

December 15, 1985

DMB 016

Docket No. 50-313

FACILITY: ARKANSAS POWER AND LIGHT COMPANY

LICENSEE: ARKANSAS NUCLEAR ONE, UNIT 1

SUBJECT: SUMMARY OF MEETING WITH ARKANSAS POWER AND LIGHT COMPANY (AP&L)  
CONCERNING THE EMERGENCY FEEDWATER SYSTEM (EFW) AT ARKANSAS NUCLEAR  
ONE, UNIT 1 (ANO-1)

### Introduction

The NRC staff met with the representatives of AP&L at the NRC offices in Bethesda, Maryland, on November 14, 1985, at the invitation of the staff. The purpose of the meeting was to discuss the status and reliability of the EFW system at ANO-1. This included the pre TMI, post TMI, current and future EFW system of ANO-1. Also, the licensee came to discuss the NRC staff initiatives relating to the EFW system. Enclosure 1 is a list of the attendees. Enclosure 2 is a copy of the material presented by the licensee at the meeting.

### Discussion

The licensee presented the agenda. The EFW system was thoroughly discussed as indicated in Enclosure 2. The current planned system modifications are mostly complete. This includes the implementations of all Lesson Learned issues, NUREG 0737 II.E.1.1 and II.E.1.2 modifications and the Emergency Feedwater Initiation and Control (EFIC) system. For the EFIC system the licensee made substantial taps into the steam generators (OTSG), over and above those made or planned for Crystal River 3 and Rancho Seco. The licensee has had good experience in the operation of the EFIC system. All that is remaining to be completed is the implementation of the modifications for the OTSG overfill protection and tornado and seismic proof condensate storage tank and associated piping. These modifications are planned for the next refueling outage which will occur about in August 1986. Since 1979 the licensee has expended over \$25,000,000 for EFW system upgrades. The licensee now is concentrating on upgrading the reliability of the secondary systems which contribute to challenges to the EFW system.

The licensee has initiated a reliability study of the EFW system at ANO-1. They believe it will result in an unreliability close to  $10^{-4}$  with all improvements considered. The staff goals are an unreliability for Auxiliary Feedwater System of  $10^{-5}$  to  $10^{-4}$ . The staff initiatives are not finalized and the criteria for establishing the initiatives are under development.

Guy S. Vissing, Project Manager  
PWR Project Directorate #6  
Division of PWR Licensing - B

Enclosures: As Stated

cc w/enclosures: See next page

~~PDR~~  
GVissing;cf  
12/17/85

8512260248 851216  
PDR ADOCK 05000313  
P PDR

MEETING SUMMARY DISTRIBUTION

Licensee: Arkansas Power and Light Company

\*Copies also sent to those people on service (cc) list for subject plant(s).

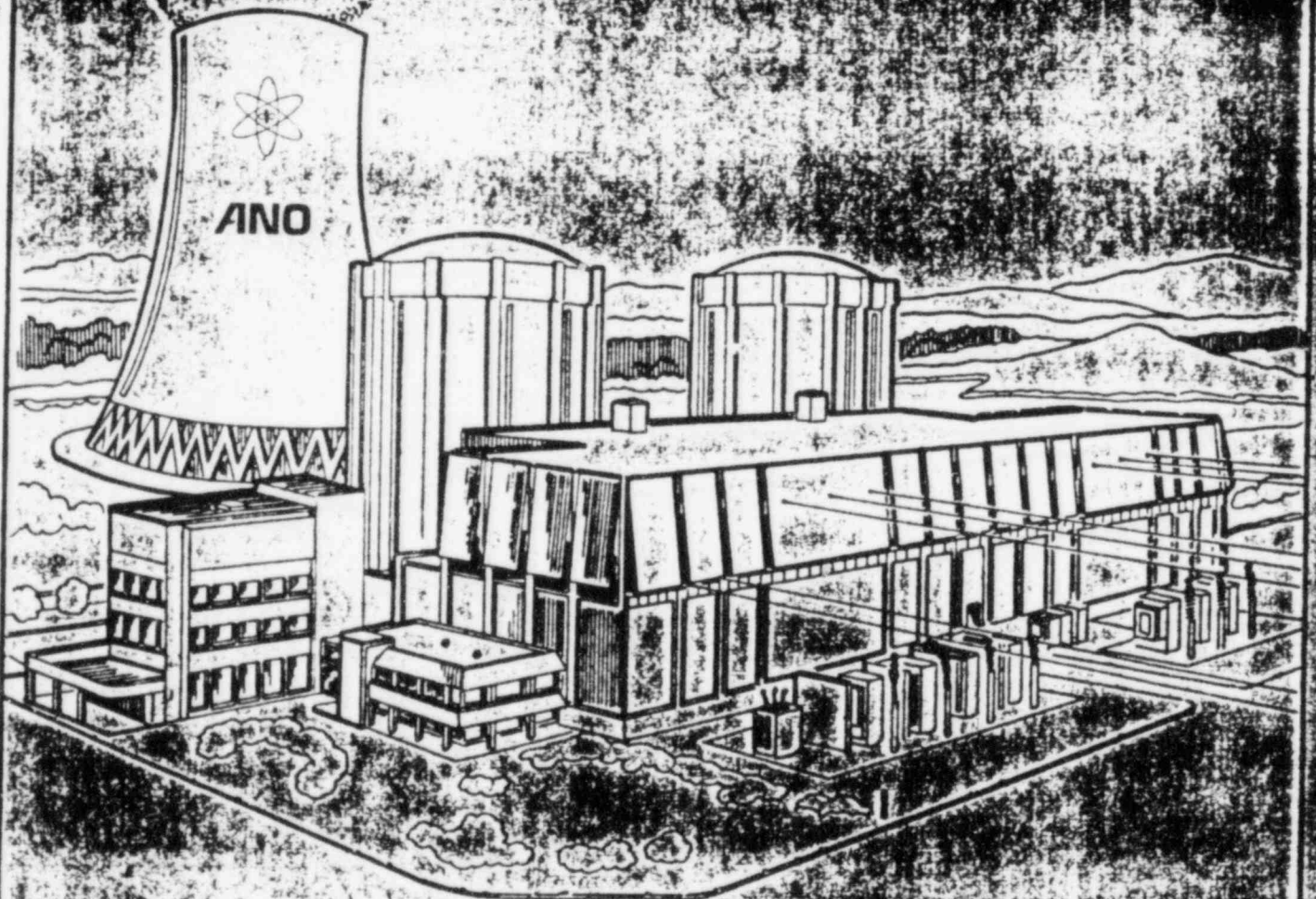
Docket File

NRC PDR  
L PDR  
PBD-6 Rdg  
JStolz  
GVissing  
OELD  
EJordan  
BGrimes  
ACRS-10  
NRC Participants  
RLee  
ATHadani  
OParr  
LRubenstein  
GEdison  
JLynn  
BMozafari  
LLieder  
MWagner  
DAllison  
JWermiel  
JRaval  
AEL-Bassioni  
WRegan

MEETING WITH AP&L, 11/14/85 CONCERNING EFWS

<u>Name</u>	<u>Organization</u>
Robert Lee	NRC
Ashok Thadani	NRC
Olan Parr	NRC
Lester Rubenstein	NRC
Gordon Edison	NRC
Jim Lynn	NRC
Brenda Mozafari	NRC
Lynn Lieder	NRC
Mary Wagner	NRC
Dennis P. Allison	NRC
Jerry Wermiel	NRC
J. H. Raval	NRC
A. El-Bassioni	NRC
William Regan	NRC
Guy Vissing	NRC
John Stolz	NRC
T. H. Cogburn	AP&L
Ted Enos	AP&L
A. J. Wrape	AP&L
Jim McWilliams	AP&L
Dan Howard	AP&L
Dan Williams	AP&L
W. M. Cawthon	AP&L
William T. Graddock	AP&L
Robert Borsum	B&W-Bethesda
Bob Enzinna	&BW
E. R. Schmidt	NUS Corp.
Larry Kroll	NUS Corp.
Rolf C. Widell	Florida Power Corp./Eng.
Gary Westafer	Florida Power Corp. Lic.

