REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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RECIP.NAME RECIPIENT AFFILIATION
EISENHUT,D.G. Division of Licensing

SUBJECT: Provides summary of three instruments which comprise inadequate core cooling sys to facilitate NRC review per Generic Ltr 82-28.Description of subcooling margin monitor encl.

DISTRIBUTION CODE: A002S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 20
TITLE: OR Submittal:Inadequate Core Cooling (Item II.F.2) GL 82-28

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NRC-83-53

WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 1200, Green Bay, Wisconsin 54305

March 9, 1983

Director, Office of Nuclear Reactor Regulation
Attention: Mr. D. G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Inadequate Core Cooling (ICC) Instrumentation System (Generic Letter 82-28)

The above referenced letter provides justification for the installation of ICC instrumentation and gives generic approval of the Combustion Engineering Heated Junction Thermocouple and Westinghouse Reactor Vessel Level Instrumentation Systems. Approval is also given for other differential pressure (d/p) measurement techniques, provided they meet NUREG-0737 design requirements and have an acceptable range as defined in the referenced letter.

In order to complete your review of ICC instrumentation we have been asked to provide 1) detailed schedules for engineering, procurement, and installation and 2) a status report delineating conformance and exceptions to NUREG-0737 requirements. Specific information is found in the attachments to this letter.

Below is a summary of the three instruments which comprise the ICC system: 1) an inventory trending system, 2) subcooling margin monitor and 3) an upgrade of the existing in-core thermocouples.

The subcooling Margin Monitor (SMM) has been installed and is functional. Action statements based on RCS subcooling have been incorporated into operating procedures. A description of the SMM is provided herein as enclosure 1.

Until now, WPSC has not committed to the installation of a reactor coolant

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inventory tracking system because it is not clear that available systems met your requirements for unambiguous indication of core water level as evidenced by the length of time it has taken for NRC approval of such systems. Furthermore, the value of such a system in aiding the operator during the course of an accident is equally undetermined. In our opinion, the RITS provides additional information to the operator which is redundant and which will not affect the operator's decision or action in maintaining adequate core cooling. Nevertheless, we are committing to installation of a reactor coolant inventory tracking system at the Kewaunee Nuclear Plant. This commitment is based, not on our agreement of the technical need for such a system, but on recognition of the NRC's resolve and determination for the requirement. We intend to install a RITS based on differential pressure measurement. A conceptual design and milestone schedule for design and installation are provided as enclosure 2 to this letter.

WPS agrees to upgrade our present in-core thermocouple system, and are planning to complete the upgrade by the end of the refueling outage 1985. A conceptual design and milestone schedule are included as enclosure 3 to this letter.

Very truly yours,

C. W. Giesler
Vice President - Nuclear Power

js

Attach.

cc - Mr. Robert Nelson, US NRC
Mr. S. A. Varga, US NRC

Enclosure 1

Subcooling Margin Monitor

In response to the requirements imposed by NUREG 0578, WPSC provided reactor coolant subcooling indication in the control room in December of 1979. The indication is provided by two diverse means: via a calculation performed by the plant process computer which is displayed and trended on a multi-pen recorder located on one of the control room mechanical control consoles, and by a Subcooling Margin Monitor (SMM) which is displayed on one of the mechanical vertical panels. The subcooling margin monitor is described below. These indications are backed up by a manual method, performed by the operator, in accordance with instructions located in appropriate emergency operating procedures.

The Subcooling Margin Monitor is an on-line microcomputer based system which uses reactor coolant process signals to provide a continuous indication of the margin from saturation conditions. The operator is provided continuous indication of either the pressure or temperature margin from saturation.

Temperature and pressure analog signals are converted to digital signals through an analog-to-digital converter. These signals are interfaced to a microcomputer. The microcomputer contains steam tables and interpolation routines from which a saturation temperature and pressure are calculated.

By comparing the saturation temperature and pressure to the actual coolant temperature and pressure, a margin from saturation is calculated. The calculated temperature or pressure margin is compared to a setpoint for the low margin alarm. Two independent analog margin signals are available for data logging purposes.

