



Fieldbus Foundation™
Freedom to Choose. Power to Integrate.

A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

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A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

CURRENT NUCLEAR INDUSTRY I&C STATUS

- 25-35 YEAR OLD LEGACY SYSTEMS
- PREDOMINANTLY EARLY ANALOG WITH OLDER PLANTS SIGNIFICANTLY PNEUMATIC
- INCREASING O&M COSTS
- LACK OF SPARE PARTS
- LOSS OF KNOWLEDGABLE MAINTENANCE STAFF
- DETREMENTAL OPERATIONAL IMPACT
- RELIABILITY & AVAILABILITY CONCERNS
- POTENTIAL CHALLENGES TO SAFETY SYSTEMS



A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

ADDITIONAL SOURCES OF PLANT PERFORMANCE PRESSURES

- NUCLEAR REGULATORY COMMISSION (NRC)
- INSTITUTE of NUCLEAR PLANT OPERATORS (INPO)
- CORPORATE MANAGEMENT
- SYSTEM DISPATCHER
- PLANT MANAGEMENT
- FELLOW PLANT EMPLOYEES
- WALL STREET (HENCE SHAREHOLDERS)



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FROM AMERICAN NUCLEAR SOCIETY'S "NUCLEAR NEW", DECEMBER 2006

47 PLANTS CURRENTLY RELICENSED

- **LICENSED 2029 – 2046**

7 PLANTS CURRENTLY UNDER REVIEW

23 ADDITIONAL PLANTS EXPECTED TO RELICENSE OVER NEXT 10 YEARS



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SIGNIFICANT I&C UPGRADES NEEDED TO ENSURE RELIABLE OPERATION

JIG-SAW PUZZLE OF STRATEGIES

- STATUS QUO – REMANUFACTURE or R&R
- UPGRADE to CONVENTIONAL DCS
- SYSTEM STRATEGY with MULTIPLE VENDORS (BEST IN CLASS)
- TOTAL INTEGRATION USING SINGLE VENDOR (THOROUGHLY PLANNED)

LOGISTICAL CONSIDERATIONS

- MOST OBSOLETE FIRST
- MOST IMPORTANT FIRST



A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

- **DEVELOP A STRATEGY THAT WILL LAST**
 - LONG TERM
 - SCALABLE
 - FLEET APPLICABLE
 - VENDOR INDEPENDENT
- **LEADING EDGE TECHNOLOGIES**
- **COMMODITY SOLUTION**
- **GLOBAL APPLICATIONS**
- **LOW SUPPORT COSTS**
- **IMPROVED HUMAN SYSTEMS INTERFACE**





A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

➤ DEVELOP A STRATEGY THAT WILL LAST

- **LONG TERM APPLICATION**
 - 30 YEARS OF ADDITIONAL LICENSE
 - ELIMINATE HISTORICAL SPARE PARTS CONCERNS
 - ELIMINATE KNOWLEDGE LOSS
 - ELIMINATE PROPRIETARY “SHACKLES”
- **SCALABLE**
 - EASE OF EXPANSION
 - CABLING/POWER CONSUMPTION/HSI VOLUME
- **FLEET APPLICABLE**
 - NON-NUCLEAR APPLICABILITY
- **VENDOR INDEPENDENT**
- **LOSE THE SHACKLES OF THE PAST**
 - I/O LIMITATIONS
 - ADDITIONAL SUPPORT REQUIREMENTS



A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

LEADING EDGE TECHNOLOGIES

➤ **FIELDBUS, PC-ETHERNET, CONVENTIONAL DCS, PLC's OR OTHERS?**

- DIFFERENT PERSPECTIVES
- ADVANTAGES TO EACH

➤ **NON-NUCLEAR SAFETY RELATED (N-NSR) APPLICATIONS**

- TURBINE & AUXILIARY BUILDING LOCATIONS
- MILD ENVIRONMENT
 - TEMPERATURES 30 – 110 DEGREES F
 - RADIATION < THAN 10E4 TID
 - SEISMIC NO OBE/SSE (INTEGRITY REQUIRED)

➤ **APPLIED ASPECTS OF NSR DIGITAL SYSTEMS UPGRADE STRATEGY**

- USED REQUIREMENTS TRACABILITY MATRIX (RTM)
- FAILURE MODES & EFFECTS ANALYSIS (FMEA)
- USE OF VENDOR VERIFICATION & VALIDATION
- SYSTEM DESIGN DESCRIPTION
 - HARDWARE
 - SOFTWARE
- APPLICATION OF ADDITIONAL END USER SOFTWARE QUALITY ASSURANCE AND CONFIGURATION MANAGEMENT PROGRAM