ANO-1  
EMERGENCY FEEDWATER  
SYSTEM REVIEW  
NOVEMBER 14, 1985



**ARKANSAS**  
POWER & LIGHT



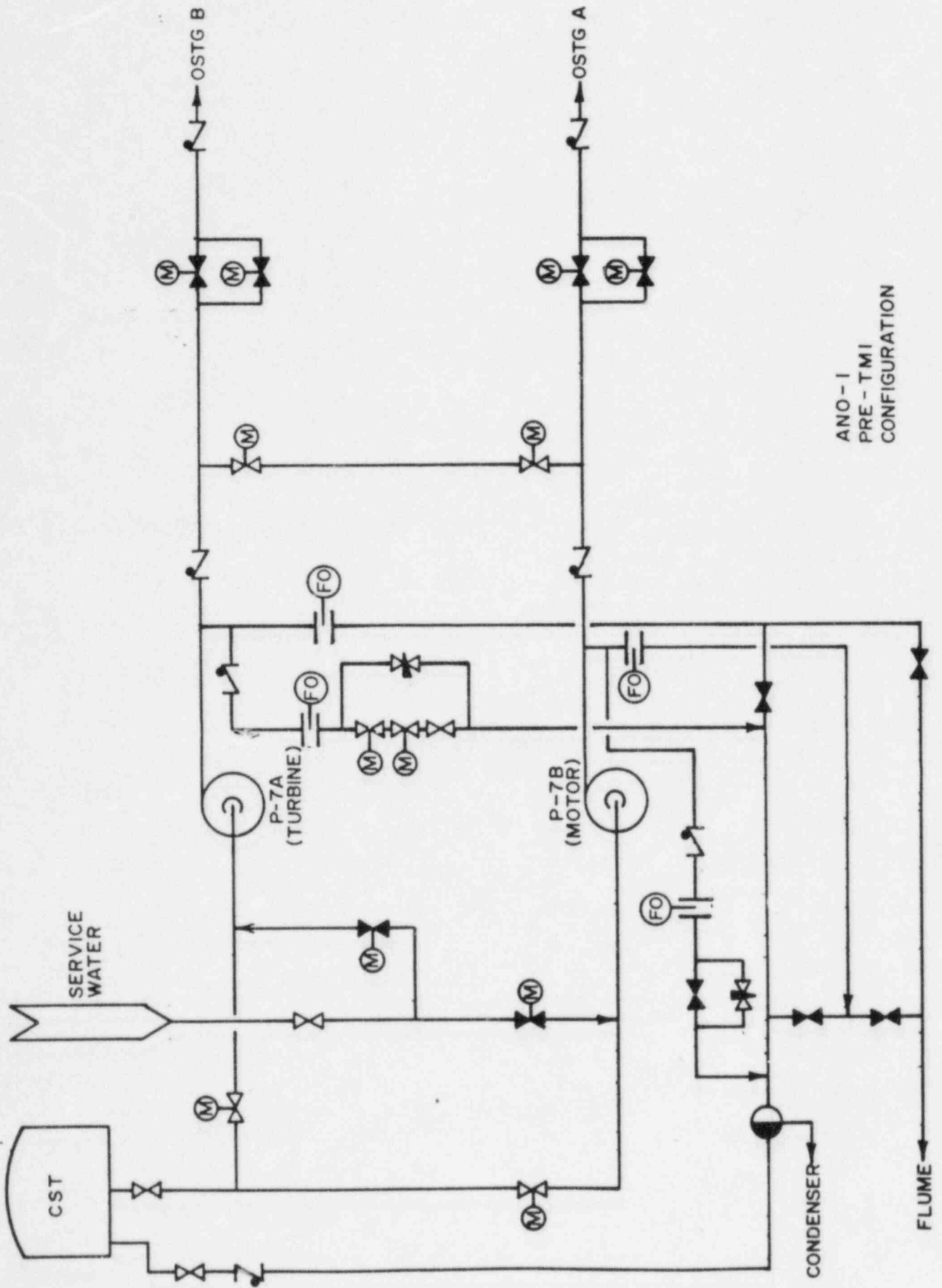
## *AGENDA*

- o OPENING REMARKS*
- o SYSTEM EVOLUTION & DESCRIPTION OF  
PRESENT SYSTEM*
- o RELIABILITY STUDIES*
- o SYSTEM PERFORMANCE*
- o PLANT TRIP REDUCTION PROGRAM*
- o CONCLUDING REMARKS*

*PURPOSE OF MEETING*

- o Update NRC on Current EFW System*
  
- o Inform NRC of AP&L Activities to Improve  
Plant Performance*

*SYSTEM EVALUATION & DESCRIPTION OF PRESENT SYSTEM*



ANO-1  
PRE-TMI  
CONFIGURATION

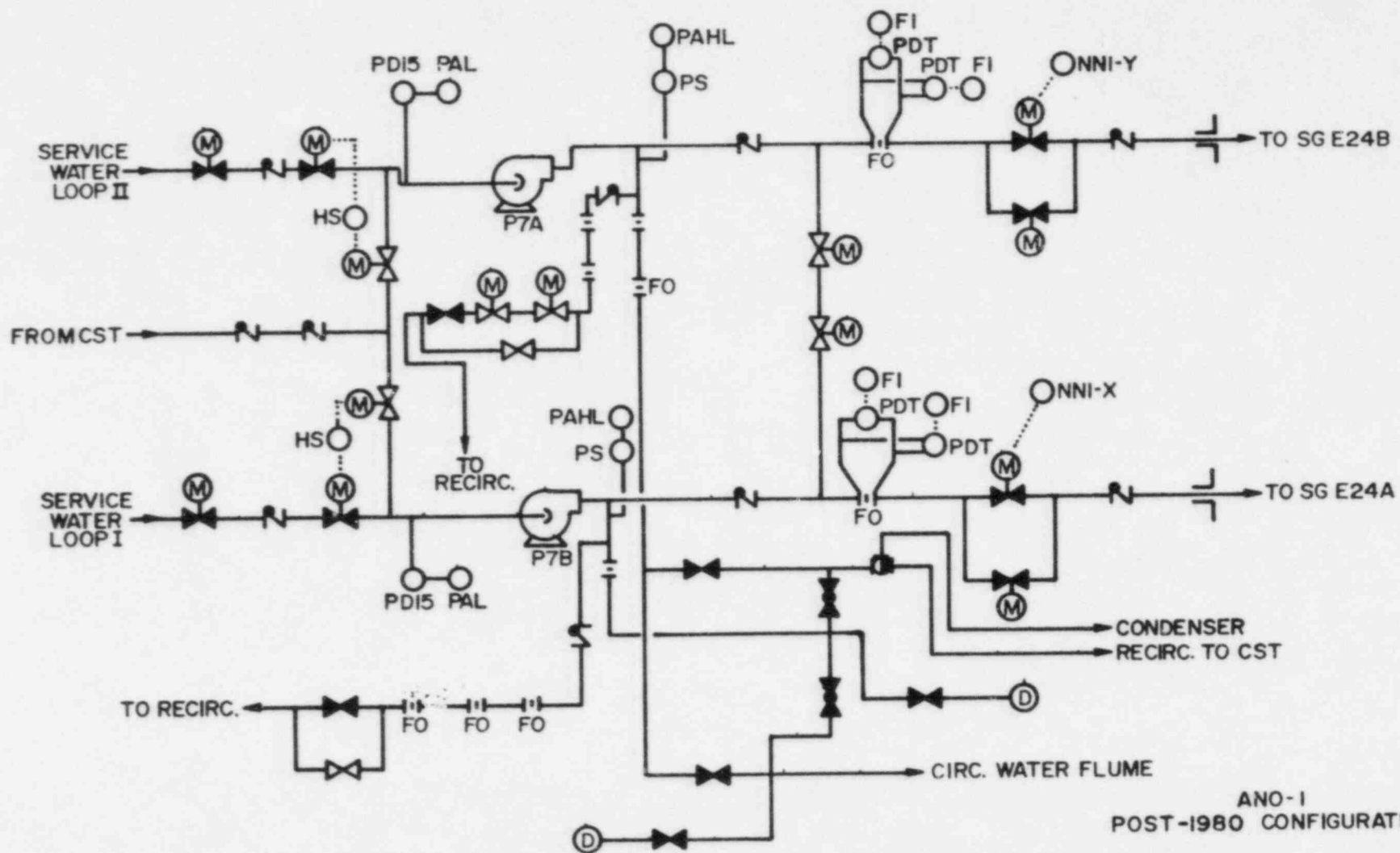
*ANO-1 POST TMI RESTART MODIFICATIONS (1979)*

- o Motor Driven Pump ICS Auto Start*
- o Control Grade Flow Indication*
- o Control Grade Anticipatory Reactor Trip*  
*Loss of Both MFW Pumps*  
*Turbine Trip*
- o EFW Auto Start Annunciation in Control*  
*Room*



## *1980 EFW SYSTEM MODIFICATIONS*

- o NNI Auto Initiation*
  - Loss of all RCPs*
  - Loss of MFW Pumps*
  - Low OTSG Level*
- o Motor Driven Pump Connected to Safety Grade Power*
- o Safety Grade Flow Indication*
- o SW Suction - Redundant Source*
- o EFW Low Suction Pressure Alarm*
- o Safety Grade Anticipatory Reactor Trip*
  - Loss of Main Feedwater*
  - Turbine Trip*
- o Upgraded NNI Power Supplies (CR-3)*
- o Motor & Turbine Driven Pump Bearing Cooling System Added*



