

February 7, 2000

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template. Document  
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into Adams*

LICENSEE: Union Electric Company

FACILITY: Callaway Plant, Unit 1 (Callaway)

SUBJECT: MEETING SUMMARY OF JANUARY 27, 2000, CONFERENCE CALL, HELD IN PLACE OF THE MEETING FOR THE SAME DATE, TO DISCUSS THE LICENSEE'S PLANNED MODIFICATION OF THE TURBINE-DRIVEN AUXILIARY FEEDWATER PUMP GOVERNOR (TAC NO. MA8034)

A teleconference was conducted on Thursday, January 27, 2000, between the Nuclear Regulatory Commission (NRC) staff and the licensee for Callaway. The conference call was held at the request of the licensee to brief the NRC on the licensee's plans for a modification to the governor for the turbine-driven auxiliary feedwater (TD-AFW) pump. The modification is to replace the current governor with a digital governor.

The teleconference was held in place of a meeting on the same subject that was to be held on January 27, 2000, in room O-4B6. The meeting notice was issued December 16, 1999. Because of the heavy snow fall in the Washington area on January 24 and 25, 2000, the licensee and its contractor decided not to come to NRC's headquarters in Rockville, Maryland, and the teleconference was held instead.

Enclosure 1 is the list of attendees, and Enclosure 2 is the handout provided by the licensee by e-mail for the teleconference. The staff did not provide any handout. The agenda for the meeting is provided on page 1 of Enclosure 2. The licensee completed its presentation and the teleconference was brought to a close. There were no decisions made by the licensee or the staff during the call. This summary documents that the teleconference was made in lieu of the scheduled meeting.

 /RA/  
Jack N. Donohew, Senior Project Manager, Section 2  
Project Directorate IV & Decommissioning  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-483

- Enclosures: 1. List of Attendees  
2. Licensee's Handout

cc w/encls: See next page

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DATE	02/01/00		02/1/00		02/2/00		02/7/00

DOCUMENT NAME: G:\PDIV-2\Callaway\Summary06.mtg.wpd

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

February 7, 2000

LICENSEE: Union Electric Company

FACILITY: Callaway Plant, Unit 1 (Callaway)

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cc w/encls: See next page

Callaway Plant, Unit 1

CC

Professional Nuclear  
Consulting, Inc.  
19041 Raines Drive  
Derwood, Maryland 20855

John O'Neill, Esq.  
Shaw, Pittman, Potts & Trowbridge  
2300 N. Street, N.W.  
Washington, D.C. 20037

Mr. J. Schnock  
Supervising Engineer  
Quality Assurance Regulatory Support  
Union Electric Company  
Post Office Box 620  
Fulton, Missouri 65251

U.S. Nuclear Regulatory Commission  
Resident Inspector Office  
8201 NRC Road  
Steedman, Missouri 65077-1302

Mr. J. V. Laux, Manager  
Quality Assurance  
Union Electric Company  
Post Office Box 620  
Fulton, Missouri 65251

Manager - Electric Department  
Missouri Public Service Commission  
301 W. High  
Post Office Box 360  
Jefferson City, Missouri 65102

Regional Administrator, Region IV  
U.S. Nuclear Regulatory Commission  
Harris Tower & Pavilion  
611 Ryan Plaza Drive, Suite 400  
Arlington, Texas 76011-8064

Mr. Ronald A. Kucera, Deputy Director  
Department of Natural Resources  
P.O. Box 176  
Jefferson City, Missouri 65102

Mr. Otto L. Maynard  
President and Chief Executive Officer  
Wolf Creek Nuclear Operating Corporation  
Post Office Box 411  
Burlington, Kansas 66839

Mr. Dan I. Bolef, President  
Kay Drey, Representative  
Board of Directors Coalition  
for the Environment  
6267 Delmar Boulevard  
University City, Missouri 63130

Mr. Lee Fritz  
Presiding Commissioner  
Callaway County Court House  
10 East Fifth Street  
Fulton, Missouri 65151

Mr. Alan C. Passwater, Manager  
Licensing and Fuels  
Union Electric Company  
Post Office Box 66149  
St. Louis, Missouri 63166-6149

Mr. Garry L. Randolph  
Vice President and Chief Nuclear Officer  
Union Electric Company  
Post Office Box 620  
Fulton, MO 65251

LIST OF ATTENDEES AT CONFERENCE CALL OF JANUARY 27, 2000

MODIFICATION OF TD-AFW PUMP GOVERNOR

<u>NAME</u>	<u>AFFILIATION</u>
J. Donohew	NRC/NRR/PDIV-2
P. Loeser	NRC/NRR/EEIB
D. Shafer	Union Electric Company
D. Cooksey	Union Electric Company
D. Wingeermuehle	Union Electric Company
W. Muskkepf	Union Electric Company
C. Pain	Union Electric Company
R. Weeks	Engine Systems Inc.
B. Abernathy	Engine Systems Inc.

where:

- NRC = Nuclear Regulatory Commission
- NRR = Office of Nuclear Reactor Regulation
- PDIV-2 = Project Directorate IV & Decommissioning, Section 2
- EEIB = Electrical and Instrumentation and Controls Branch

