NRC plan and action

The enclosure to this paper provides details. The principal concern expressed is that there has not been sufficient systems-level testing to demonstrate the acceptability of any device proposed to measure vessel level, and that the required implementation date of January 1, 1982 is thus in some jeopardy.

Contact: T. Huang, NRR, 49-29420
L. Phillips, NRR, 49-27140

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PDR/LPDR

The staff believes that further delay of the required implementation of level measurement systems beyond January 1, 1982 would result in slower progress and may or may not result in better level measurement systems which would further enhance plant safety.

We therefore believe that the current schedule requirements (January 1, 1981 for selection and documentation of the measurement system and January 1, 1982 for installation) should be maintained. However, we also believe that some flexibility should be maintained to permit development of improved systems where the specific documentation submittals include or subscribe to a viable development and testing plan to prove the concept selected on reasonable schedule.

William J. Dircks
Executive Director for Operations

Enclosure:
As stated

ENCLOSURE

THE CONCERN OF TMI ACTION PLAN II.F.2

TO DETERMINE A LOGICAL IMPLEMENTATION DATE

FOR REACTOR VESSEL LEVEL INSTRUMENTATION

1. NRC Requirements

Before TMI, NRC had no requirements for instrumentation for detection of inadequate core cooling. Following the TMI accident, the Lessons Learned Task Force (NUREG-0578) and the Office of Nuclear Reactor Regulation (the 1979 clarification letters) have established requirements for the instrumentation for detection of inadequate core cooling. As stated in NUREG-0578, Category A items shall be implemented pr or to January 1, 1980, and Category B items prior to January 1, 1981. (Category A: develop procedures and describe existing instrumentation; new instrument design, subcooling meter installation, and implementation schedule. Category B: complete new instrument installation.) This implementation schedule was described in the October 1979 letter from H. R. Denton (NRC) to All Operating Nuclear Power Plants and confirmed in NUREG-0660, "NRC Action Plan." Consistent implementation schedules for NTOLs are required by NUREG-0694, "TMI-Related Requirements for New Operating Licenses." However, based upon the staff's review of state-of-the-art, design progress, and the equipment procurement situation, the staff has recently proposed that the implementation schedule for reactor vessel level Category B requirements be rescheduled to January 1, 1982 and the documentation required for Category B should be reported by the licensee by January 1, 1981. This latest implementation schedule was described in a clarification letter dated October 31, 1980 to all Licensees of Operating Plants and Applicants for Operating Licenses and Holders of Construction Permits. As indicated by the following discussion, even the revised schedule is in jeopardy.

2. Status of Current Industry Planning

Four types of systems for detection of Inadequate Core Cooling (ICC) were described in the LOFT/UTILITY Technology Transfer Meeting. The instrumentation described included the Westinghouse Differential Pressure Measurement of Reactor Vessel Water Level (Figure 1), the CE Heated Junction Thermocouple System (HJTC) (Figure 2), the EPRI sponsored Noninvasive Water Level Measurement Technique (Neutron Detectors) (Figure 3), and the DAVCO Microwave Liquid Level Gauge for A High Radiation Environment (Figure 4). Among those four systems three (excluding the DAVCO system which is under development) have been currently proposed by utilites for use to meet NRC requirements. The DAVCO Microwave Liquid Level Gauge was demonstrated in the presentation and aroused considerable interest from the utilities, the research community and the NRC. However, it still needs an extensive research and development effort before it could be installed in an operating reactor.

Based on the presentation in the meeting, it appears that each of the industry proposed systems has inherent advantages and disadvantages. However, none of the proposed systems has been demonstrated to be reliable under various simulated accident conditions which could challenge the validity of the measurements.

It should be noted that some utilities, mostly B&W owners, are taking the position that no additional ICC instrumentation is needed based on their analyses. They rely primarily on the subcooling monitor to detect the advent of ICC and on core exit thermocouples and hot leg RTDs to detect the near advent and existence of ICC. They contend that existing level measurement methods do not meet all of the NRC design requirements. The staff has indicated in correspondence to B&W owner utilities (letter from D. Eisenhut dated September 29, 1980) that this position is unacceptable to the staff. The early warning of the subcooling meter is ambiguous (not necessarily loss of coolant); a reliable level measurement system would enhance detection of the advent of ICC and provide prompt indication of the effectiveness of measures to prevent or recover from the condition.

