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

June 27, 1985

Docket Nos. 50-369
and 50-370

FACILITY: McGuire Nuclear Station, Units 1 and 2

LICENSEE: Duke Power Company

SUBJECT: SUMMARY OF MAY 2, 1985 MEETING ON PROPOSED CHANGES FOR TEMPERATURE DETECTION: McGUIRE NUCLEAR STATION, UNITS 1 AND 2

On May 2, 1985 the NRC met in Bethesda, Maryland, with Duke Power Company (DPCO) and Westinghouse to discuss plans to justify and implement changes to the Resistance Temperature Detectors (RTDs) and their associated mechanical and electrical equipment used to generate Reactor Coolant System (RCS) temperature signals for protection and control systems. Meeting attendees are listed in Enclosure 1. Viewgraph slides used during the presentations are shown in Enclosure 2.

The change would replace the existing RTD bypass system with fast response thermowell RTDs installed in existing RCS pipe penetrations. One RTD would be provided in each hot leg (HL) scoop (total of 3 per HL) and one RTD would be provided at the bypass penetration to each cold leg (CL). An additional spare RTD would be installed in a new penetration in each RCS CL piping. All existing bypass piping would by removed. The Westinghouse 7300 electronic gear would be modified to accept signals from three HL and one CL RTD per loop, average the three HL signals, and use the averaged signal to generate Tavg and ΔT. The modifications to the 7300 gear would also permit manual defeat of failed signals.

The presentations described the ongoing development and analytical efforts for the new system. Analyses will show that the time response of the proposed system is adequate for plant protection. Streaming tests will be conducted during the second half of 1985 and will provide plant specific data on the nature and stability of the streaming patterns during steady state and load change operations. A new calorimetric procedure recently developed by Westinghouse will be used which reduces flow measurement uncertainty because RTDs can measure temperature difference more accurately than absolute temperature. Existing FSAR analyses are based upon an RTD response time of 8 seconds and remain bounding because associated filter time constants on measured Tavg and ΔT were previously increased from 2 to 6 seconds due to HL temperature oscillations experienced at McGuire Unit 2. Technical Specifications associated with flow measurement uncertainty due to RTD accuracy is not expected to change because flow measurement evaluations would be based upon the new calorimetric procedures.

Revised safety analyses and proposed technical specification changes for the revised system will be provided for NRC review during the second half of 1985. DPCO desires NRC approval in early 1986 in order to implement construction hardware modifications during the presently scheduled April 1986 Unit 2 refueling outage.

Darl Hood

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Enclosure:
As stated

DESIGNATED ORIGINAL
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ENCLOSURE 1

ATTENDEES

May 2, 1985

NAME	ORGANIZATION
Darl S. Hood	LB #4/DL/NRR
Robert Gill	Duke/Licensing
Larry Phillips	NRR/DSI/CPB
Harry Balukjian	NRR/DSI/CPB
Gene Hsii	NRR/DSI/CPB
Tom Dunning	NRR/DSI/ICSB
Mark A. Grace	Westinghouse/Nuclear Safety
Roger Schreiber	Westinghouse/Fluid Systems
Walter Lyman	Westinghouse/Fluid Systems
Roy Owoc	Westinghouse/Licensing
Bill Reckley	Duke/Reactor Safety
R. W. Revels	Duke/Design Engr.
J. R. Hilley, Jr.	Duke/Design Engr.
W. M. Suslick	Duke/Nuclear Performance

MEETING SUMMARY DISTRIBUTION

Docket No(s): 50-369/370
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G. Hsii
T. Dunning

bcc: Applicant & Service List

ENCLOSURE 2

PRESENTATION OUTLINE

1.	INTRODUCTION	DUKE
2.	COST/BENEFIT	DUKE
*3.	DESIGN DESCRIPTION	WESTINGHOUSE
*4.	DESIGN FEATURES	WESTINGHOUSE
5.	SAFETY ANALYSIS	WESTINGHOUSE
6.	LICENSING REPORT CONTENTS	DUKE
7.	SCHEDULE	DUKE