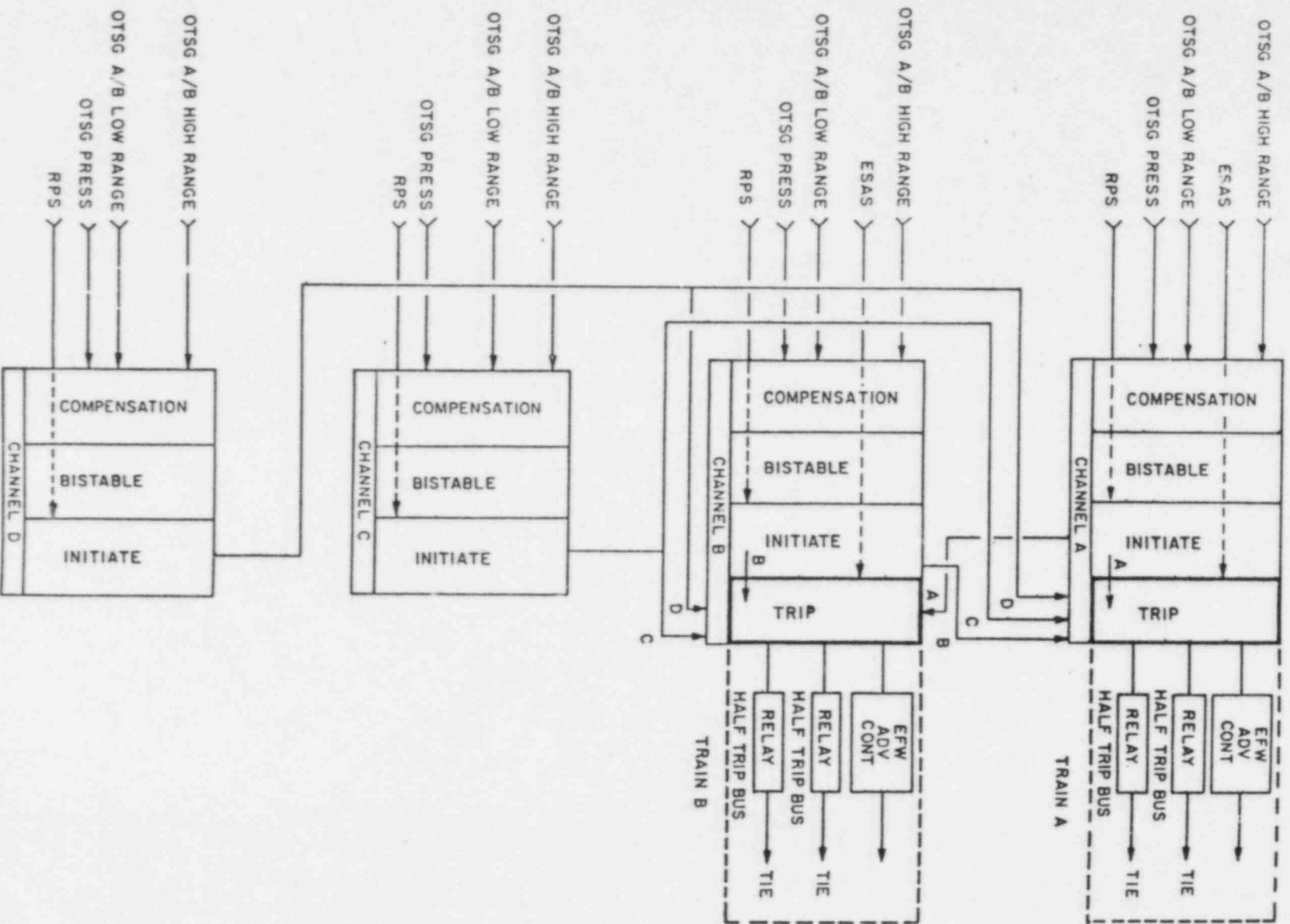
ANO-1  
POST-1980 CONFIGURATION

## *1982 EFW SYSTEM MODIFICATIONS*

- o EFIC Cabinets Installed and Powered*
- o New C09 Installed*
- o OTSG Level Measurement System*
  - OTSG Level Taps*
  - New Level Transmitters*
  - EFIC Compensation*
  - Indication on C09*
  - Indication on SPDS*
- o OTSG Pressure Measurement System*
  - MSL Taps*
  - Pressure Transmitters*
  - EFIC Compensation*
  - Indication on C09*
  - Input to Steam Line Isol. System*
  - Indication on SPDS*
- o Protection System Inputs to EFIC*
  - RPS, Loss of RCPs, Loss of MFWPs*
  - ESAS Loss RCS Pzr or High RB Pzr*

*1982 EFW SYSTEM MODIFICATIONS (Continued)*

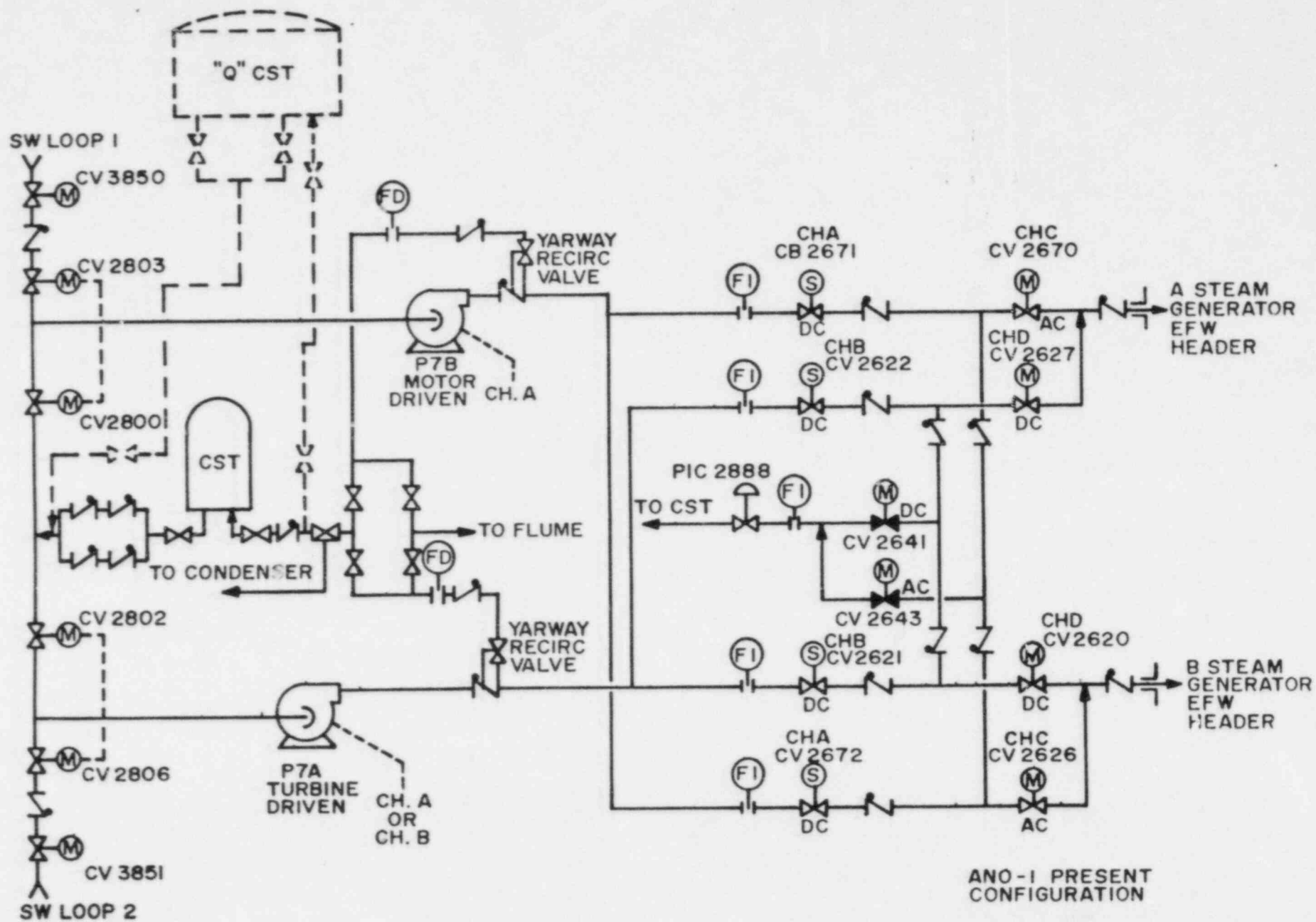
- o New EFW Turbine Driver Installed  
Electronic Speed Control W/Ramp  
Existing Steam Admission Valves  
to Step Open  
EFW Steam Piping Modified  
New DC Steam Admission Valves  
Welded in - Locked Open*
- o EFW Related Annunciation Consolidated on K12*