# Agenda

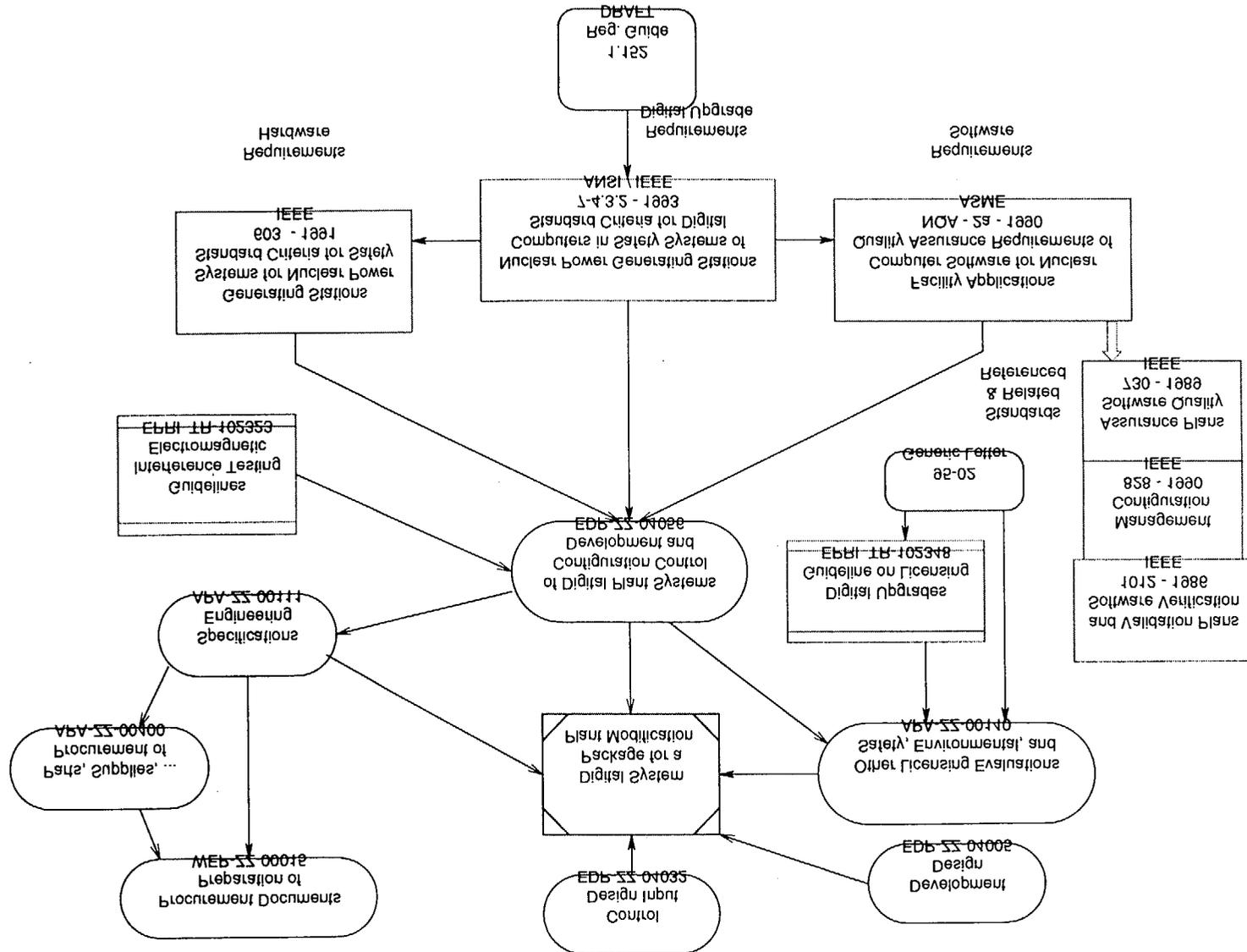
## January 27th, 2000

8:30 AM	Introduction	Dave Shafer - AmerenUE
8:40 AM	High Level Design & Modification Overview	Darrell Cooksey - AmerenUE
8:50 AM	Supplier Background & Qualification	Robin Weeks - Engine Systems
9:15 AM	System Design	Darrell Cooksey - AmerenUE
9:25 AM	Equipment Design	Chris Payne - Engine Systems
	Equipment Qualification & Testing	Brad Abernathy - Engine Systems
9:55 AM	Licensing Process	Dave Shafer - AmerenUE / NRC
10:10 AM	Open Discussion / Conclusions	All

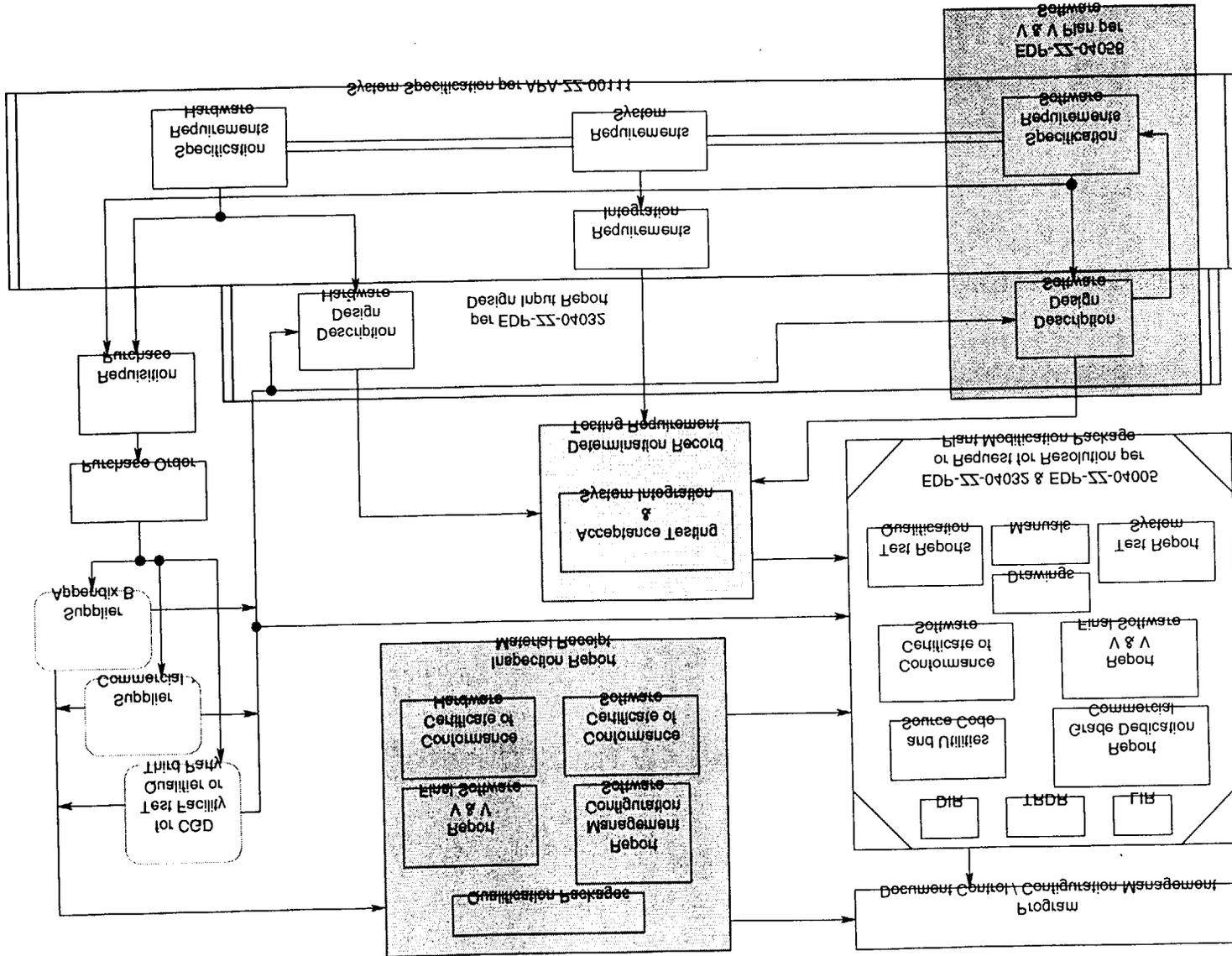
# Terry Turbine Governor & Controls Modification