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RTD Cost Analysis

Primary Benefits

- Radiation level reduction
- Reduce outage time
- Increased accessibility

Primary Detriments

- Installation cost
- Piping removal / disposal costs
- Maintenance requirements

DESIGN DESCRIPTION

1. MAJOR FEATURES
2. ADVANTAGES
3. MECHANICAL MODIFICATIONS
4. ELECTRICAL MODIFICATIONS

MAJOR FEATURES

1. FAST RESPONSE THERMOWELL RTDs ARE INSTALLED IN EXISTING RC PIPE PENETRATIONS
   - ONE IN EACH HOT LEG SCOOP (TOTAL 3 PER HL)
   - ONE AT BYPASS PENETRATION TO EACH CL
2. ADDITIONAL SPARE RTD INSTALLED AT NEW PENETRATION IN EACH CL
3. SIGNALS FROM THE 3 HL RTDs ARE ELECTRONICALLY AVERAGED FOR USE BY PROTECTION AND CONTROL SYSTEMS
4. ALL BYPASS PIPING IS REMOVED

ADVANTAGES

1. PROPOSED MODIFICATION IS AS EFFECTIVE AS THE SYSTEM IT REPLACES

   - AFFORDS ADEQUATE TIME RESPONSE
   - PROVIDES AVERAGE HL TEMPERATURE
   - RETAINS ABILITY TO REPLACE RTDs

2. ADDITIONAL BENEFITS

   A) ALARA

   B) AVAILABILITY

MECHANICAL MODIFICATIONS

- REMOVE RTD BYPASS PIPING SYSTEM
- MACHINE HOT LEG SCOOPS FOR RTD WELLS
- MODIFY COLD LEG BYPASS PIPE NOZZLE FOR RTD WELL
- ADD BOSS ON COLD LEG FOR RTD WELL
- CAP BYPASS RETURN PIPE ON PUMP SUCTION LEG