3. NRC Research Coordination

Both INEL and ORNL presented the status of development of instrumentation for detection of ICC during the LOFT Meeting. They have investigated the use of absolute temperature type thermocouples, heated junction type thermocouples, a torsional ultrasonic level probe, etc. (see Table 1) and have performed an analysis of the methods consicered achievable for detection of ICC. The data obtained from these RES research programs are promising; however, the instrumentation systems need further development and testing to support design for installation in commercial reactors. NRC/DOE research facilities which can be made available for such testing include THTF, SEMISCALE, and LOFT. LOFT is an especially appropriate test bed for final integral testing since it is a PWR with most of the test relevant characteristics of a commercial PWR, but includes extensive instrumentation systems not available on a commercial PWR. The instrumentation relevant to ICC monitoring includes thermocouples at discrete levels above and within the core (including fuel clad thermocouples), a conductivity probe for level monitoring, and gamma densitometers to indicate coolant quality conditions in the coolant piping.

The objectives of power plant instrumentation research sponsored by RES are (1) to provide proof of principle for selected conceptual designs, (2) to provide confirmatory test data on specific commercial designs, (3) to extend the instrumentation technology where appropriate, and (4) to provide a technology transfer from research programs. The research is to provide developmental data relating to functional capability; the qualification testing of systems and components must be performed by the industry.

In response to the TMI Task Action Plans I.D.5 and II.F.2, RES has been conducting work on possible liquid level measuring concepts. In order to advance NRC licensing requirements, the facilities for reactor safety research such as LOFT, SEMISCALE, THTF and advanced instrumentation test facility, etc. will be used, under NRC research coordination, to test industry supplied prototype systems which are being considered for installation in operating reactors.

The vendors and RES will meet and establish tests needed for the industry proposed systems at various test facilities. In some instances where the testing schedule at NRC/DOE facilities does not support product development on a schedule consistent with the January 1, 1982 installation requirement, the supplier is planning to perform essential development testing at industry facilities. Later testing at NRC/DOE facilities would then be confirmatory in nature. The status of proposed test plans follows:

(1) The Westinghouse Reactor Vessel Level Instrumentation System (RVLIS) is being installed in the SEMISCALE facility. Data will be taken during the upcoming test program planned for the last quarter of CY 1980, and the testing is expected to be continued until the end of fiscal year 1981.

(2) The CE Reactor Vessel Level Monitoring System (RVLMS) is in the final design stage; however, CE's prototype has been tested in THTF at ORNL. An additional test program at CE facilities is in progress. Installation of the CE system for testing in either the SEMISCALE or in the LOFT facility is being negotiated between RES and CE. The first test may occur early in 1981 and the program possibly concluded by the end of fiscal year 1981.

(3) The EPRI sponsored NNC Neutron Detector (which is being installed for testing in Farley 1 & 2) is being installed in the LOFT facility. Installation is expected to be completed in time for the L3-6 test in mid-December 1980, which includes partial core uncovery. Testing is expected to be completed by the end of FY 81.

(4) The DAVCO Microwave Liquid Level Gauge is still in the development stage. It has to be subjected to proof of principle testing in separate effects facilities, such as autoclaves, prior to an integral test in the LOFT or other facility. To go through a prerequisite series of tests will take approximately six months to one year. DAVCO has provided window materials to NRC for materials testing which is now in progress. The prototype could then be installed in integral test facilities for tests which may be concluded by the end of the fiscal year 1982. Potential industry sponsors of this system indicate that an effort will be made to complete the development at an earlier date.

(5) The torsional ultrasonic probe (Figure 5) is still in the research and development state and has no commercial sponsors. However, the probe is available and can be tested and improved. The test may be performed in the early part of 1981 and could be concluded by the end of the fiscal year 1981.

4. NRC Plan and Action

None of the instrumentation systems proposed by the industry to date have been tested under simulated reactor operating conditions to substantiate functional reliability and accuracy.

The utility representatives who attended the LOFT meeting have requested that the II.F.2 implementation dates be extended to allow completion of instrument development programs before a system must be selected for procurement. They have expressed the concern that systems procured prior to the completion of development and testing may prove to be unacceptable to NRC, and would result in unnecessary expense.

The staff is of the opinion that existing technology provides reasonable confidence that a DP measurement system, comparable to the Westinghouse system, can enhance the quality of ICC monitoring systems. Additional analyses and testing of existing systems are required to identify any situations where erroneous measurements may be indicated and to provide for data processing which identifies and negates or alarms such erroneous indications if they should occur. Also, the staff may need to reconsider the advisability of some requirements (e.g., level measurement with pumps running) based on the analyses and test results.