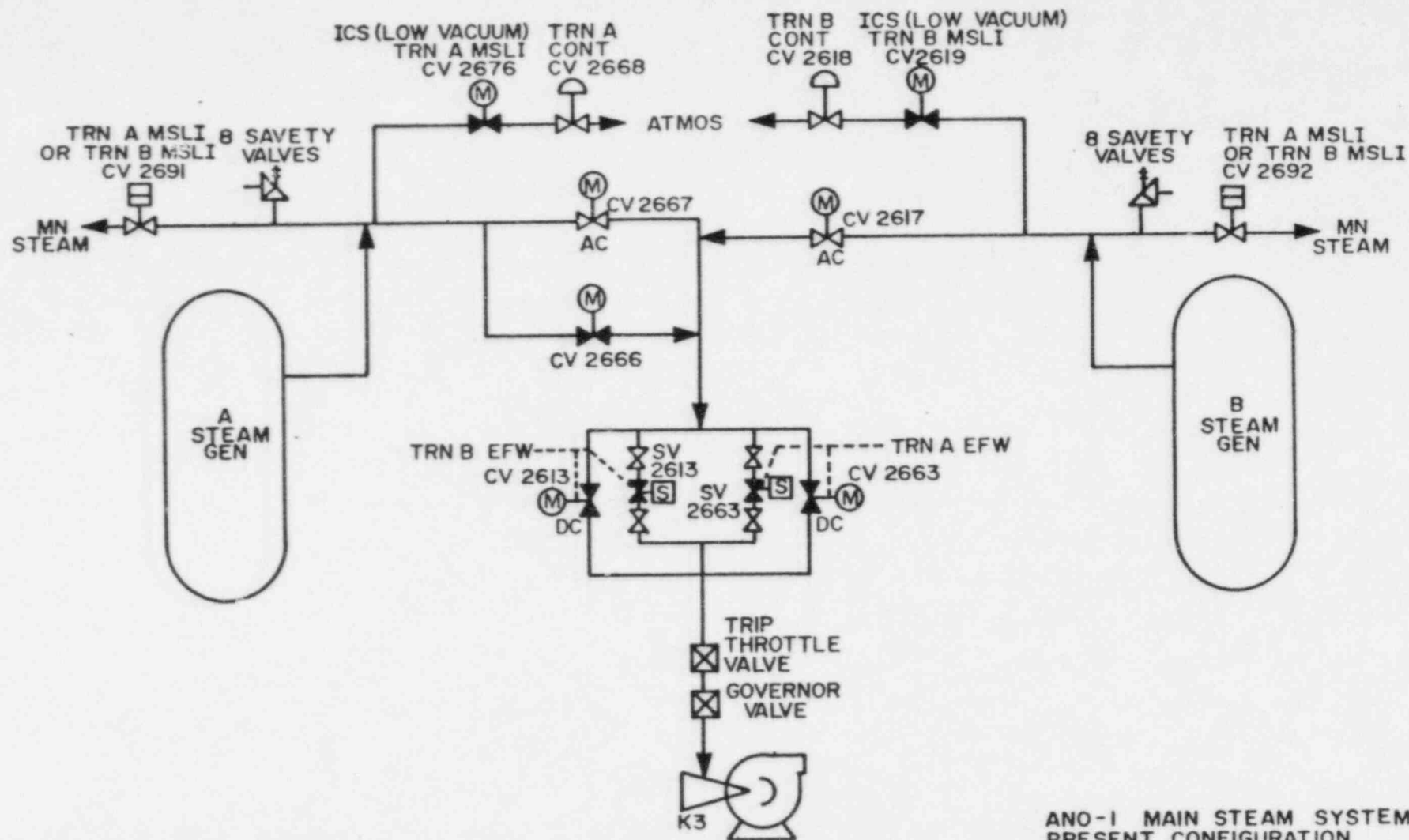




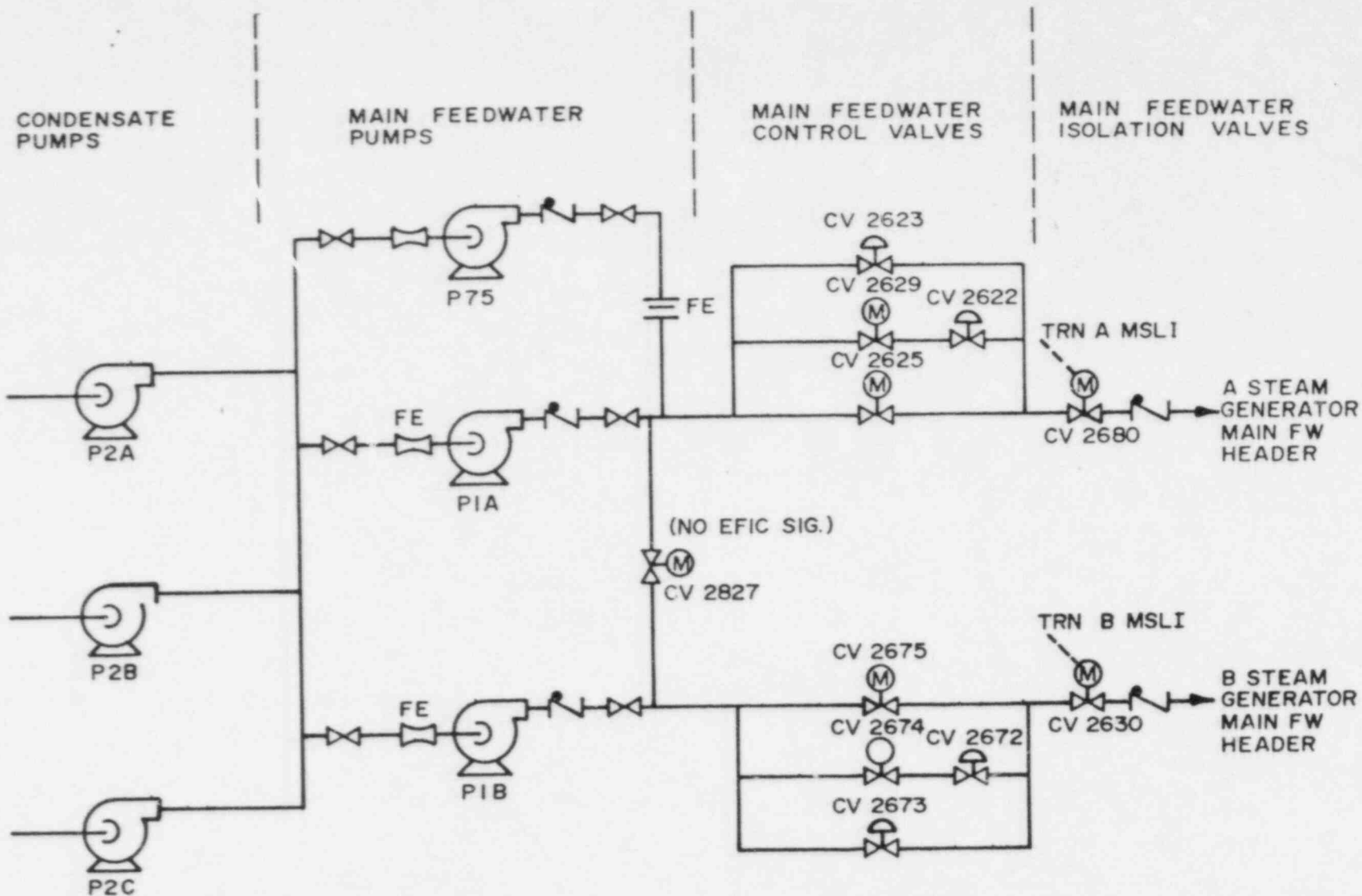
## *1984 EFW SYSTEM MODIFICATIONS*

- o EFW Discharge Piping & Valves Installed*
- o EFIC Connected to Controlled Components*
- o EFW and EFIC Controls Installed on C09*
- o EFW and EFIC Annunciation Installed on K12*
- o Safety Grade DC MCCs Installed*
- o EFW Turbine Driver Steam Admission System  
Connected*

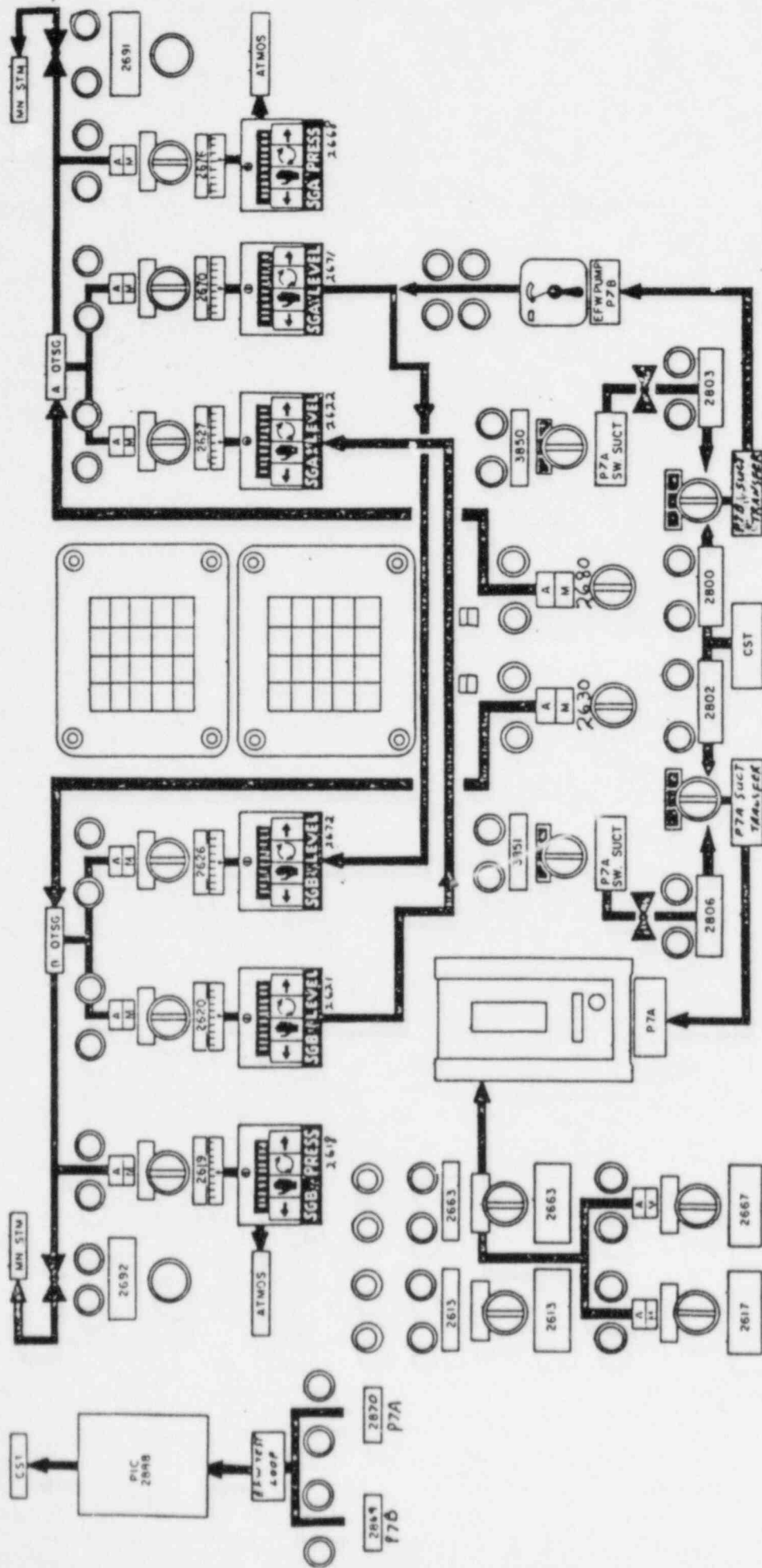




ANO-1 MAIN STEAM SYSTEM  
PRESENT CONFIGURATION



ANO-1  
MAIN FEEDWATER SYSTEM  
PRESENT CONFIGURATION





*PRESENT EFW SYSTEM DESIGN SUMMARY*

- o Safety Grade Initiation & Control System  
(EFIC)*
- o Designed to:  
IEEE 279-71  
IEEE 384-75  
IEEE 323-74  
IEEE 344-75*
- o Redundant & Diverse Motive Pump & Valve  
Power Supplies*
- o Exceeds APCSB 10-1*
- o Full Flow, Auto Terminated, On-Line  
Test Capability*
- o Safety Grade Automatic FOGG OTSG Control*