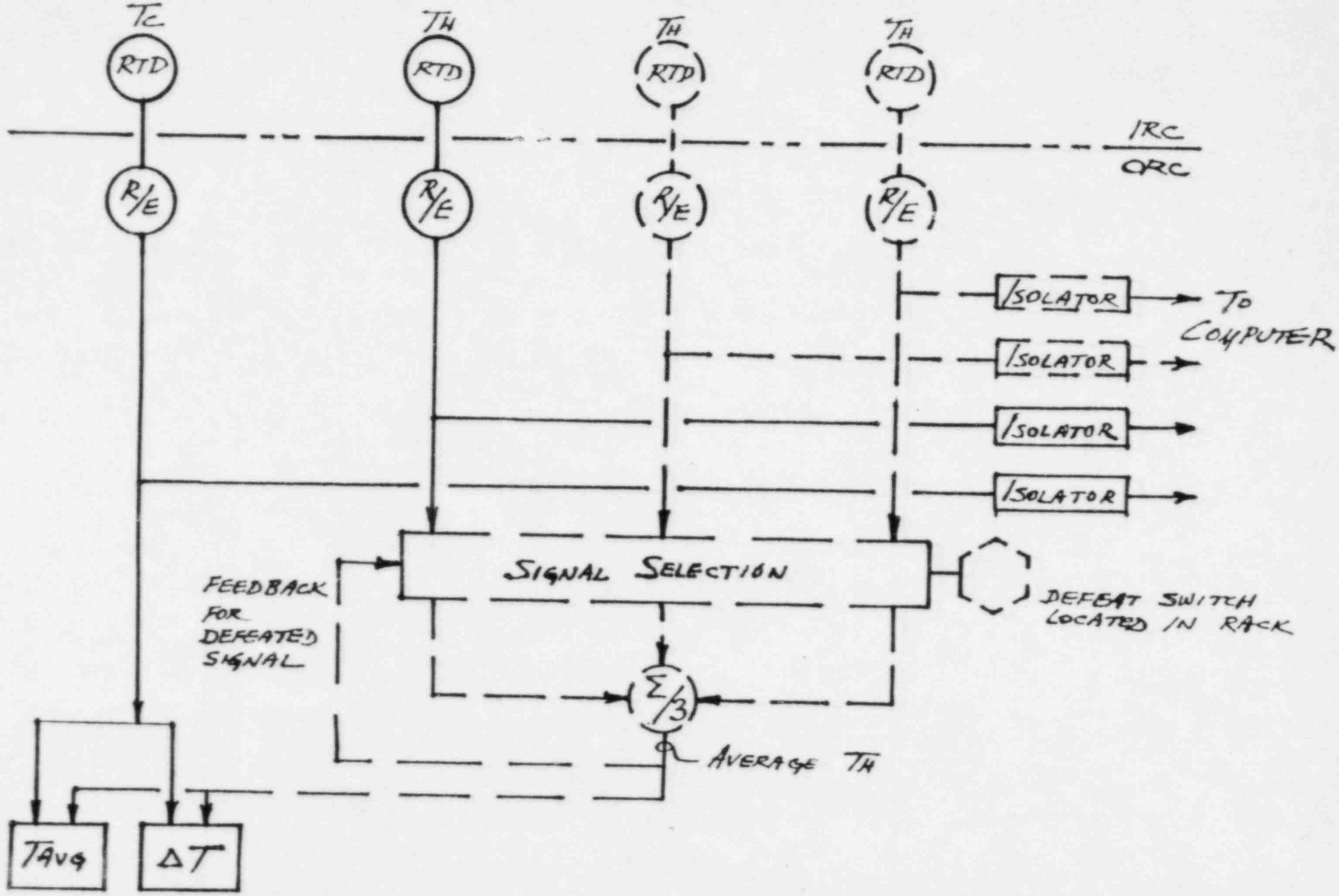
ELECTRICAL MODIFICATIONS

7300 GEAR IS MODIFIED TO PERFORM THE FOLLOWING ADDITIONAL FUNCTIONS:

- ACCEPT SIGNALS FROM 3 HOT LEG AND 1 COLD LEG RTD PER LOOP
- ELECTRONICALLY AVERAGE THE 3 HOT LEG SIGNALS
- USE THE AVERAGE SIGNAL TO GENERATE TAVG AND ΔT
- PERMIT MANUAL DEFEAT OF FAILED SIGNALS