We believe that heated thermocouple systems and absolute temperature type thermocouple systems monitoring deviation from saturation at discrete axial locations can be provided with only slightly less confidence in their ultimate acceptability. Other systems promise potential advantage in simplicity and possibly in reliability but have greater risks with respect to development schedule and ultimate acceptability.

The staff believes that further delay of the required implementation of level measurement systems beyond January 1, 1982 would result in slower progress and may or may not result in better level measurement systems which would further enhance plant safety.

We therefore believe that the current schedule requirements (January 1, 1981 for selection and documentation of the measurement system and January 1, 1982 for installation) should be maintained. However, we also believe that some flexibility should be maintained to permit development of improved systems where the specific documentation submittals include or subscribe to a viable development and testing plan to prove the concept selected on reasonable schedule.

The burden to arrange for appropriate test programs and to provide the selected systems for testing will be on the industry. NRC will cooperate by making NRC/DOE facilities available for testing and by evaluating the acceptability of some instrumentation concepts by the end of CY 81.

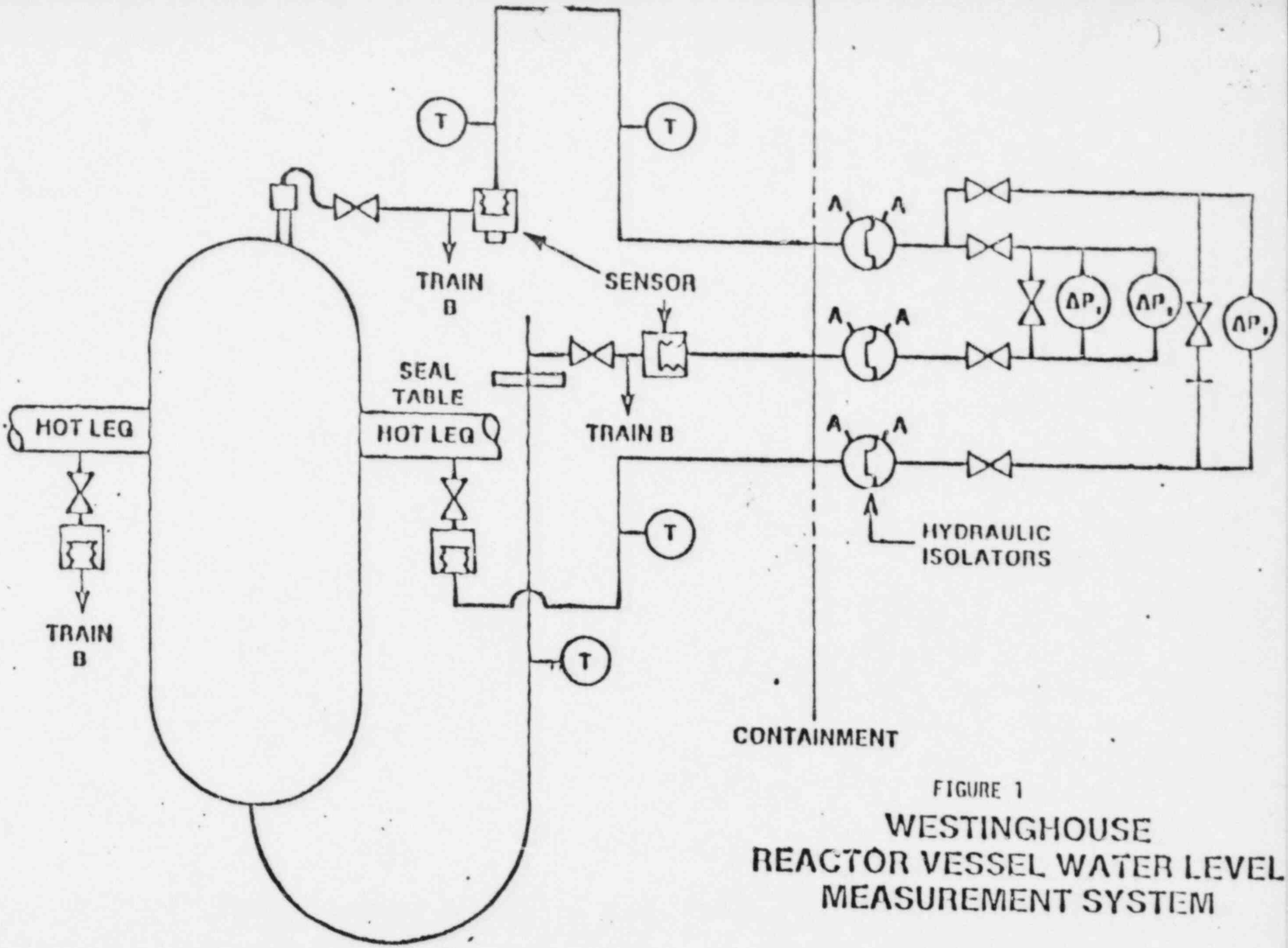


FIGURE 1

WESTINGHOUSE
REACTOR VESSEL WATER LEVEL
MEASUREMENT SYSTEM

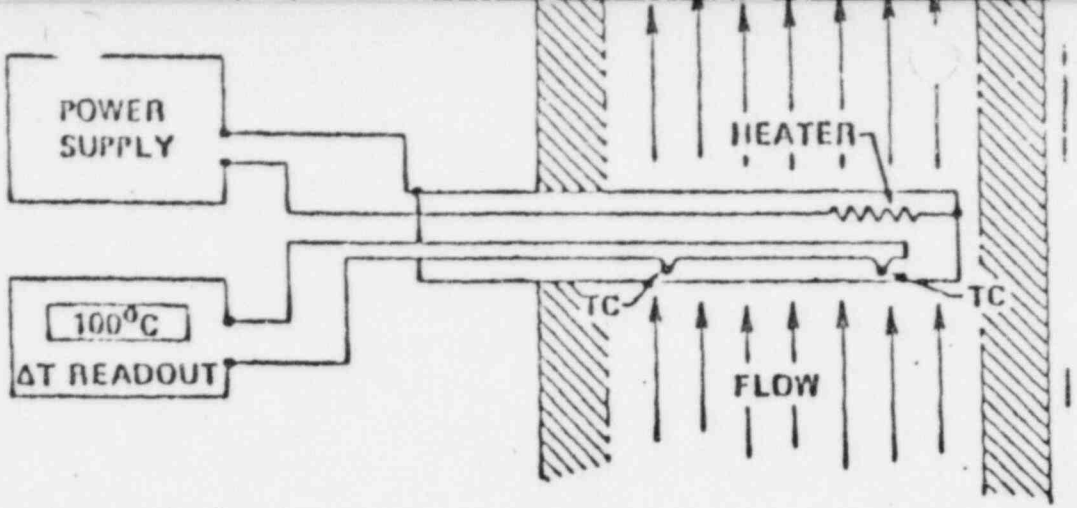
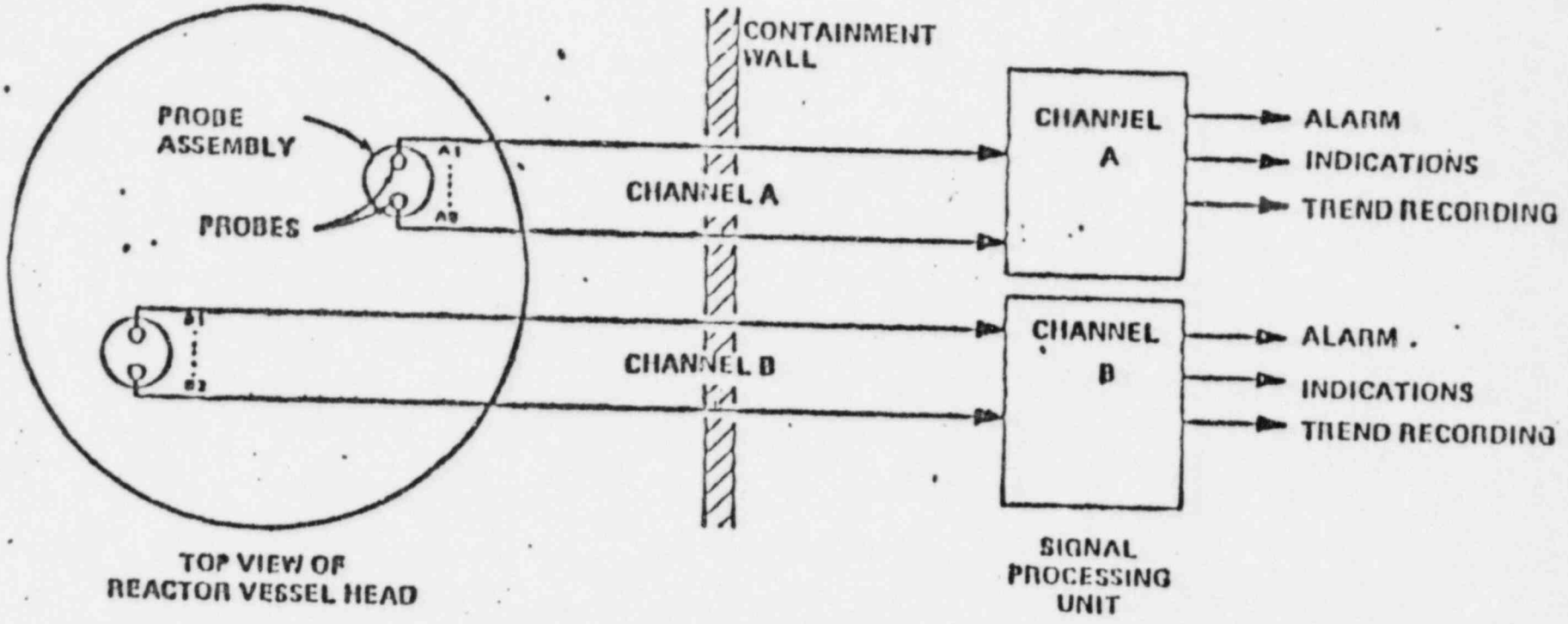