Software diagnostics are periodically executed to detect observable software malfunctions. A diagnostic failure is indicated by a flashing meter display.

During normal operation the Subcooled Margin Monitor will display either Temperature Margin or Pressure Margin, depending on the mode selected. The value displayed will be updated with a newly calculated value every two seconds.

The mode select switch is an alternate action pushbutton. The position is indicated by backlighting of the TEMP or PRESS segments.

TEMPERATURE MARGIN

The temperature margin is displayed in °F with resolution to 0.1 degree when the pushbutton indicates TEMP. This value is the difference between the measured reactor coolant temperature and the temperature at which the coolant will boil (the saturation temperature).

TEMP MARGIN = SATURATION - REACTOR COOLANT TEMP

The saturation temperature is a function of the Reactor Coolant Pressure and is calculated from the measured pressure. The calculation is based on the standard Steam Tables.

All input signals are converted to engineering units (°F and PSIA) using appropriate scaling factors.

The highest of four monitored thermocouples is used to calculate temperature margin. This is compared to the saturation temperature calculated from the lowest of two measured pressure values. This gives the worst case temperature margin.

PRESSURE MARGIN

The Pressure Margin is displayed in PSI with a resolution to 1 pound when the pushbutton indicates PRESS. This value is the difference between the measured Reactor Coolant Pressure and the pressure at which the coolant will boil (the saturation pressure).

PRESS MARGIN = REACTOR COOLANT PRESSURE - SATURATION PRESSURE

The saturation pressure is a function of the Reactor Coolant Temperature and is calculated from the measured core exit temperature. The calculation is based on the standard steam tables.

All input signals are converted to engineering units (°F and PSIA) using appropriate scaling factors.

The lowest of the two measured pressure values is used to calculate pressure margin. This is compared to the saturation pressure calculated from the highest of the four measured temperature values. This gives the worst case pressure margin. In the case of overlapping ranges a signal at or near the end of its range will be excluded from the calculation.

The pressure inputs for the Subcooled Margin Meter are taken from the Reactor Coolant System Hot Leg Pressures and the temperature from four incore thermocouples (one from each core quadrant).

The following is a discussion of NUREG-0737 Appendix B criteria. The numbering is consistent with Appendix B.

1. Environmental Qualification

The SMM processor and display was designed by Combustion Engineering as a "Safety Class 1, Seismic Class 1, and Quality Class 1 instrument." The governing standards were IEEE 344-1975 and 323-1974.

The process signals which provide input to the SMM are primary system pressure and core exit temperature.

The pressure signals are Class 1E and have been qualified in accordance with the WPSC equipment qualification program.

The cabling inside containment associated with the core exit thermocouples is not presently environmentally qualified. The thermocouple cabling will be upgraded in the future. Details of this upgrade are provided in enclosure 3. The signals have been provided with isolation from safety grade instrumentation loops.

2. Single Failure

The single failure criterion to be applied to this instrument as stated in NUREG 0737 Appendix B is that:

> "No single failure within either the accident monitoring instrumentation, its auxiliary supporting features or its power sources concurrent with the failure that are a condition or a result of a specific accident should prevent the operator from being presented the information necessary for him to determine the safety status of the plant and to

bring the plant to a safe condition and to maintain it in a safe condition following an accident."

Even though the RCS subcooling indication is not essential for the operator to determine the safety status of the plant, the control room has been provided with multiple and diverse indication such that the single failure criterion has been met.

The Subcooled Margin Monitor continuously checks for a number of detectable failures. These include abnormal input signals and computer board failures. If one of these detectable failures is found, the display will flash. The flashing can be cleared only by correcting the failure.

In the event that a failure occurs, the operator has several alternate methods to obtain subcooling margin as noted above. He may elect to make the determination manually or he may read the indication calculated by the plant process computer. The plant computer calculates the margin based on the hottest thermocouple, the average of 6 disperse T/C's or on RCS loop RTD's. The value is normally displayed on a trend chart recorder, and in addition it can be displayed on a plant computer CRT, digital display or hard copy.