High Level Design &  
Modification Overview

# Governing Documents



# Purchased Software



# Terry Turbine Governor & Controls Modification

Engine Systems Inc.  
Company Profile

# ESI Company Profile

## History

- Bruce GM Diesel, Founded 1969, NJ
- Relocated to Rocky Mount, NC - 1969
- Power Systems Division of Morrison-Knudsen -1974
- MKW Power Systems - 1990
- Engine Systems Inc. - 1996 to present
  - Diesel Repair Group of Kirby Corporation

# ESI Company Profile

## Products

- ElectroMotive Division (EMD) of General Motors - Authorized Distributor for US East Coast and Caribbean
- Generator Set Packager
  - 700-3500 kWe
  - Stationary Power for Base Load, Peaking, and Standby Emergency Power
  - Marine Power for Diesel/Electric Propulsion and Shipboard Power

# ESI Company Profile

## Products

- US Navy CVN High Shock Qualified Gensets
  - 2000 kWe
  - 12 units delivered
- Marine Propulsion Engine Packager
  - 1000-5000 BHP
- Worldwide Distributor for EMD Diesels in Nuclear Applications
  - 10CFR50 Appendix B Supplier
  - 37 nuclear sites worldwide

# ESI Company Profile

## Products

- Woodward Governor Company Central Distributor, Power Control Services (1995-1998)
- Woodward Nuclear Distributor - 1996 to present
- Other
  - Engine/Generator Controls and Switchgear

# ESI Company Profile

## Services

- Engineering Design
  - Control modifications
  - Piping modifications
  - Load Studies
- Testing
  - Seismic
  - Environmental
  - Materials

# ESI Company Profile

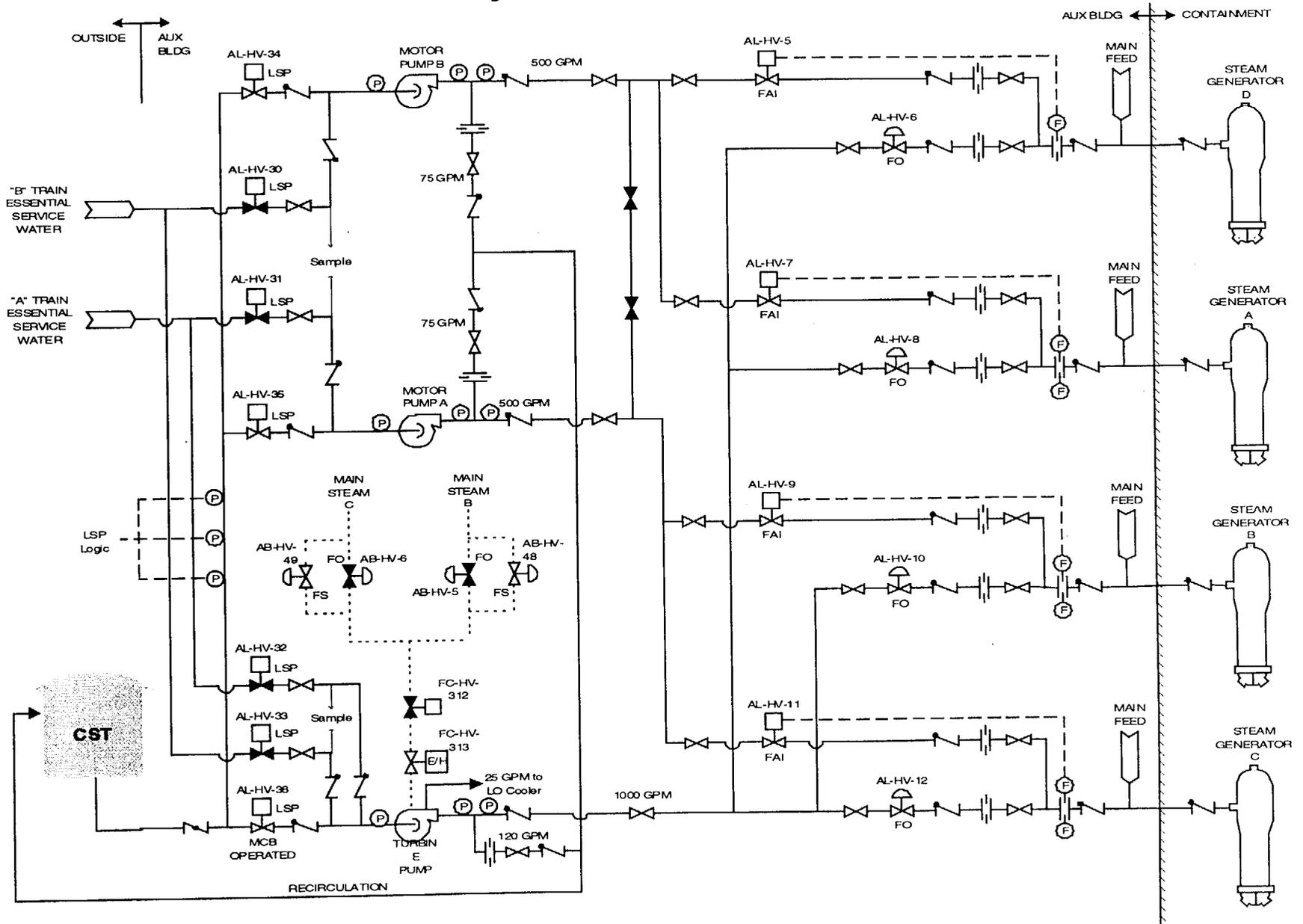
## Services

- Field Service
  - Worldwide support
  - On-site Technicians and QC
- Training
  - ESI Training Center
  - On-site