FIGURE 2

CE HEATED JUNCTION THERMOCOUPLE



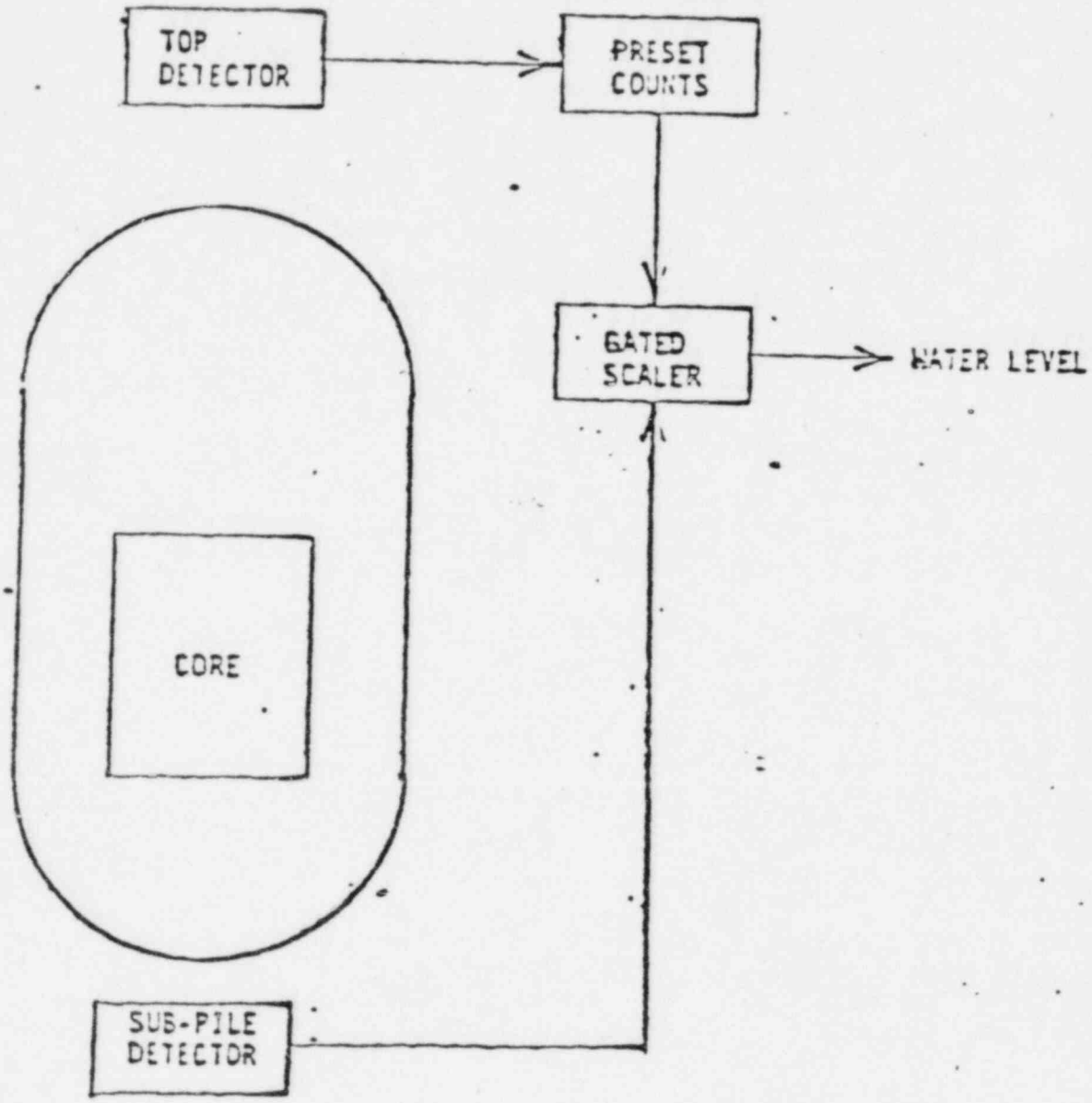
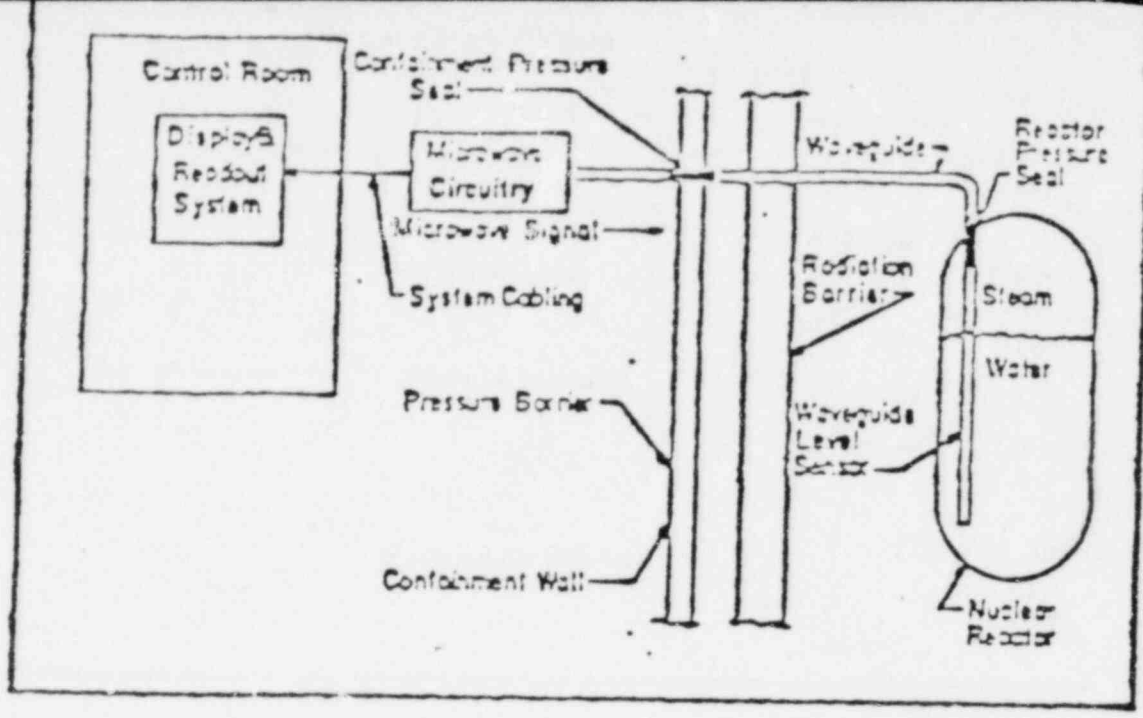


FIGURE 3

NNC NEUTRON DETECTOR
SIMPLIFIED DIAGRAM OF
SYSTEM TO MEASURE
WATER LEVEL IN SHUTDOWN REACTOR
(AMPLIFIERS AND POWER
SUPPLIES NOT SHOWN)

(a)



(b)