3. Class 1E Power Source

The SMM is powered from RR172 circuit 48. This is a normal, reliable, although non-safeguards power source and is backed by the safeguards diesel generators.

4. Availability

The SMM is a single channel instrument which is capable of continuous function except during on-line testing. During the test period, other methods are available to determine the subcooled margin (see response 2). IEEE-279 is not applicable to this system as the SMM provides no protection function.

5. Quality Assurance

Procedures governing the design, procurement, and installation are under the authority of the Kewaunee Operational Quality Assurance Program.

6. Continuous Indication

Continuous indication of subcooling margin is provided for in the control room by a digital display.

7. Recording of Instrument Outputs

No provisions have been made for recording the output of the SMM. Trend recording (strip chart) is available from the subcooling margin calculating function of the plant process computer.

8. Identification of Instruments

The SMM is identified to the operator in a manner consistent with normal practice at Kewaunee. Operators are trained as to its function during the course of an accident.

9. Isolation

Electrical isolation is provided at the interface of the SMM and safety grade signals and between safeguards and normal power supplies.

Enclosure 2

Reactor Inventory Tracking System (RITS)

As noted in the cover letter to this attachment WPSC has not previously committed to the installation of a Reactor Vessel Level Indication System (RITS). Consequently, the design of the RITS is under development at this time. The information contained in this attachment will therefore be general in nature. Additional information will be forwarded to NRC as the design and installation progresses.

The following is in response to the appendix to the referenced letter. The numbering is consistent with the appendix.

1. System Description

It is the intention of WPSC to install a differential pressure (d/p) type instrument of our own design. The RITS range will cover a span from the top of the vessel head to below the active fuel region. The dp signal will be compensated to account for the average temperature along the vertical sensing lines and for RCS water density to improve the accuracy of the system.

The Reactor Inventory Tracking System will be designed as a safety grade system and will provide class 1E indication in the control room.

The final system description will be made available to NRC upon completion.

2. System Analysis

The design analysis and test data to support the RVLIS will be forwarded to NRC at completion of the project.

3. Description of Tests

Test description and results for evaluation and calibration will be provided to NRC prior to placing the system in service for emergency use.

4. NUREG-0737 Appendix B

(1) All equipment shall be environmentally qualified and Class 1E up to isolation in Foxboro racks. Instruments do not need to read accurately during a safe shutdown earthquake.

(2) Two single failure proof trains will be provided. A single line is run from the vessel to d/p cells. Although passive failure of this line is beyond the licensing basis for Kewaunee, its failure is tolerable since a diverse signal will be provided; i.e., the incore T/C's provide an independent channel which monitors core cooling.

(3) Class 1E power will be provided for the Class 1E portions of the system.

(4) Channel may be bypassed for test or calibration during power operation provided time out of service is minimal.

(5) The RITS is a safety grade system and will be designed, installed and maintained under the guidance of the WPSC QA program.

(6) Continuous indication will be provided.

(7) RITS will have the capability to drive a chart recorder to provide the trending function.

(8) The RITS will be clearly identified and the operators will be trained in its emergency use.

(9) Isolation will be provided at Foxboro racks.

5. Processing & Display

Computer hardware, software and display functions will be described at project completion.

6. Schedule

The milestone schedule for design, installation, testing and training is attached.