# Terry Turbine - Governor & Foxboro Control Loop

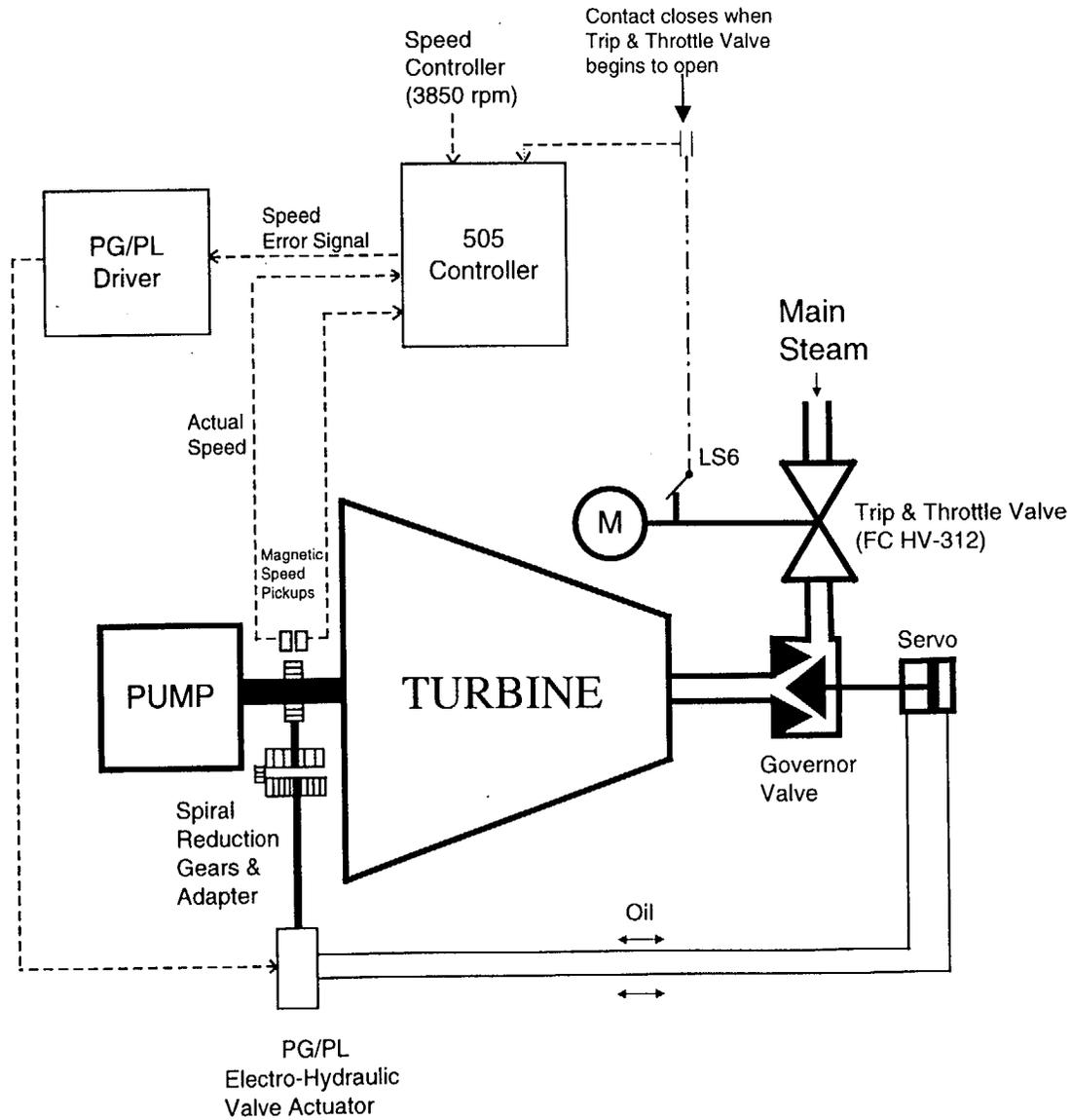
System Design

# Auxiliary Feedwater System





# New TDAFP Control Overview



# Terry Turbine - Governor & Foxboro Control Loop

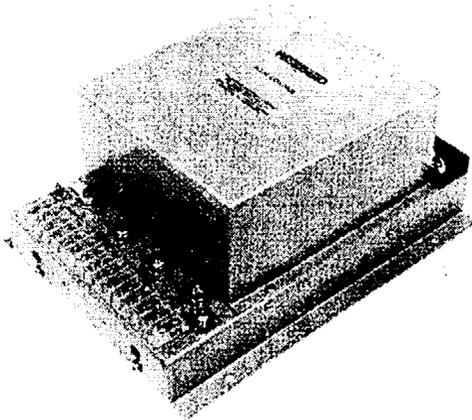
Present Equipment Design

# Currently Installed Woodward & Foxboro Control Loop Components

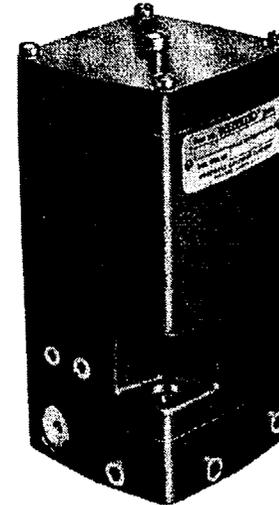
- EGM- Electric Governor Magnetic
- Dropping Resistor
- RGSC - Ramp Generator / Signal Converter
- MPU- Magnetic Pick-up
- EGR- Electric Governor Remote
- Remote Servo
- Foxboro 4-20MA Speed Controller

# Presently Installed Woodward Components

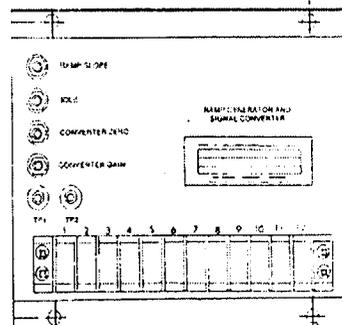
EGM



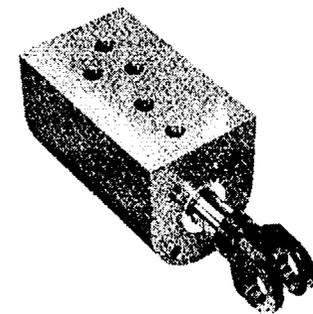
EGR



RGSC



Remote Servo



# Present Component Description

- *EGM* - Analog Compensated Speed Control manufactured By Woodward Governor from 1959 to 1998.
  - Requires 48VDC supply.
  - Receives actual speed input from MPU.
  - Receives its reference speed set point from a remote speed setting device such as the RGSC
  - Provides a controlled voltage output to the EGR
  - Provides tachometer output
  - Helps control stability

# Present Component Description Continued

- EGR - Hydro-electric actuator which receives an electric voltage from the EGM control. The voltage causes a shift in the internal pilot valve position causing high pressure oil to be ported to the remote servo.
  - Requires external oil source.IE; Turbine
  - Requires turbine drive for pump pressure

# Present Component Description Continued

- RGSC - An analog device that receives a 4-20 ma signal from the Foxboro controller.
  - Provides a controlled preset ramp rate
  - Speed setting reference for the EGM.