RTD Averaging Block Diagram

Typical for Each of 4 Channels



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TIME RESPONSE

1. FIRST ORDER RESPONSE OF NEW SYSTEM EQUALS 5.5 SECONDS (VERIFIED BY TEST)

2. ORIGINAL BASIS WAS 4.5 SECONDS

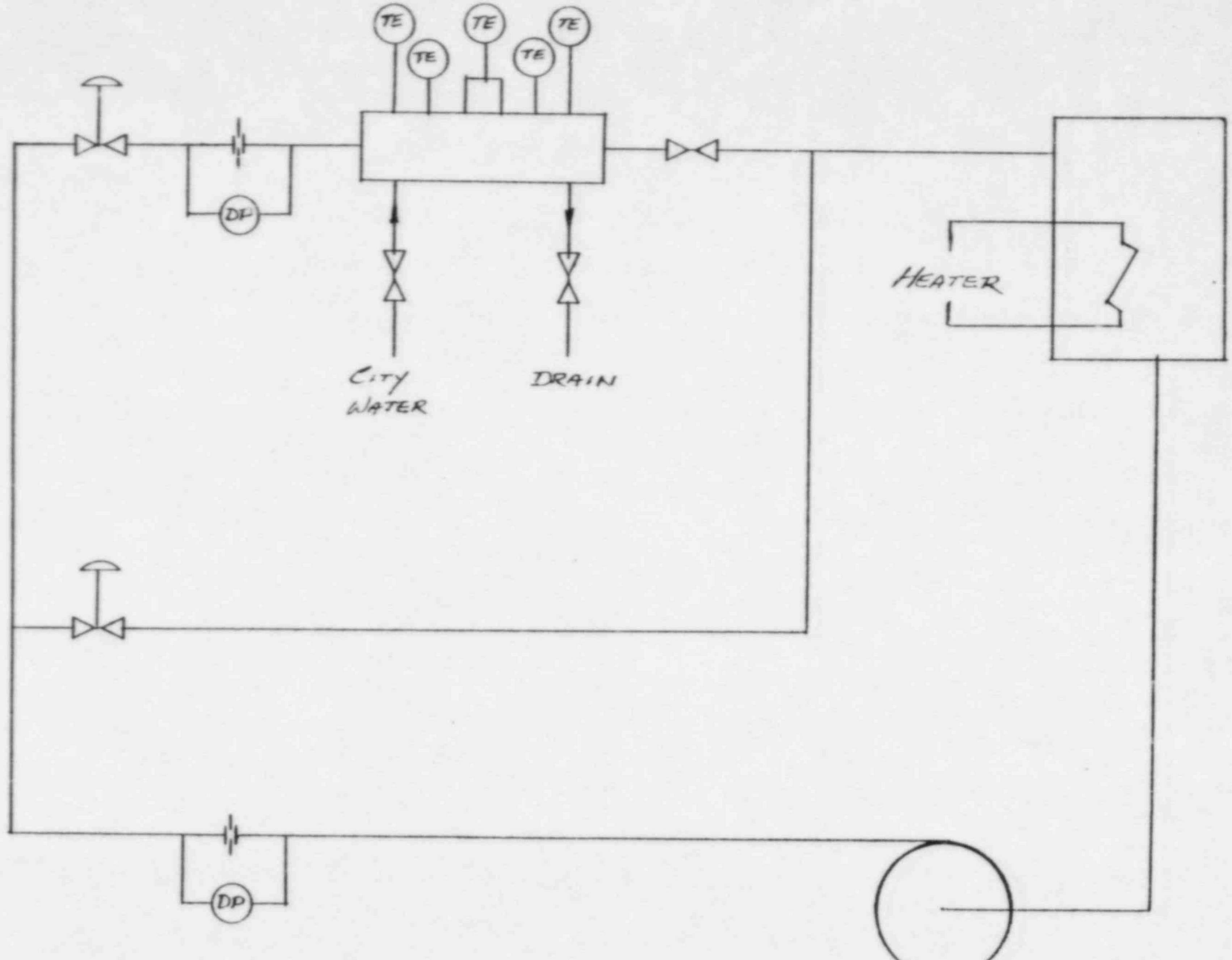
3. RECENTLY REANALYZED AT 8.5 SECONDS

   - INCREASED TO DAMP TEMPERATURE FLUCTUATIONS IN ONE LOOP OF UNIT 2

   - ANALYSIS SHOWED ACCEPTABLE RESULTS

TIME RESPONSE

	RTD BYPASS SYSTEM		FAST RESPONSE THERMOWELL RTD SYSTEM
	ORIGINAL BASIS	REVISED 10/84	
RTD BYPASS PIPING AND THERMAL LAG	2.0 SEC.	2.0 SEC.	-
RTD RESPONSE TIME	0.5	0.5	5.5
RTD FILTER TIME CONSTANT	2.0	6.0	0.0
ELECTRONICS DELAY	1.5	1.5	1.5
TOTAL RESPONSE TIME	6.0 SEC.	10.0 SEC.	7.0 SEC.