7. Procedures

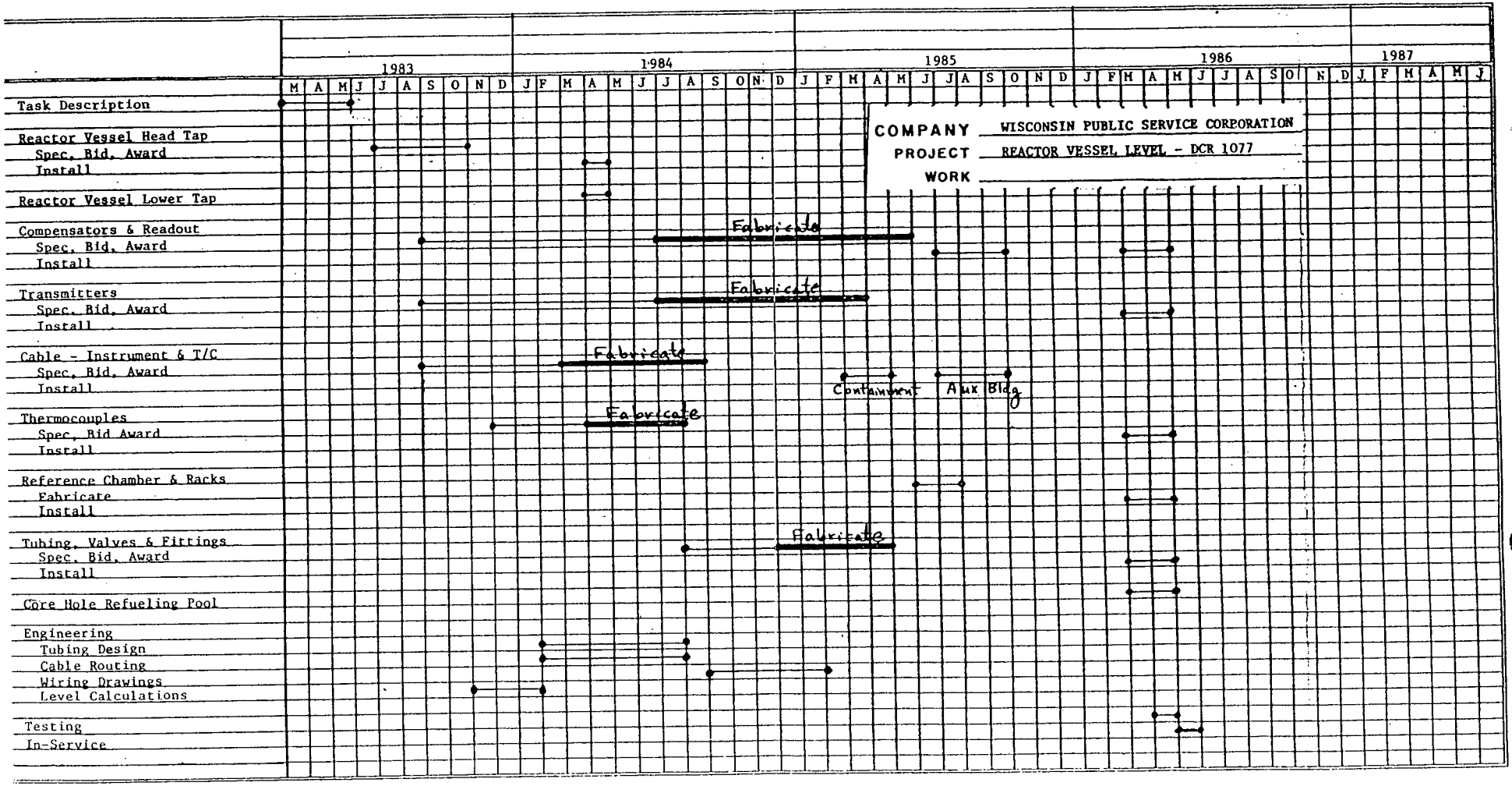
Procedures for the use of the RITS will be a plant specific application of the Westinghouse Owners Group's Emergency Response Guidelines.

8. Operator Instructions

See "Procedures" above.