*PRESENT EFW DESIGN SUMMARY (Continued)*

- o Safety Grade Continuous Level Control*
- o ICS Independent ADV Pressure Control*
- o Controlled Turbine Driver Start System*
  - Solenoid Valve Warmup & Roll*
  - Govenor Ramp to Set Speed*

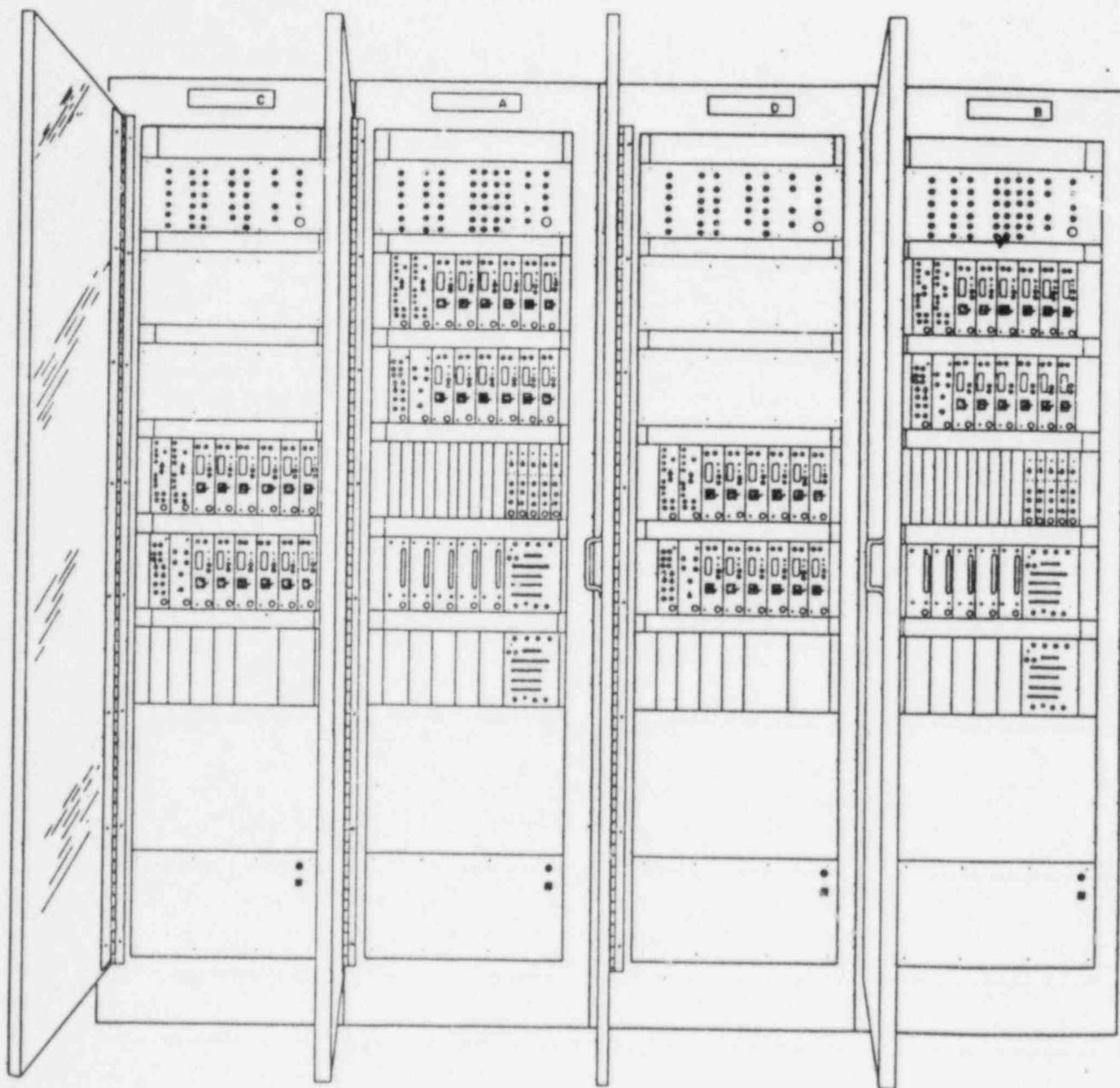
*ANO-1 CONTROL ROOM DESIGN REVIEW  
EFW SPECIFIC HEDS*

*SIGNIFICANCE RATING*

	<i>I</i>	<i>II</i>
<i>Pre 1984 System</i>	<i>3</i>	<i>1</i>
<i>Current System</i>	<i>0</i>	<i>0</i>

## *EFIC FEATURES*

- o 4 Channel 1 of 2 Taken Twice Initiation*
- o Pzr & Temp Compensated OTSG Level*
- o On-Line, Half Trip Test Capability from  
Bistable to Actuated Device*
- o On Board Test Facilities for Complex  
Compensation & Control Functions*
- o Fiber Optic Interchannel Isolation*
- o Extensive Cabinet & External Annunciation*



EFIC CABINET FRONT VIEW



## EFIC INITIATION

### INITIATE

### PARAMETER

EFW

Trip all RCPs

Trip both MFW Pumps

Low SG A Level

Low SG B Level

Low SG A Pzr.

Low SG B Pzr.

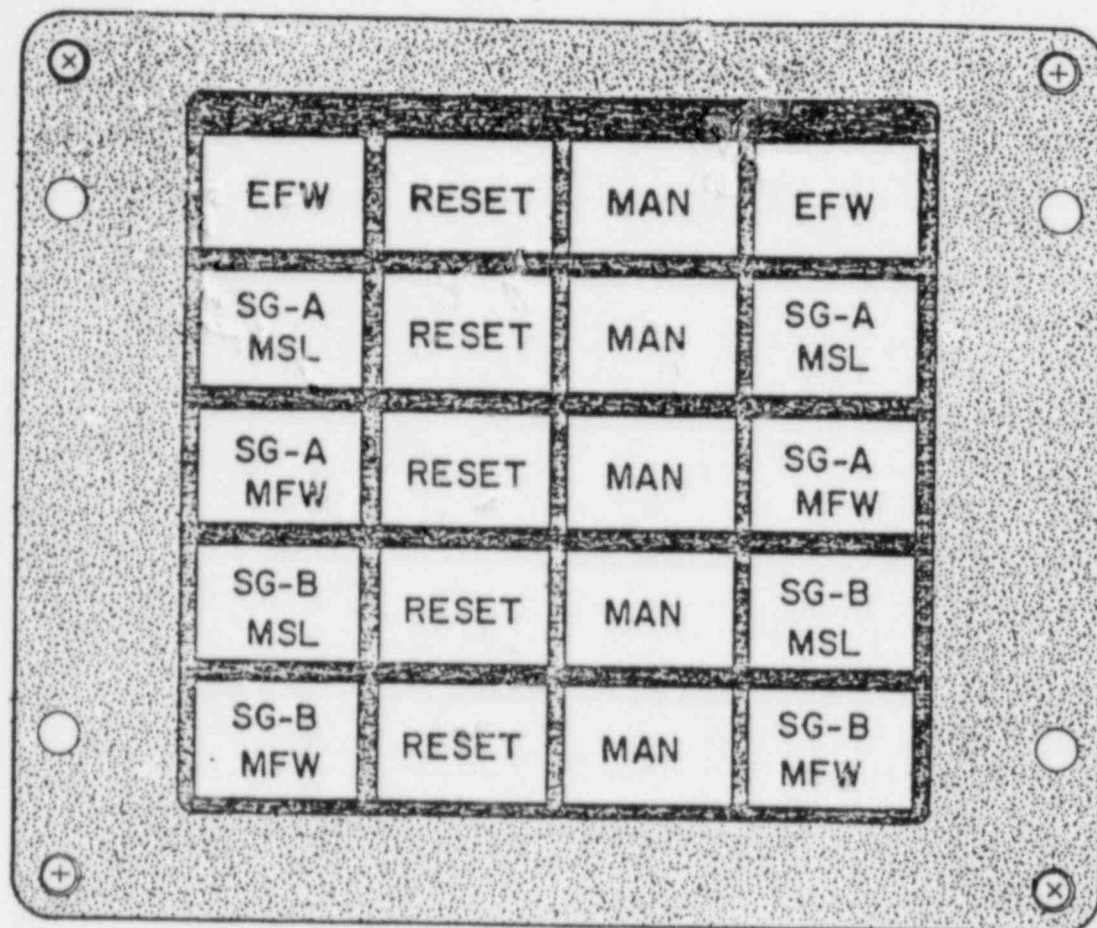
ESAS ECC Trip

SG A MSL Isol.