TIME RESPONSE TEST SCHEMATIC

TIME RESPONSE

CONCLUSION: TIME RESPONSE OF THE PROPOSED SYSTEM IS MORE THAN ADEQUATE FOR PLANT PROTECTION

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STREAMING ACCURACY

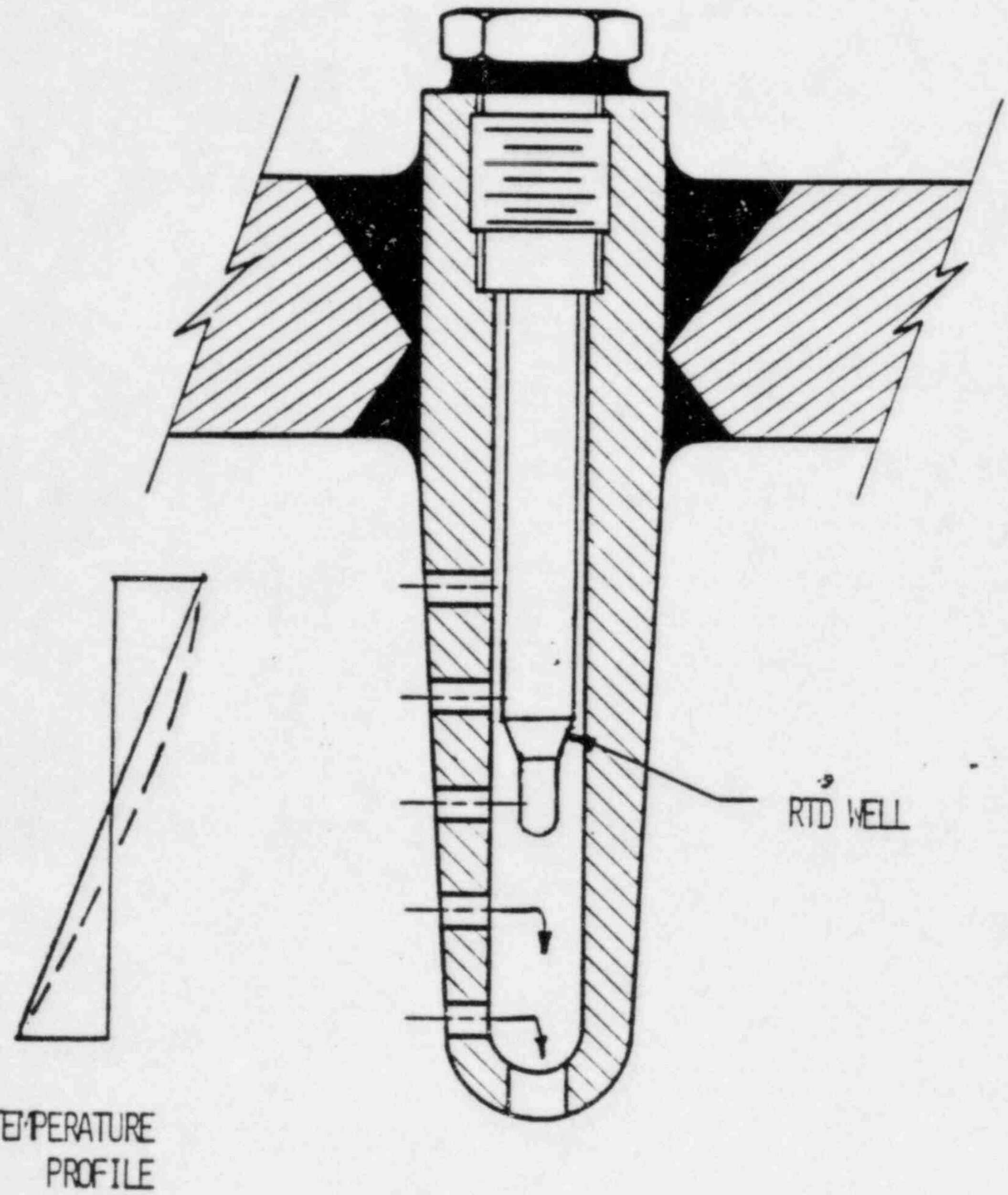
1. ACCURACY RELATIVE TO BYPASS LOOPS

2. STREAMING TEST

STREAMING ACCURACY

- TEMPERATURE MEASURED AT 3 POINTS
- RTD TIP LOCATED AT MIDDLE SCOOP HOLE
- MEASURES AVERAGE SCOOP TEMPERATURE, ASSUMING LINEAR GRADIENT
- ERROR DUE TO NON-LINEARITY WILL BE ASSESSED IN SUBMITTAL
- WORK TO DATE INDICATES SMALL EFFECT

STREAMING ACCURACY



STREAMING ACCURACY

- CURRENT 1.2° F STREAMING ERROR INCLUDES AN ALLOWANCE FOR FLOW IMBALANCE
- PROPOSED MODIFICATION ELIMINATES THE FLOW IMBALANCE
- NET RESULT SHOULD BE NO INCREASE IN ERROR ALLOWANCE FOR TEMPERATURE STREAMING