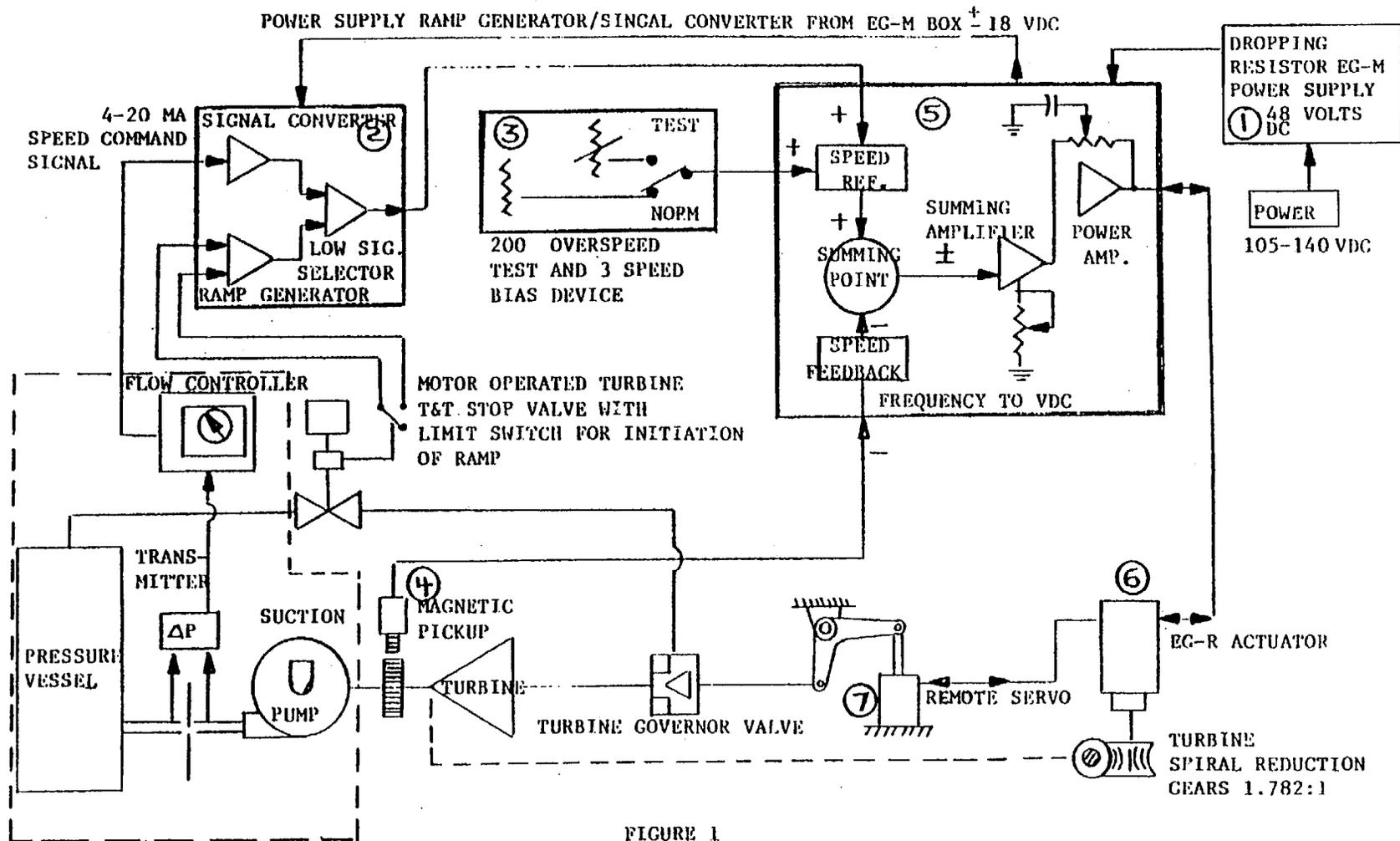
## Present Component Description Continued

- Remote Servo - The device that provides actual work output. Connected to the steam valve.
- Dropping Resistor - Provides a drop in the 125 VDC supply to a usable 48VDC for EGM operation.
- MPU- Used to detect the turbines speed.
  - Provides an AC sine wave which the control converts to a DC reference voltage.

# Present Component Description Continued

- *Foxboro Controller*- Provides two separate control loops. Each control loop has the ability to provide a 4-20 ma control signal to the RGSC which in turn provides a corresponding turbine speed range of 1280-3850 RPMS.