Low SG A Pzr.

SG B MSL Isol.

Low SG B Pzr.



TRAIN A OR TRAIN B

*EFIC VECTORS*  
*VECTOR SIGNALS TO EFW VALVES*

<i>PRESSURE STATUE</i>	<i>SGA EFW VALVES COMMAND</i>	<i>SGB EFW VALVES COMMAND</i>
<i>SGA &amp; SGB &gt; 600 PSIG</i>	<i>OPEN</i>	<i>OPEN</i>
<i>SGA &gt;600 PSIG &amp; SGB &lt;600</i>	<i>OPEN</i>	<i>CLOSE</i>
<i>SGA &lt;600 PSIG &amp; SGB &gt;600</i>	<i>CLOSE</i>	<i>OPEN</i>
<i>SGA &amp; SGB &lt;600 PSIG &amp; SGA &amp; SGB WITHIN 100 PSID</i>	<i>OPEN</i>	<i>OPEN</i>
<i>SGA 100 PSI &gt; SGB</i>	<i>OPEN</i>	<i>CLOSE</i>
<i>SGB 100 PSI &gt; SGA</i>	<i>CLOSE</i>	<i>OPEN</i>

- o Vector Action Based Solely on Instrument Inputs  
to EFIC - no Manual Actions*
- o No Single Operator Action Can Isolate EFW to  
Both Steam Generators*

## *EFIC CONTROL*

### *o Redundant OTSG Level Rate Control*

*Low Level Setpoint*

*Natural Circulation Setpoint*

*SBLOCA/REFLUX Boiling Setpoint*

*Capability for Manual Override  
with Auto Restoration*

### *o OTSG Pressure Control*

*Auto Opening of ADV Block Valves*

*ADV Control to Maintain Set Pzr.*

*EFW/EFIC UPGRADE RESOURCES*

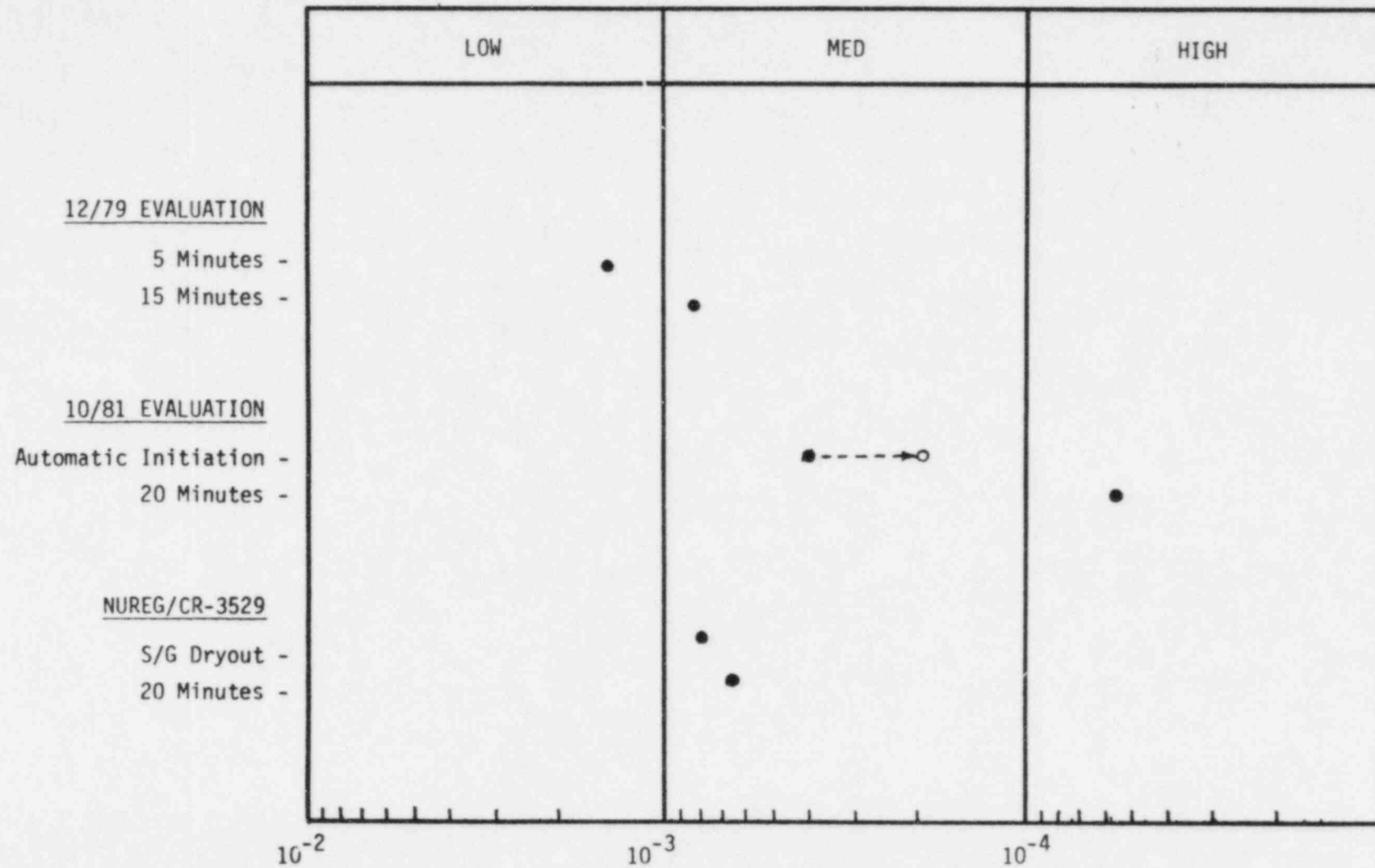
- o \$15,500,000. Total Project Cost*
- o 900 Ft of Seismic Class II 600 Lb Pipe*
- o 25,000 Ft of Cable*
- o 1000+ Electrical Terminations*
- o 22,000 Electrical Craft Manhours*
- o 22,000 Mechanical Craft Manhours*
- o 10,000 AP&L Manhours*
- o 16 Weeks Outage Time*
- o 24 Hour Standby Functional Testing*

*RELIABILITY STUDIES*

*EFW RELIABILITY STUDIES*

<i>12/79</i>	<i>BAW - 1584</i>	<i>Generic FA177 Study</i>
<i>10/81</i>	<i>EFW/EFIC Reliability Study (B&amp;W)</i>	<i>Plant Specific</i>
<i>6/82</i>	<i>NUREG/CR-2787 (IREP-Sandia)</i>	<i>Plant Specific</i>
<i>4/83</i>	<i>EFIC Initiation Logic Reliability Study (VITRO)</i>	<i>Plant Specific Control Logic Only</i>
<i>2/84</i>	<i>NUREG/CR-3529 (Brookhaven)</i>	<i>NUREG-0611</i>