STREAMING TEST

SCHEDULE: SECOND HALF OF 1985

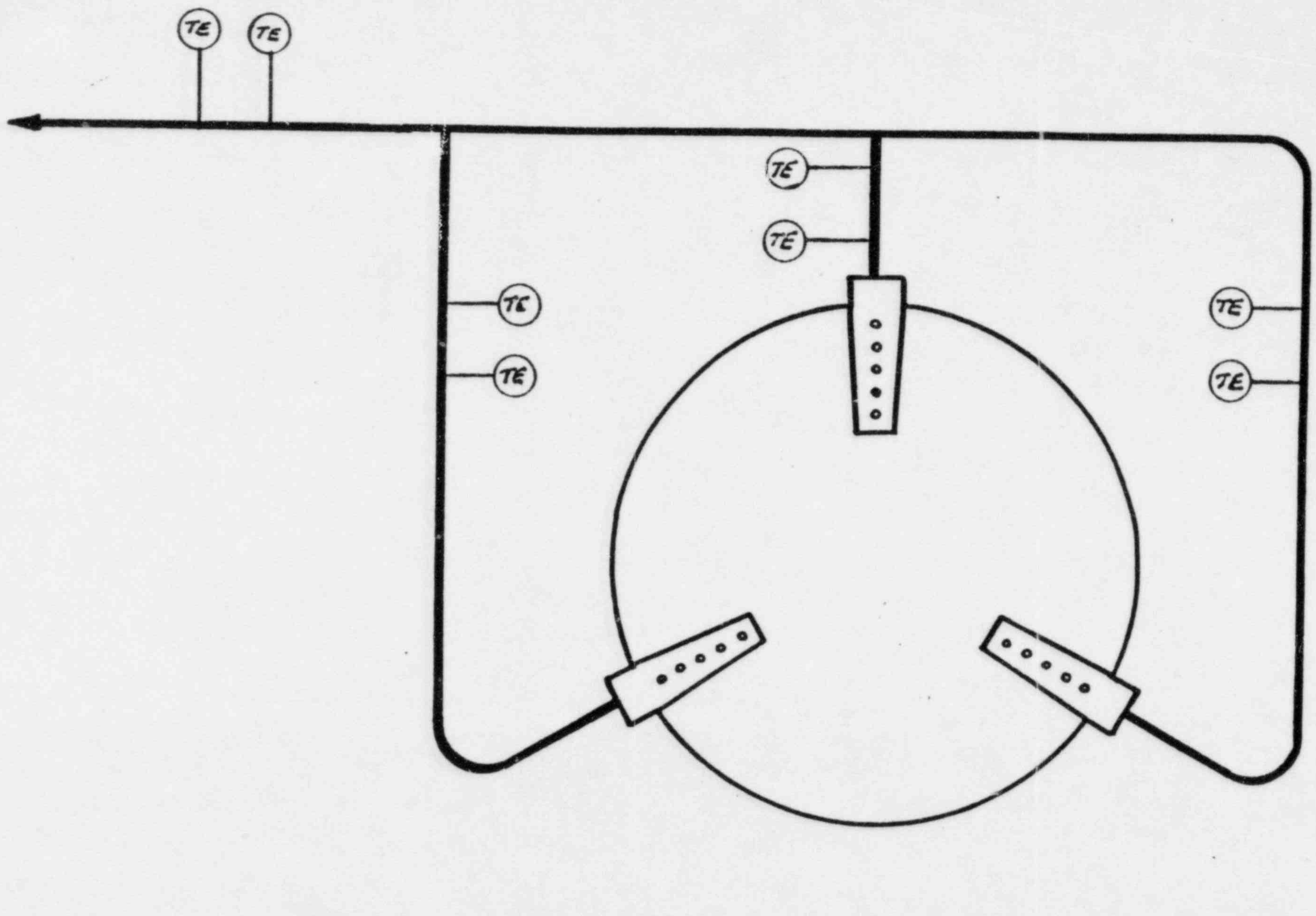
PURPOSE: OBTAIN PLANT SPECIFIC DATA ON THE NATURE AND STABILITY OF THE STREAMING PATTERNS

CONCEPT: TAKE T/C MEASUREMENTS OF BYPASS PIPE TEMPERATURES AT THE FOLLOWING LOCATIONS:

- o EACH SCOOP PIPE
- O BYPASS HEADER

TEST ARRANGEMENT

(TYPICAL OF 2 LOOPS)



STREAMING TEST

- DATA WILL BE TAKEN OVER PERIOD OF SEVERAL MONTHS INCLUDING LOAD CHANGES
- WILL PROVIDE 3 POINT MAP OF TEMPERATURE DISTRIBUTION
- USED TO VERIFY RTD READINGS AFTER THE MODIFICATION

STREAMING ACCURACY

CONCLUSIONS:

- o STREAMING ACCURACY EQUIVALENT TO PRESENT ALLOWANCE FOR BYPASS LOOPS
- o WILL BE VERIFIED BY TEST

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	B) STREAMING ACCURACY	
	C) CONTROL/PROTECTION INTERACTION	
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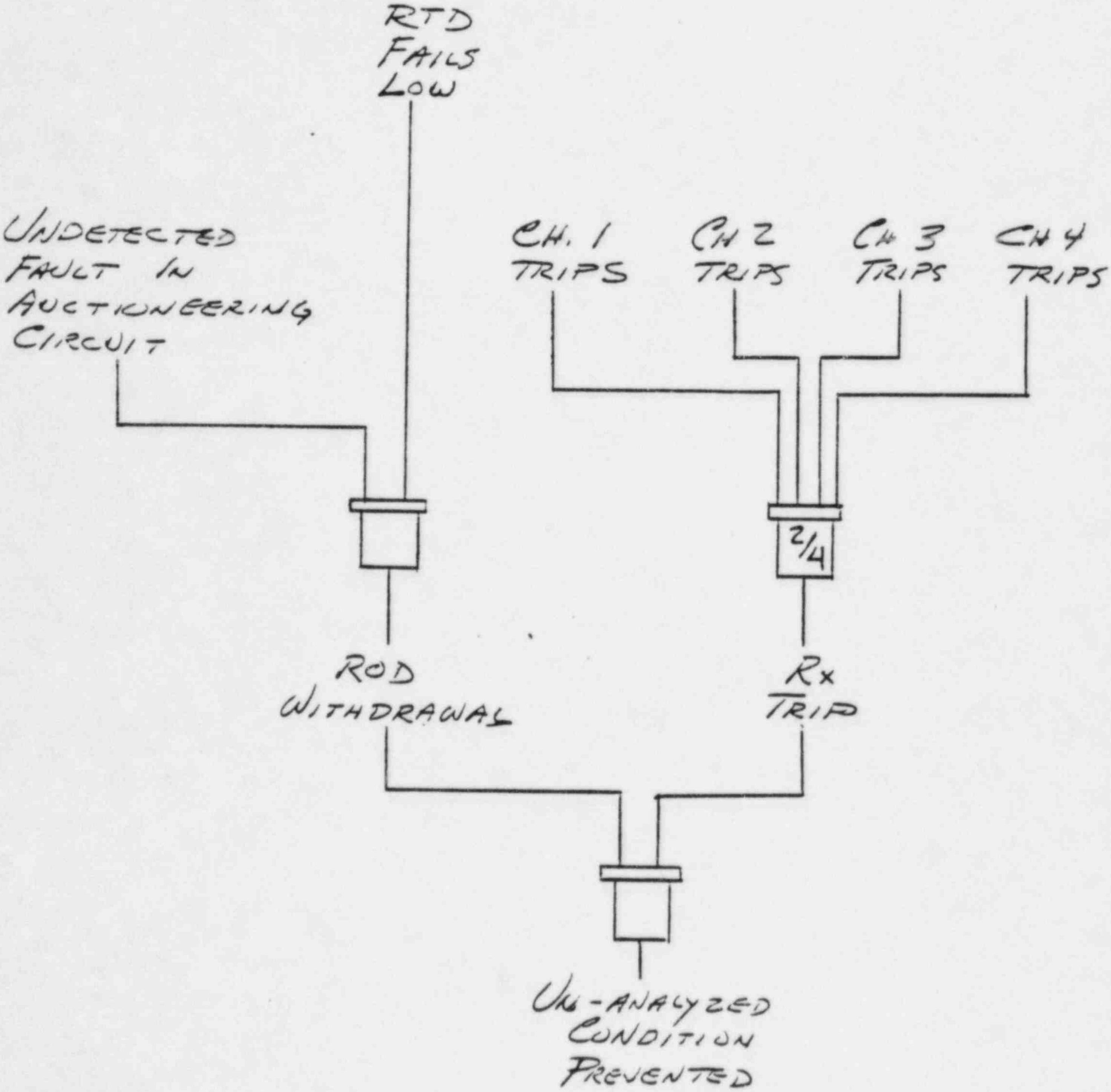
CONTROL/PROTECTION INTERACTION

- SYSTEM DESIGN MEETS IEEE 279

- TYPICAL SCENARIO AS FOLLOWS:


RTD
FAILS
LOW
UNDETECTED
FAULT IN
AUCTIONEERING
CIRCUIT
CH. 1
TRIPS
CH 2
TRIPS
CH 3
TRIPS
CH 4
TRIPS
2/4
ROD
WITHDRAWAL
Rx
TRIP
UN-ANALYZED
CONDITION
PREVENTED

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	D) CALORIMETRIC ACCURACY	
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&.	SCHEDULE	DUKE

CALORIMETRIC ACCURACY

1. W HAS DEVELOPED A NEW CALORIMETRIC PROCEDURE THAT REDUCES FLOW MEASUREMENT UNCERTAINTY

   - APPLIES GENERICALLY
   - FIRST USE ON MCGUIRE

2. BASED ON THE FACT THAT RTDs CAN MEASURE TEMPERATURE DIFFERENCE MORE ACCURATELY THAN ABSOLUTE TEMPERATURE.

CALORIMETRIC ACCURACY

DIFFERENTIAL TEMPERATURE FLOW MEASUREMENT PROCEDURE

(TYPICAL PLANT)