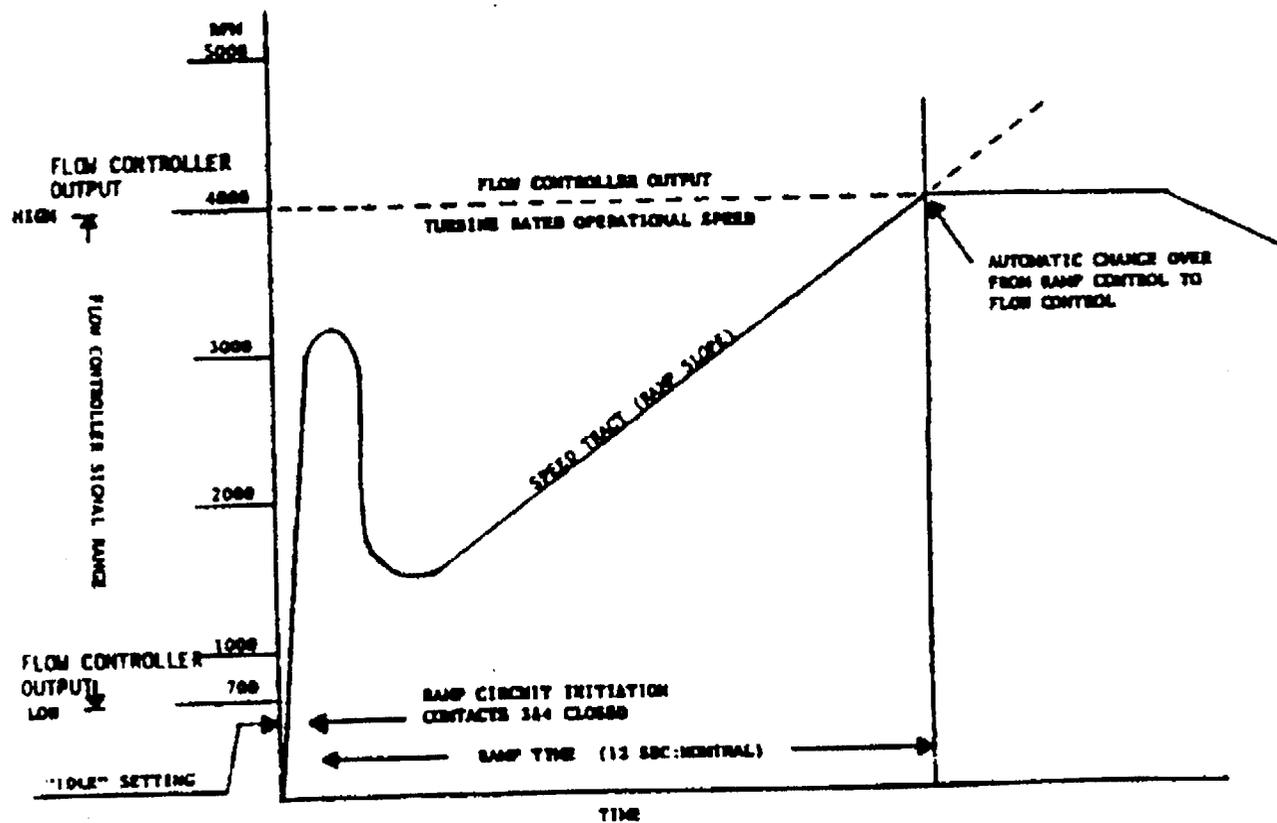
TYPICAL CUSTOMER EQUIPMENT

FIGURE 1

SCHMATIC, TURBINE GOVERNOR CONTROL.  
 SPECIAL INSTRUCTIONS: CONTROL SYSTEM, SECTION 6, TYPE  
 GS-2, F-40176 THRU 40180

# WOODWARD

## Typical EGM start-up Characteristics



# Terry Turbine - Governor Control Loop

Proposed Equipment Design

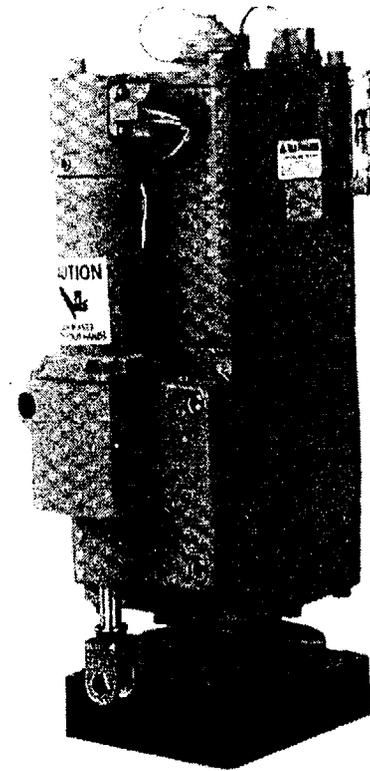
# Proposed Woodward Components

- 505 Digital Control
- PGPL Actuator
- PGPL Actuator Driver
- Remote Servo
- MPU

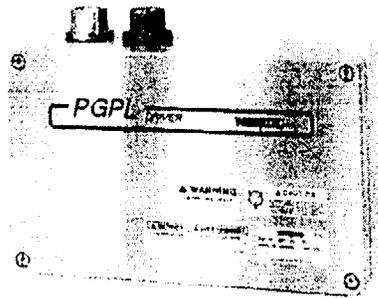
# Proposed Woodward Components

505

PGPL Actuator



PGPL Driver



# Proposed Component Description

- 505 - Proportional microprocessor-based speed control designed for steam turbine operation. Built by Woodward Governor from 1994 to present.
  - Over 2000 sold world wide commercially
  - Uses previously developed software.
  - Operates on 125VDC.
  - Provides critical speed avoidance and controlled ramp rates
  - Provides remote speed setting
  - Provides local and remote tachometer.
  - Provides PID control

# Proposed Component Description Continued

- PGPL- Hydro-electric actuator which receives an electronic input from a proportional interface driver. This input is converted to a controlled pressure which is sent to a remote servo.
  - Requires turbine drive for pump pressure
  - Requires a driver interface
  - Has a self contained oil sump

## Proposed Component Description Continued

- PGPL Driver- Provides a proportional analog output for the PGPL Actuator. This output based on servo position and control voltage.
  - Requires 24VDC supply

MPU- Used to detect the turbines speed.

- Provides an AC sine wave which the control converts to a DC reference voltage

# Advantages of the 505 System

- Uses Commercial Off The Shelf software (COTS)
- Has redundant MPU inputs
- Has analog I/O for trouble shooting and alarms.
- Has overspeed trip test capabilities.
- Eliminates-
  - Voltage dropping resistor
  - Max Valve position indicator
  - Ramp generator signal converter
  - Overspeed test device

# Terry Turbine Governor & Control Modification

Equipment Qualification and Testing

# Engine Systems, Inc.

- Commercial Grade Dedication Program
- ESI Biaxial Seismic Test Table
- Qualification of components
  - IEEE323-1974/1987
  - IEEE344-1975/1987

# Terry Turbine Governor & Control Modification

- **Major Components:**
- **Mechanical**
  - Woodward Governor PGPL Actuator
  - Speed Reducing Gearbox Assembly
  - Woodward Governor Remote Servo

# **Major Components:**

**( continued)**

- **Electrical**

- Turbine Control Panel Assembly containing:
  - Woodward Governor PGPL Driver
  - Woodward Governor 505 Digital Control

- **Qualification Methodology**

Perform necessary Dedication activities to verify that the commercially available material is suitable for Nuclear Safety Related Applications. Verifications include:

- Physical Critical Characteristics
- Performance Critical Characteristics
- Reliability Critical Characteristics

# Mechanical Equipment

- **PGPL Actuator**
- The PGPL Actuator replaces the existing EGR actuator and adapter plate. The PGPL Actuator receives the control signal from the electronic control. This signal is converted to a controlled hydraulic pressure which is transferred to the remote servo for positioning of the steam control valve.

# Mechanical Equipment

- **Speed Reducing Gearbox Assembly**
- The governor speed reducing gearbox mounts between the PGPL actuator base and the existing drive pad and reduces the drive speed of the governor by a 2:1 ratio. This component is necessary to provide proper operating speeds for the PGPL actuator.

# Mechanical Equipment

- **Remote Servo Assembly**
- The remote servo receives the hydraulic pressure signal from the PGPL actuator, amplifies it and drives the steam control valve accordingly. The new remote servo will mount in approximately the same location as the existing remote servo.