ANO-1 LMFW

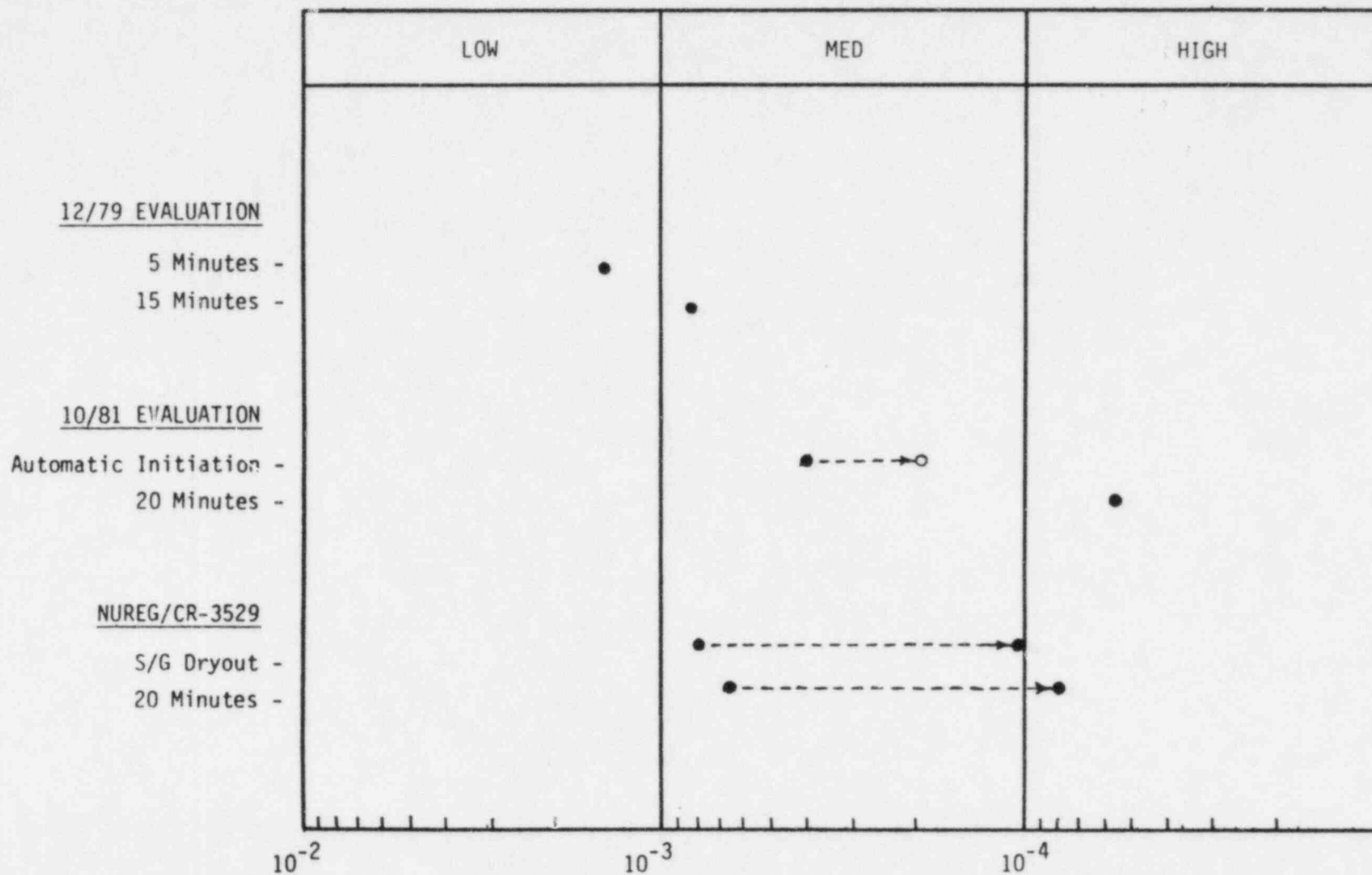




*UPDATE TO NUREG/CR-3529  
CONSISTENT WITH NUREG-0611/BROOKHAVEN*

- o Single Point Failures Eliminated By  
Q CST (4 x 10E-04)*
- o Maintenance Outages In Violation of  
Technical Specifications*
- o Full Flow Testing Not Credited*
- o Plant Specific Initiation Reliability*

# ANO-1 LMFW



*ADDITIONAL ADJUSTMENTS TO NUREG/CR-3529  
NOT QUANTIFIED*

- o Stuck Open SG Relief Valve Failure Conservative  
Application to AND-1 as Compared to  
Other Brookhaven Analyses*
- o 5 Minute Limited Operator Action*
- o 3rd Pump (AFW/Startup Pump)*
- o Alternate Decay Heat Removal*

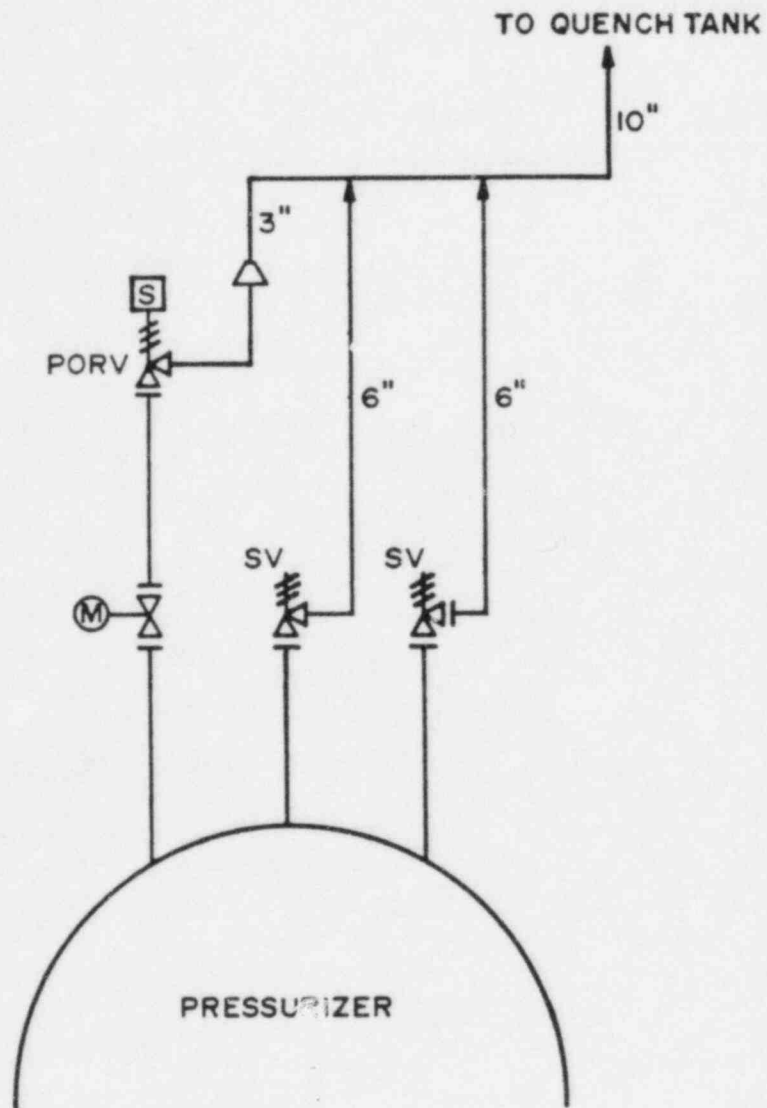
1981 REVISION TO STANDARD REVIEW PLAN

*"An Acceptable AFWS Should Have an Unreliability in the Range of  $10^{-4}$  to  $10^{-5}$  per Demand Based on an Analysis Using Methods and Data Presented in NUREG-0611 and NUREG-0634. Compensating Factors such as Other Methods of Accomplishing the Safety Functions of the AFWS or Other Reliable Methods for Cooling the Reactor Core During ABnormal Conditions may be Considered to Justify a Larger Unavailability of the AFWS."*

*DECAY HEAT REMOVAL SYSTEMS  
ADDRESSED IN ANO-1 EOPs*

- o Main Feedwater Pumps*
- o Startup Pump*
- o EFW*
- o Condensate Pumps to SGs*
- o Service Water Pumps to SGs*
- o Feed & Bleed Cooling*
  - High Head HPI Pumps*
  - Full Decay Heat Removal Capability*
  - Supported by Analysis*

ANO-1  
PORV & PRESSURIZER SAFETY VALVES



*SYSTEM PERFORMANCE*

## *EVALUATION OF CURRENT SYSTEM PERFORMANCE*

- o Existing EFW System is Completely New  
and has been in Operation Only  
During 1985*
- o Operational History is too Short to  
Develop Meaningful History of  
Performance*
- o Components, Maintenance, & Operation are  
Similar to ANO-2 and Similar  
Performance is expected*
- o No Single or Two Train Failures have  
been Experienced During 1985 with  
the new System*