3 HOT LEG RTDS AND R/E CONVERTERS

1 COLD LEG RTD AND R/E CONVERTER

AT HOT STANDBY:

- MEASURE OHMS, ALL RTDS IN A LOOP
- DEFINE ZERO LOAD TEMPERATURE, AVERAGE OF 4 RTDS
- ADJUST R/E CONVERTERS FOR DIFFERENCES FROM AVERAGE TEMPERATURE
- RECONNECT RTD TO R/E CONVERTERS, MEASURE ALL TEMPERATURES (VOLTS)

AT POWER:

- MEASURE ALL TEMPERATURES (VOLTS), DEFINE CHANGES IN TEMPERATURE, SPECIFY AVERAGE HOT LEG TEMPERATURE AND COLD LEG TEMPERATURE
- CONCURRENTLY MEASURE SECONDARY POWER (CAN BE ONE LOOP AT A TIME), CALCULATE PRIMARY FLOW
- CONCURRENTLY MEASURE ELBOW TAP ΔPS

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

1. RTD RESPONSE TIME

2. RTD ACCURACY

   - FLOW MEASUREMENT UNCERTAINTY
   - RCS Tavg UNCERTAINTY
   - PROTECTION SYSTEM SETPOINTS

3. CONCLUSIONS

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

1. RTD RESPONSE TIME

- Typical RTD Bypass System about 6 seconds
- Fast Response Thermowell RTD System about 7 seconds

DUE TO HOT LEG TEMPERATURE OSCILLATIONS EXPERIENCED AT McGUIRE 2, FILTER TIME CONSTANTS ON MEASURED Tavg AND DELTA-T WERE INCREASED FROM 2 TO 6 SECONDS. ANALYSES WERE PERFORMED TO JUSTIFY AN OVERALL RESPONSE TIME OF 8 SECONDS. THEREFORE, CURRENT ANALYSES REMAIN BOUNDING.

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

2. RTD ACCURACY

* FLOW MEASUREMENT UNCERTAINTY

  - EVALUATIONS WILL BE BASED ON NEW CALORIMETRIC PROCEDURES

    * Minimum measured flow remains unchanged
      - no impact on DNB transients
    * Thermal design flow remains unchanged
      - no impact on non-DNB transients
      - no impact on LOCA analyses

  - TECHNICAL SPECIFICATION FOR FLOW MEASUREMENT UNCERTAINTY IS UNCHANGED

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

2. RTD ACCURACY (cont)

* RCS Tavg UNCERTAINTY

  - DNB TRANSIENTS

    * Core limits remain unchanged
    * Safety analysis-DNBR limit unchanged
    * Design DNBR limit increase is small

  - NON-DNB TRANSIENTS

    * Evaluations will be based on the new RTD accuracy

  - TECH SPEC CHANGES MAY BE REQUIRED FOR INDICATED Tavg

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

2. RTD ACCURACY (cont)

* PROTECTION SYSTEM SETPOINTS

  - OVERTEMPERATURE AND OVERPOWER DELTA-T TRIPS
    * Evaluate existing margin between safety analysis limit and tech spec limit
    * Derive new setpoint equations, if necessary

  - LOW REACTOR COOLANT LOOP FLOW TRIP
    * Evaluate existing margin between safey analysis limit and tech spec limit
    * Reanalyze transients affected by low flow trip setpoint, if necessary

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

AFFECTED TRANSIENTS

NON-DNB

- TURBINE TRIP/LOSS OF EXTERNAL ELECTRICAL LOAD (Non-ITDP)
- LOSS OF NORMAL FEEDWATER/LOSS OF AC POWER (Non-ITDP)
- FEEDLINE RUPTURE (Non-ITDP)
- LOCKED ROTOR (Non-ITDP, Low Flow Trip)
- RCCA EJECTION (Non-ITDP)

[Non-ITDP transients reanalyzed due to T-ave unc.]

DNB

- PARTIAL LOSS OF FLOW (Low Flow Trip)
- UNCONTROLLED RCCA BANK WITHDRAWAL AT POWER (OTΔT)

McGUIRE RTD BYPASS ELIMINATION

SAFETY ANALYSIS IMPACT

3. CONCLUSIONS

* ALL CHANGES CAN BE EASILY ACCOMMODATED IN THE SAFETY ANALYSES
* FEW TECHNICAL SPECIFICATION CHANGES MAY BE REQUIRED

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