9. Schedule for Additional Submittals

Additional information will be provided as indicated in this enclosure.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Task Description
Reactor Vessel Head Tap
Spec, Bid, Award
Install
Reactor Vessel Lower Tap
Compensators & Readout
Spec, Bid, Award
Install
Transmitters
Spec, Bid, Award
Install
Cable - Instrument & T/C
Spec, Bid, Award
Install
Thermocouples
Spec, Bid Award
Install
Reference Chamber & Racks
Fabricate
Install
Tubing, Valves & Fittings
Spec, Bid, Award
Install
Core Hole Refueling Pool
Engineering
Tubing Design
Cable Routing
Wiring Drawings
Level Calculations
Testing
In-Service
COMPANY WISCONSIN PUBLIC SERVICE CORPORATION
PROJECT REACTOR VESSEL LEVEL - DCR 1077
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Enclosure 3

Core Exit Thermocouples

WPSC agrees to upgrade the existing core exit thermocouple system and will modify the system from and including the vessel head connectors through to the power supply, reference junction box, and display. The thermocouples themselves will not be altered due to the expense of time, money and exposure.

The following is in response to the appendix to the referenced letter. The numbering is consistent with the appendix.

1. System Description (Conceptual Design)

(1) Replace the present T/C connectors at the vessel head with qualified connectors.

(2) Separate T/C's into two trains from T/C ports to Class 1E microprocessors.

(3) Install two Class 1E microprocessors to read T/C temperatures, make reference junction compensation, and provide isolated signals for Plant Process Computer (PPC), RITS, SMM, and qualified T/C display.

(4) Install a qualified backup display for T/C temperatures. To be mounted in place of the present Honeywell readout box.

(5) Provide two trains of qualified T/C wire from vessel to relay room or two qualified in-containment reference junction boxes and T/C cable between them and vessel.

(6) Provide input to the PPC in the form required.

(7) All Class 1E portions of the sytem are to be powered from an instrument bus (i.e., microprocessors and backup display).

(8) Schedule is attached.

2. Design Analysis for RITS

N/A

3. Description of Planned Tests and Results

The core exit T/C system will be functionally tested prior to its return to service. The test procedure and results will be available for NRC inspection.

4. NUREG-0737 Attachment 1

(1) A diagram of the core exit thermocouples is attached.

(2) The primary displays are generated by the plant process computer. The displays will be a hard copy core map, hottest T/C, selected average, and trend recorder.

(3) The backup display is anticipated to be a safety grade, human factors engineered, digital output device which is driven by redundant qualified microprocessors.

(4) The reactor operators will be trained on the use of the displays.

(5) The core exit T/C displays will be reviewed as part of the Control Room Design Review.

(6) A description of the design including power sources will be provided when available.

(7) The system will be environmentally qualified from the vessel head connector to the isolation devices.

5. Describe Computer, Software, and Display

A description of the system will be provided when available.

6. Schedule

Attached.