*PLANT TRIP REDUCTION PROGRAM*

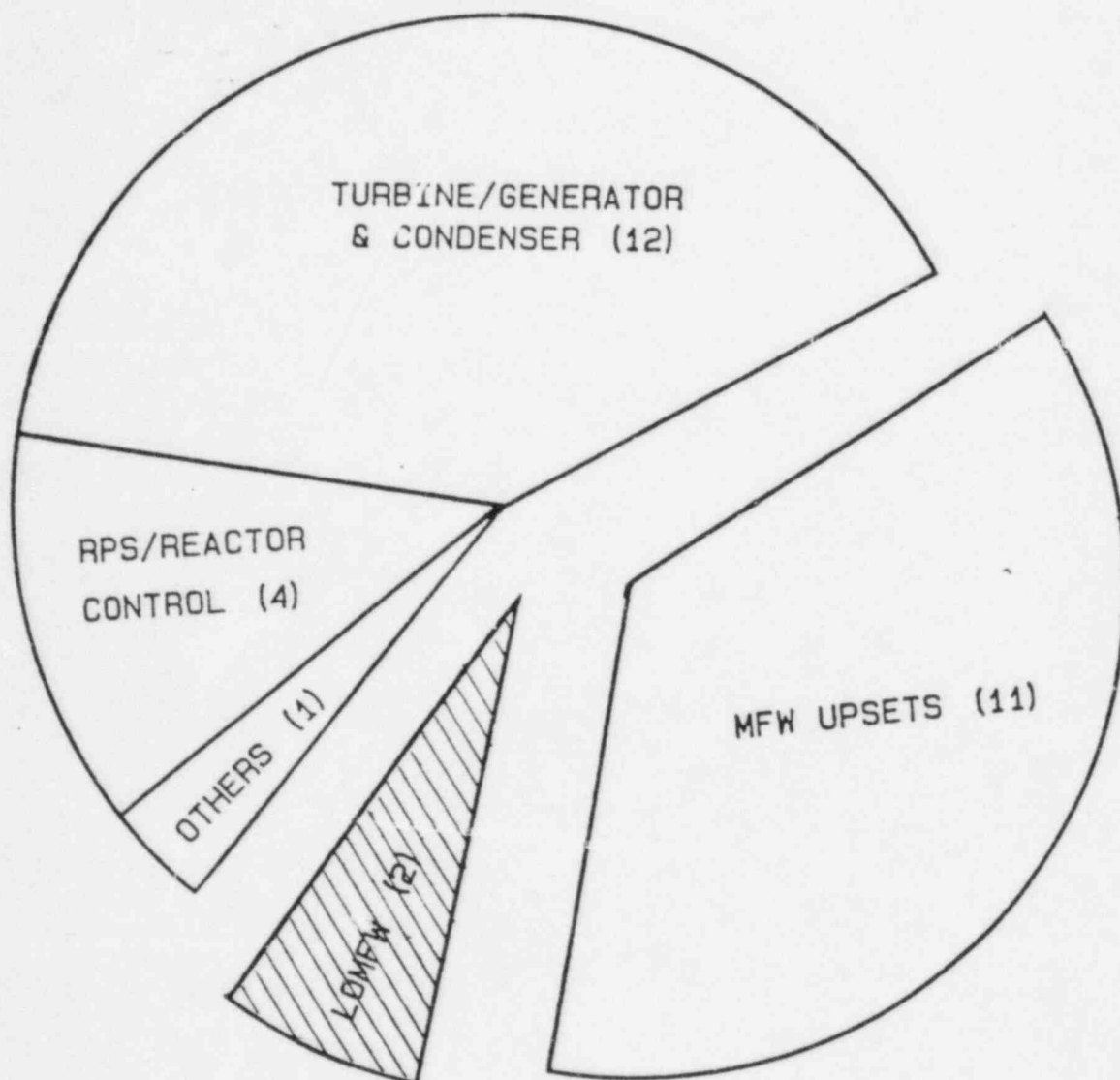
*PLANT TRIP REDUCTION PROGRAM*

*Why Have Such a Program?*

*o Reduces Challenges to Safety Systems*

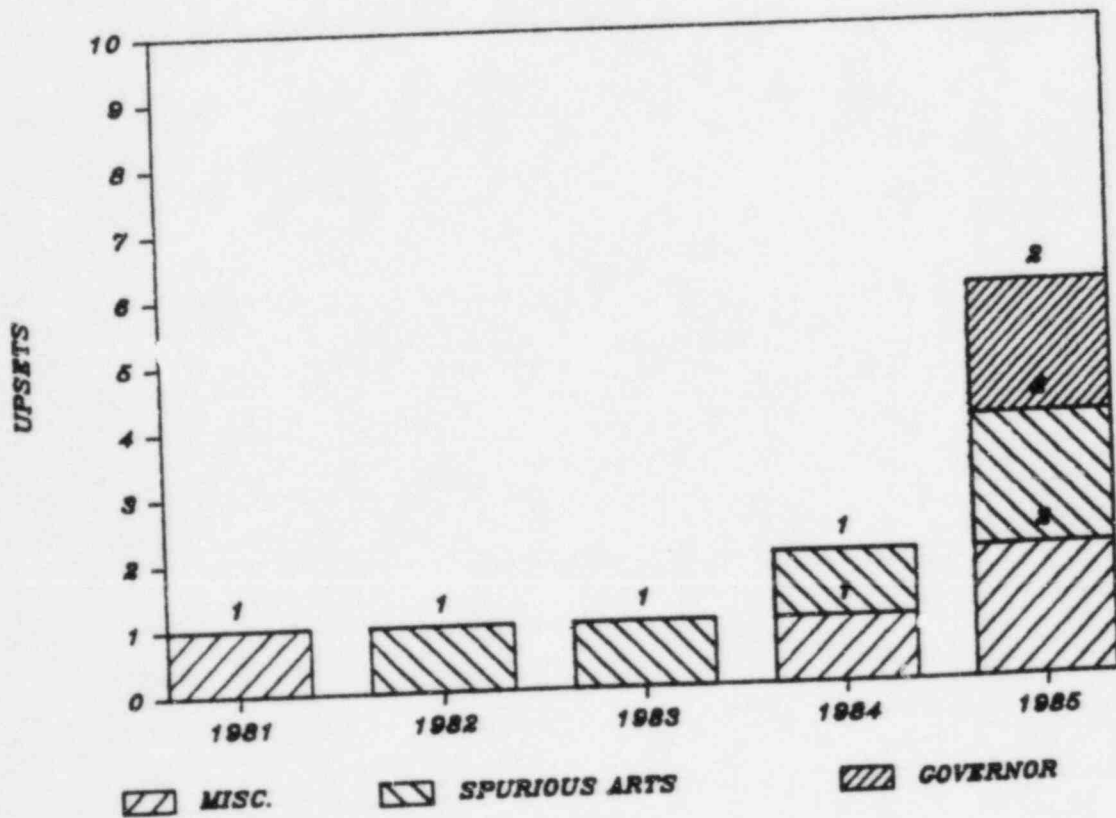
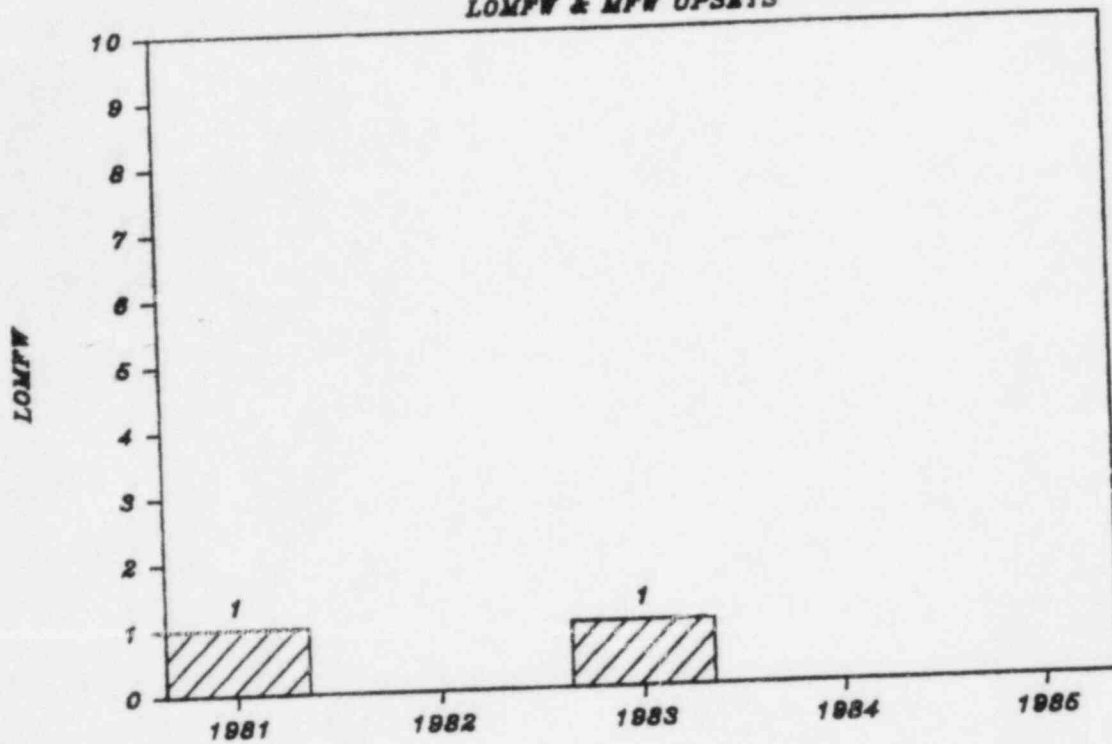
*o Economics*

# PLANT TRIPS



1981-1985

# PLANT TRIPS LOMPW & MPW UPSETS



## *TRIP REDUCTION EFFORTS*

### *o BWOOG*

- Transient Assessment Program*
- Availability Committee*
  - Evaluation of ICS (11/85)*
  - Evaluation of ICS Input*
  - Failures (11/85)*
  - Reduction of Feedwater Pump*
  - Trips (12/85)*
  - Reduction of Trips Due to*
  - Personnel Error (ongoing)*
- 1154 Task Force*
  - Follow Up to 6/85 Davis Besse*
  - Event*
- Turbine Trip Reduction (1986)*

### *o NUMARC*

- Followup on all Automatic Scrams*
- Identification of Root Cause*
- Action Plan to Correct Discrepancies*
- Goals*
  - 3 or less Auto Trips while Synch*
  - 5 or less Auto Trips while Critical*

## *ANO-1 TRIP REDUCTION EFFORTS (Continued)*

### *o ANO Specific Efforts*

- Participation in BWOG Programs*
- Feedwater Control Evaluation*
  - Considering Major EFWPT Control*
  - Mods*
  - Possible MFW Reliability Study/*
  - FMEA*
- ARTS Modification to Reduce Spurious*  
*Trips*
- Plant Specific Simulator to Improve*  
*Operator Training*
- Maintenance/Human Performance*  
*Improvements*
- Defeated Low Vacuum Trip to MFW Pumps*
- Installed MFP Control Oil Filters*
- Defeated Low Hotwell Level Trip to*  
*Condensate Pumps*
- Defeated Low Lube Water Flow Trip to*  
*Circulating Water Pumps*
- Changed MSIV Solenoid Valves to*  
*Normally Deenergized*

*PROGRAMS TO IMPROVE MAINTENANCE  
AND HUMAN PERFORMANCE*

- o Work Control Center/Maintenance  
Management Computer System*
- o Preventative & Predictive Maintenance  
Improvement Project*
- o Technical Manual Review & Update Project*
- o Procedure Writer's Guide & Writer/  
Reviewer Training Program*
- o Drawing Updates/Plant Labeling Program*
- o Training Programs  
Facilities  
20% of Operator, Technician Time  
INPO Accreditation  
Plant Specific Simulators*
- o Control Room Design Review & Improvement  
Project*

*CONCLUDING REMARKS*



## *CONCLUSIONS*

- o 1st EFIC System Installed - 1984  
No Operational Problems*
- o High Quality System*
- o System Meets or Exceeds all Applicable  
Regulations*
- o SER Concludes Compliance with II.E.1.1 &  
II.E.1.2 & GL 81-14*
- o Meets Reliability Guidance in Standard  
Review Plan*
- o Loss of MFW Challenge Rate is low*
- o Current Plans/Schedules are Concentrated on  
Primary System and Trip Reduction  
Efforts*