# Mechanical Equipment Qualification

- **Physical Critical Characteristics**
  - Part Number of Component
  - Revision Level of Component
    - Engineering/QA Audit of Manufacturer
    - Dedication inspection of item
  - Dimensional Inspections
    - Engineering determination of critical dimensions, interface, construction of item
    - Dedication inspection of item

# Mechanical Equipment Qualification (continued)

- **Performance Critical Characteristics**
  - Factory Testing of Component
    - Engineering/QA Audit of Manufacturer
  - ESI Supplementary Testing of Component
  - ESI Seismic Testing of Component

# Electrical Equipment Qualification

- **Turbine Control Panel Assembly**
- The turbine control panel houses the electronic governor controls (specified below), DC/DC power supply, control relays, indicating lamps, ground fault detection equipment, trip & throttle valve motor controller, control contactors, surge suppression diodes, fuses and terminal strips as required. The equipment is housed in a 36" x 30" x 12" NEMA 12 enclosure and will be mounted in the same location as the existing turbine control panel. The included governor controls are:

# Electrical Equipment Qualification

(continued)

- **Woodward 505 Digital Turbine Control**
  - The 505 control is a microprocessor based turbine control providing turbine control functions and a proportional output signal for controlling the steam control valve.

# Electrical Equipment Qualification

(continued)

- **Woodward PGPL Driver**
  - The PGPL Driver receives a proportional control signal from the 505 control and, in conjunction with a feedback signal received from the remote servo, provides a position control signal to the PGPL actuator to position the steam control valve.

# Electrical Equipment Qualification

(continued)

- **Physical Critical Characteristics**
  - Part Number of Component
  - Revision Level of Component
  - Software Identification (505 control)
  - Software Revision level (505 control)
    - Engineering/QA Audit of Manufacturer
    - Dedication inspection of item
  - Dimensional Inspections
    - Dedication inspection of assembly

# Electrical Equipment Qualification (continued)

- **Performance Critical Characteristics**
  - Factory Testing of Assembly
    - Engineering/QA Audit of Manufacturer
  - ESI Supplementary Testing of Assembly
  - ESI Seismic Testing of Assembly
  - EMI Testing (505 control)

# Electrical Equipment Qualification

(continued)

- **Reliability Critical Characteristics**
- Woodward 505 Digital Control
  - The 505 control is a Commercial Off the Shelf Digital Control
  - Available from Woodward Governor since 1994
  - Over 2,000 units shipped since inception of control
  - 505 control contains only Firmware
  - No programming of control. Only “Tuneables”

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics** (continued)
- **Built-In Quality of Design**
  - Engineering/QA Audit of Manufacturer
    - Audit of QA Program, organization, and special processes applicable to 505 control.
    - Evidence of implementation of QA plans in the production of equipment

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics (continued)**
  - Audit of Woodward digital system/software development procedures
  - Evidence of implementation of software development procedure in the evolution of the product software
  - Woodward Governor Verification and Validation methods for 505 software.

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics (continued)**
  - Review of 505 controller design, software architecture and internal diagnostics.
  - Review of Woodward software testing methods
  - Review of evolution of 505 control including experience with previous designs

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics** (continued)
  - Documented Product Operating History
    - Review of extent, relevance and success of operating history of the 505 control (all 3 current models) as well as previous 505 models.
    - Review shall include surveys of end users to determine satisfaction level of control.

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics** (continued)
- **Failure Management**
  - Engineering/QA Audit of Manufacturer
    - Identification of credible failure modes
    - Failure Modes and Effects Analysis (FMEA) performed identifying failure modes and assessing their significance
    - Review of operating history of the 505 control

# Electrical Equipment Qualification (continued)

- **Reliability Critical Characteristics** (continued)
- **Reliability**
  - 505 control has demonstrated reliability
    - Review of extent, relevance and success of operating history of the 505 control (all 3 current models) as well as previous 505 models. Review shall include surveys of end users

# Terry Turbine Governor & Control Modification

## Summary

- ESI will perform Engineering/QA audit of Woodward Governor for hardware verification
- All items supplied will be functionally tested by ESI in addition to factory tests. ESI tests will simulate system as components will be interconnected with ancillary equipment
- A seismic test will be performed on each piece of equipment