7. Guidelines for Use of RITS

N/A

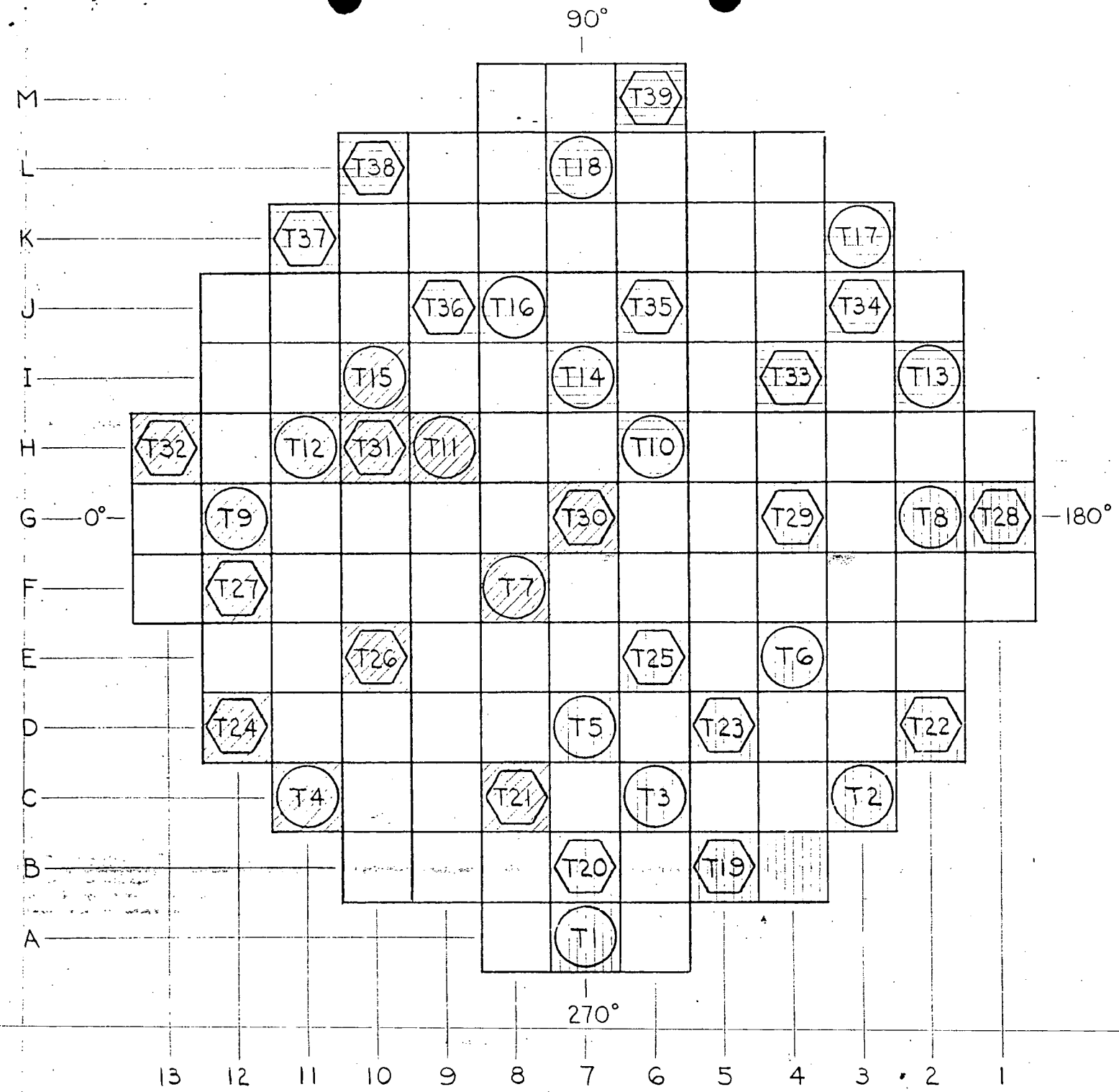
8. Operator Instructions

Operator actions based on core exit temperature will be based on plant specific implementation of the Westinghouse Owners Group's Emergency Response Guidelines.

9. Schedule for Additional Submittals

Revised schedules will be provided yearly in May.