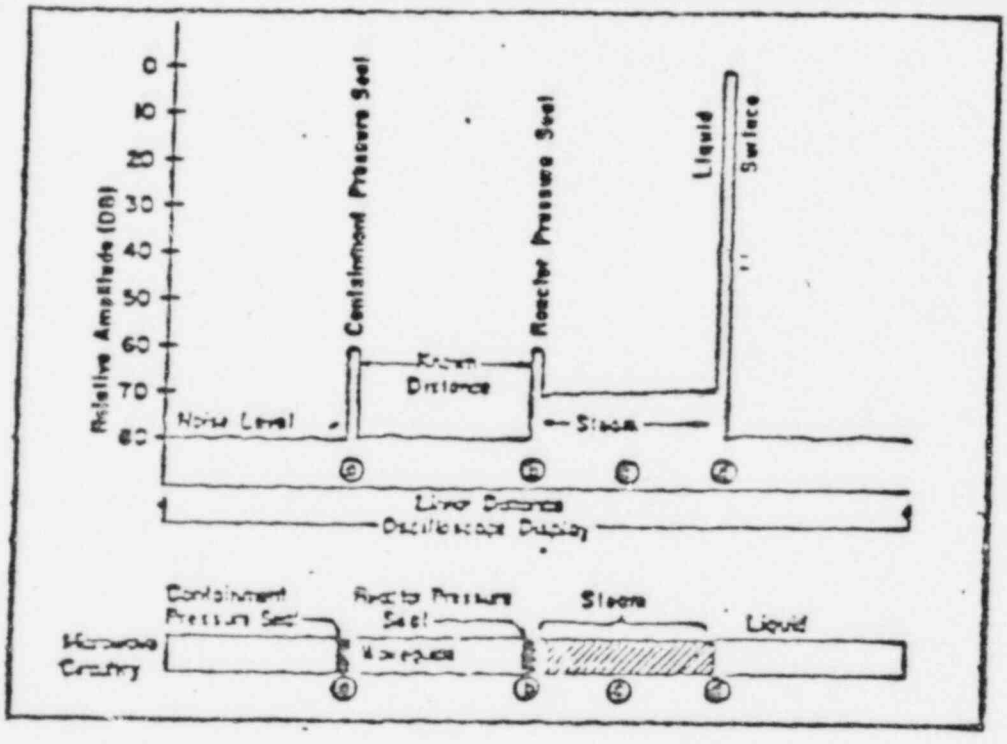
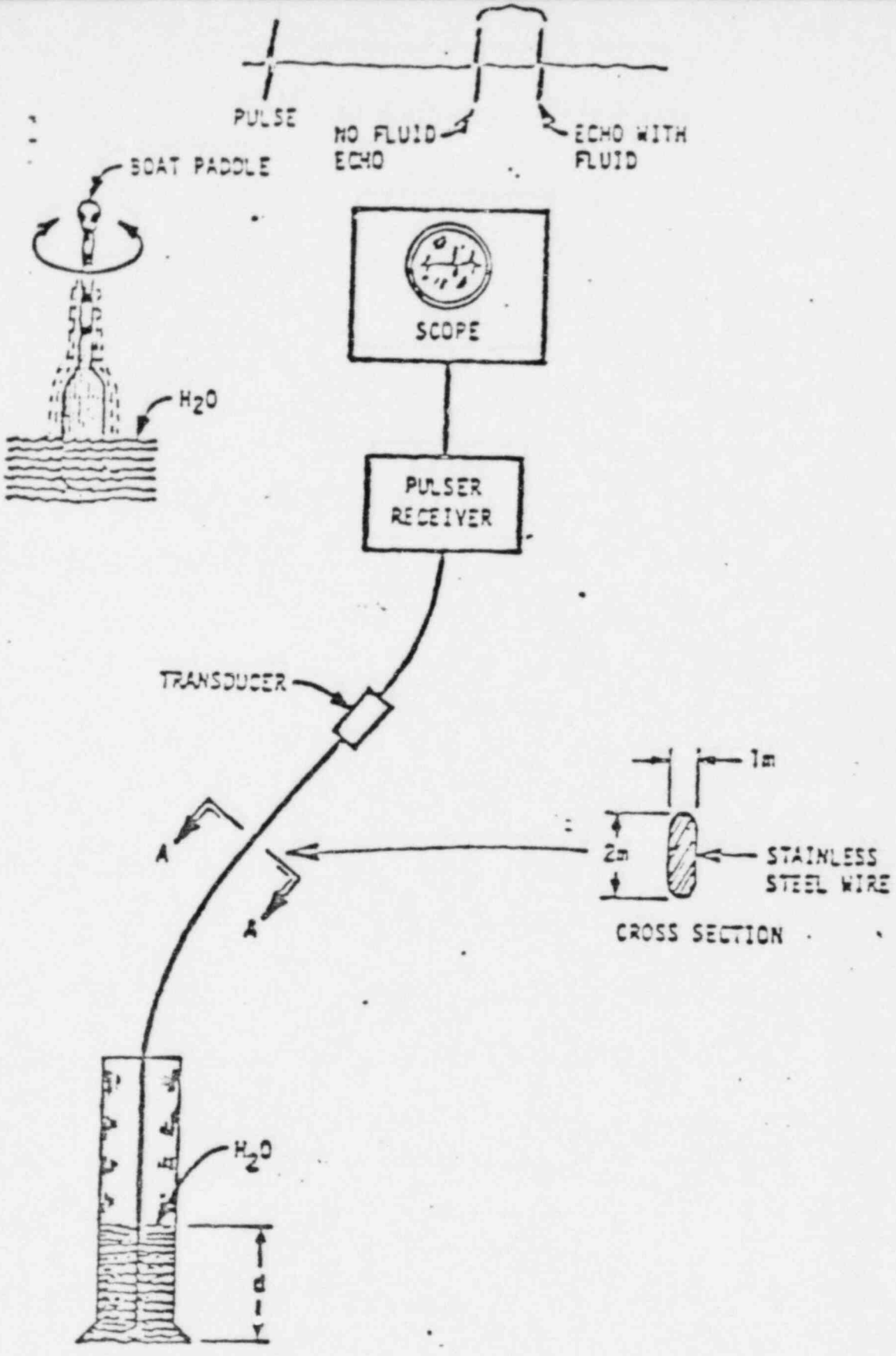