# Terry Turbine Governor & Control Modification

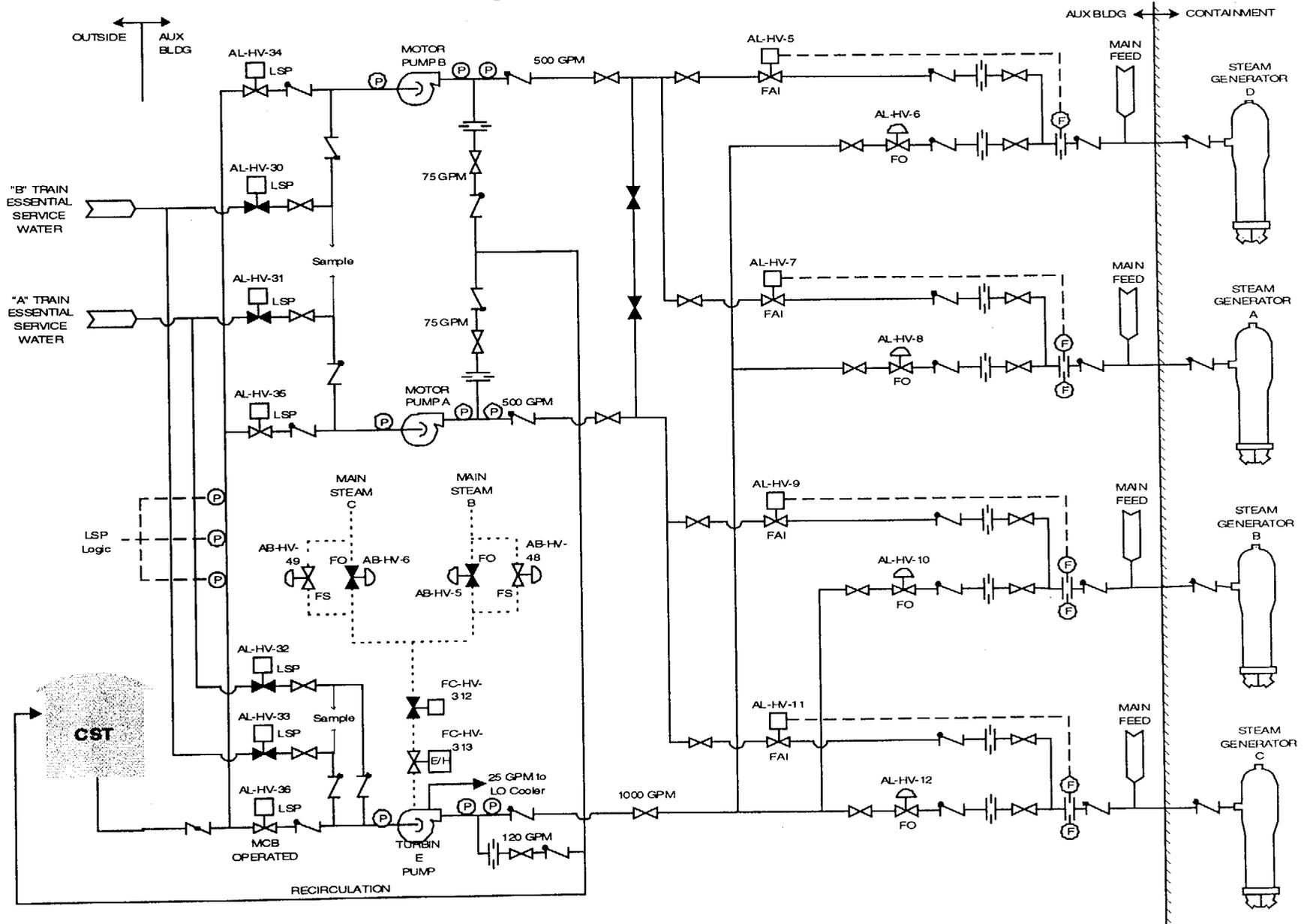
## Summary

- Woodward 505 digital control has been supplied since 1994. Extensive operating history documented with over 2000 units shipped.
- 505 is a commercial off the shelf unit with firmware only.
- ESI will perform extensive Engineering/QA audit of Woodward Governor for software development and verification activities.

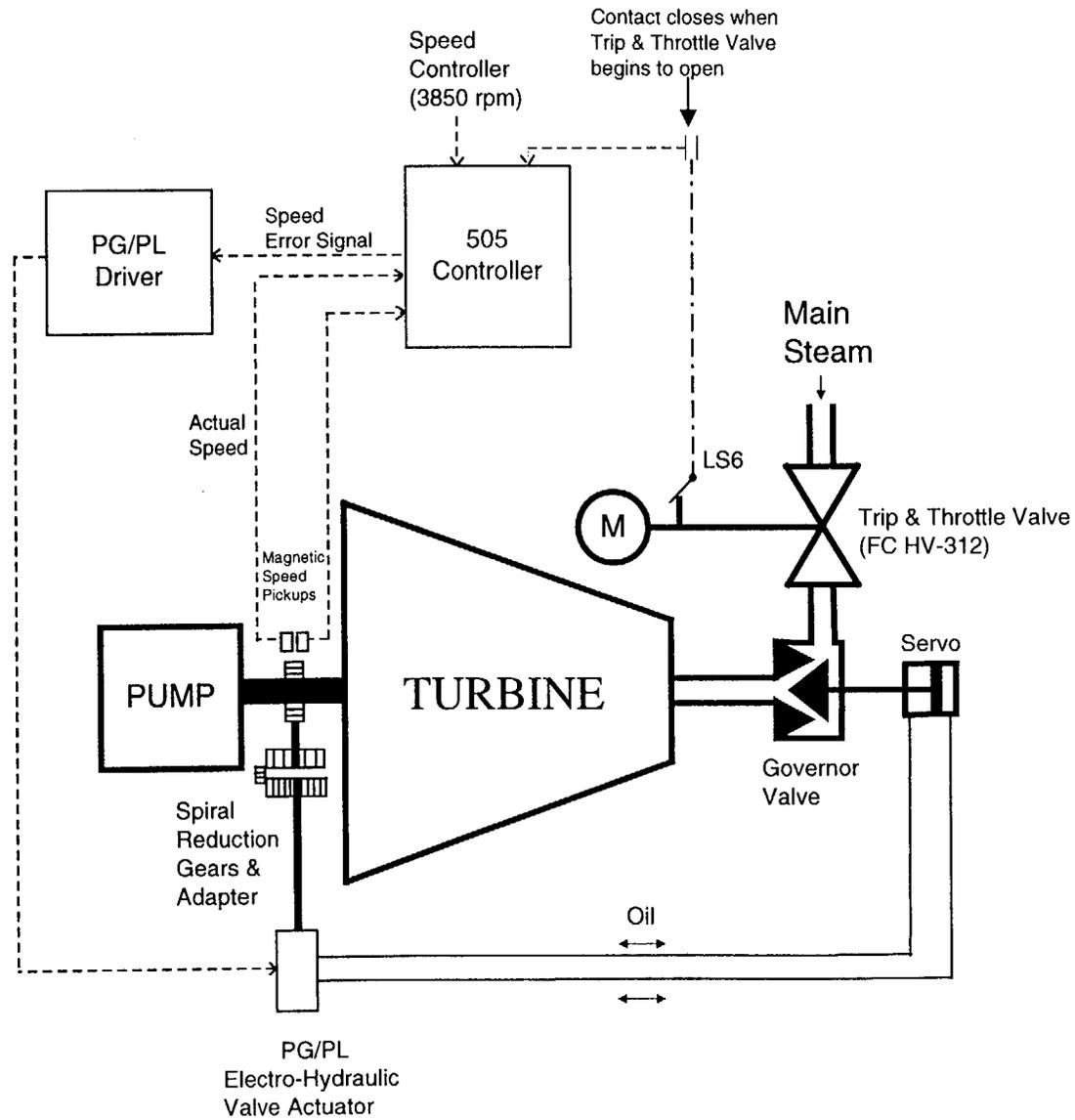
# Terry Turbine Governor & Control Modification

Licensing Process

# Auxiliary Feedwater System



# New TDAFP Control Overview



# Terry Turbine Governor & Control Modification

Conclusions

## Conclusions

- Commercial Grade Dedication of devices to be used in the Terry Turbine Governor and Controls modification will demonstrate with reasonable assurances that the hardware items and software items comply with the functional and performance requirements.
- The modification process at Callaway will provide adequate review and documentation of the Commercial Grade Dedication effort to justify implementation under 10 CFR 50.59.

No development of application software for this project.

No risk of Common Mode Failures

No change to Licensing Documents (FSAR, Tech Specs,...)

No new system failure modes

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scanned into Adams*

TELECONFERENCE MEETING SUMMARY OF JANUARY 27, 2000, BETWEEN THE NRC AND  
CALLAWAY DATED: February 7, 2000.

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E-MAIL (w/encl. 1)

J. Zwolinski/S. Black  
S. Richards  
E. Peyton  
P. Loeser  
D. Lange, EDO  
W. Johnson, RGN-IV