LOCATION OF 39 THERMOCOUPLES IN REACTOR HEAD



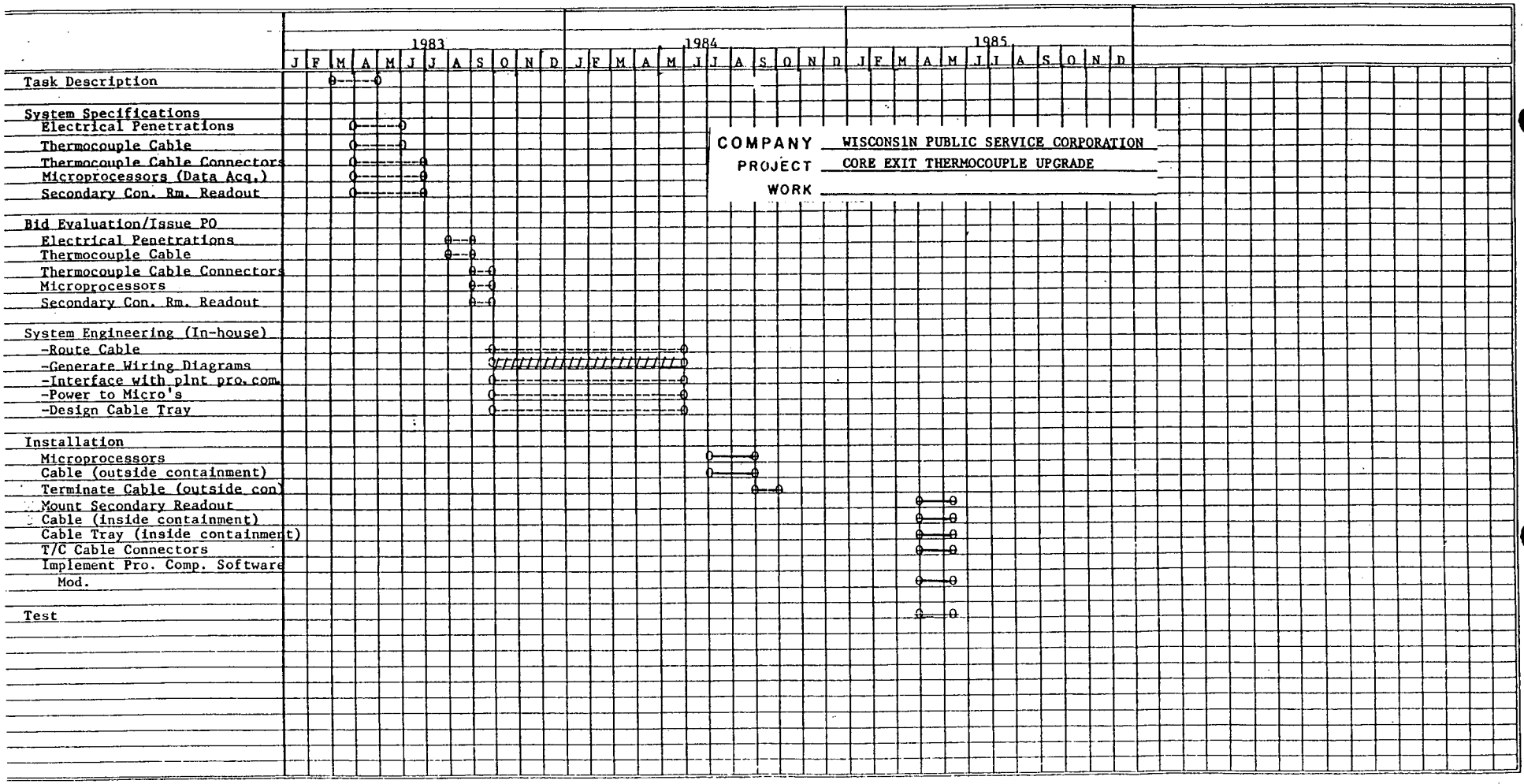
THERMOCOUPLES CONNECTED TO REFERENCE JCT BOX NO. 1.

THERMOCOUPLES CONNECTED TO REFERENCE JCT BOX NO. 2.

THERMOCOUPLE CONNECTION VIA VESSEL PENETRATION AT L-10.

THERMOCOUPLE CONNECTION VIA VESSEL PENETRATION AT D-12

THERMOCOUPLE CONNECTION VIA VESSEL PENETRATION AT B-4.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Task Description
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Thermocouple Cable
Thermocouple Cable Connectors
Microprocessors (Data Acq.)
Secondary Con. Rm. Readout
Bid Evaluation/Issue PO
Electrical Penetrations
Thermocouple Cable
Thermocouple Cable Connectors
Microprocessors
Secondary Con. Rm. Readout
System Engineering (In-house)
-Route Cable
-Generate Wiring Diagrams
-Interface with plnt pro. com.
-Power to Micro's
-Design Cable Tray
Installation
Microprocessors
Cable (outside containment)
Terminate Cable (outside con)
Mount Secondary Readout
Cable (inside containment)
Cable Tray (inside containment)
T/C Cable Connectors
Implement Pro. Comp. Software Mod.
Test
COMPANY WISCONSIN PUBLIC SERVICE CORPORATION
PROJECT CORE EXIT THERMOCOUPLE UPGRADE
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COMPANY WISCONSIN PUBLIC SERVICE CORPORATION
PROJECT REACTOR VESSEL LEVEL - DCR 1077
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