FIGURE 4

DAVCO MICROWAVE LIQUID LEVEL GAUGE
FOR USE IN A
HIGH RADIATION ENVIRONMENT



TORSIONAL PULSE ON FLATTENED WIRE IS DELAYED BY DENSE MEDIUM MUCH LIKE A BOAT PADDLE IN WATER.

FIGURE 5 TORSIONAL ULTRASONIC PROBE CONCEPT

TABLE 1

REACTOR VESSEL WATER LEVEL DETECTOR

System	Supplier	Status	Problems	Test Dates	Special Features
Heated Junction T/C (Differential Temp. Type)	ORNL	Some testing performed on prototype units	Droplet effects; Need droplet shield	Semiscale late 1980 Possible LOFT to be scheduled	Indicates wet or dry surface reflecting the heat removal capability of the coolant quality existing at discrete axial levels
Heated T/C (Absolute Temp. Type)	INEL	New prototype; Need further evaluation	No commercial development	ORNL late 1980	
Heated Junction T/C (RVLMS)	CE	Conceptual design similar to ORNL's HJTC	Suitable for level detection above core only	Under development & test at CE Semiscale or LOFT early 1981	
Ultrasonic	ORNL	Built & tested under research & development	Funding and development problems	ORNL early 1981	Near continuous level indication
Neutron Detector	NNC (EPRI sponsored)	Proof of principle needed Some prototype testing performed	Reliability of signal interpretation	LOFT late 1980	No leads in vessel
Differential Pressure (RVLIS)	W	Built commercial	Need further evaluation under simulated accident condition	Semiscale late 1980 Possible LOFT to be scheduled	Continuous level indication - can possibly be installed within one year
Microwave Liquid Level Gauge	DAVCO	New Conceptual Design	Need further development & system design	Semiscale or LOFT late 1981	Continuous level indication

ENCLOSURE 4

ENCLOSURE 4

STAFF REVIEW SCHEDULE FOR NUREG-0737 SECTION II.F. 2

Item No./ MP Desig.	Title	Applic.	Type	Implement	Licensee Submit	Staff SER	Comments
II.F.2 (MP F-26)	Instrumentation for Inadequate Core Cooling	All	*				* Preimplementation review for generic design and postimplementation review for plant specific installation.
	1 Licensee submittal: design description and supporting analysis.				01/01/81		
	2 Staff: develop generic positions/questions.					Complete	
	3 Staff: transmit positions/ questions to licensees					Complete	
	4 Licensee submittal: response to questions/positions				09/01/81		
	5 Generic SERs and Model TS					12/01/81	
	6 Installation			01/01/82			
	7 Licensee submittal: qualification of system for operation				03/01/82		
	8 Staff: issue plant specific approval and TS					05/01/82	
	9 Staff: issue plant specific SERs					07/01/82	

ENCLOSURE 5

FIGURE 8-1 EARLIEST POSSIBLE ICC INSTALLATION SCHEDULE – SONGS 2

Based on Data through 4/81

▽ EARLIEST EXPECTED DELIVERY FOR FIRST UNIT

□ INSTALLATION COMPLETE

○ QUALIFICATION COMPLETE (ESTIMATED)

Based on Data through 8/81

▼ ACTUAL REVISED DELIVERY DATE

■ INSTALLATION COMPLETE (ASSUMES PLANTSHUTDOWN)