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COMMODITY SOLUTION

- **NO SINGLE VENDOR DEPENDENCIES FOR NON-NSR COMPONENTS**
 - ENTIRE SYSTEMS SHOULD BE COMMODITY PRODUCTS
 - NOT YET COMPLETELY THERE – VERY CLOSE
 - STILL CHASING UNIVERSAL INTEROPERABILITY
- **SOME LEGACY ISSUES STILL MAKE FULL COMMODITY BASED FIELDBUS SYSTEMS A GOAL**



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GLOBAL APPLICATIONS

➤ BROAD BASED

- NOT INDUSTRY DEPENDENT
- INCREASING OPERATING BASE
- USERS GROUP SHARING OPPORTUNITIES
 - LESSONS LEARNED
 - PROBLEMS
 - APPLICATION INTELLIGENCE AQUISITION

➤ POTENTIAL FOR OVERHEAD REDUCTIONS

- SPARE PARTS DEPOTING
- RESOURCE SHARING



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- **LOWER SUPPORT COSTS**
 - **MAINTENANCE**
 - **CALIBRATIONS & REPAIRS**
 - **ENGINEERING**
 - **SYSTEM SUPPORT**
 - **MODIFICATIONS**
 - **OPERATIONS**
 - **EFFICIENCY GAINS**
 - **SUPPLY CHAIN**
 - **REDUCED INVENTORIES**



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IMPROVED HUMAN SYSTEMS INTERFACE

➤ **MOVEMENT FROM DISCRETE INTERFACES TO 'SOFT' INTERFACE**

➤ **BETTER & FASTER INFORMATION AWARENESS**

➤ **NOT JUST DEVICE FUNCTIONAL SPEEDS – HUMAN COGNITIVE SPEED THROUGH BETTER HSI**

➤ **EXISTING NUCLEAR PLANTS NOT READY FOR THE “GLASS COCKPIT” JUST YET**

(ALL CRT/PLASMA/LCD CONTROL ROOM – ALSO REGULATORY ISSUES WITH SOFTWARE COMMON MODE FAILURE)



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STRATEGY DETERMINATION



5 POTENTIAL VENDORS
3 FINALISTS
2 VENDORS WITH REAL
FIELDBUS CAPABILITES

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FIRST IN FIELDBUS

SMAR SELECTED AS
VENDOR DUE TO
SUPERIOR FFB
CAPABILITES AND ABILITY
TO MEET PLANT SPECIFIC
CUSTOMIZING



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TECHNOLOGY ADVANTAGES

- **FF SELECTED OVER CONVENTIONAL DCS TO ELIMINATE HISTORICAL VENDOR DEPENDENCY AND PHYSICAL REQUIREMENTS**
- **FOUNDATION FIELDBUS ALLOWS CONTROL STRATEGY TO BE “PUSHED” DOWN TO LOOP LEVEL AT THE ACTUAL FIELD DEVICES**
- **FF SELECTED OVER TYPICAL “MANUFACTURING” NETWORKS DUE TO MORE “PROCESS” FRIENDLY CAPABILITIES**
- **FF PROVIDES MORE “DETERMINISTIC” CONTROL CONFIGURATION THAN PC/ ETHERNET STRATEGY**
- **DETERMINISTIC CONTROL A MAJOR CONSIDERATION FOR THE NUCLEAR USER**

smar

FIRST IN FIELDBUS

A NUCLEAR PERSPECTIVE ON A FOUNDATION FIELDBUS APPLICATION

OCONEE CONTROL ROOM PRIOR TO MODIFICATION



1960'S CONFIGURATION

**LARGE NUMBER OF
DISCRETE INTERFACE
DEVICES**

**OBSOLETE PNEUMATIC &
AGING ANALOG**

**INCREASED
MAINTENANCE AND
AVAILABILITY ISSUES**

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OBSOLETE CONTROL ROOM RECORDERS



**RECORDERS ORIGINALLY
USED FOR OPERATOR
INDICATIONS AS WELL AS
PROCESS RECORDS**

**ELIMINATING 95% OF
RECORDERS**

**DATA RETENTION ON PLANT
COMPUTER**

**VIDEO/PAPER RECORDERS
REMAIN FOR MINIMUM SET OF
PROCESS TRENDING
REQUIREMENTS**



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TYPICAL PNEUMATIC CONTROL DEVICES



LARGE NUMBERS OF OBSOLETE PNEUMATIC CONTROL DEVICES THROUGHOUT BALANCE OF PLANT

INTEGRATION INTO FF AND CONTROL ROOM HUMAN SYSTEM INTERFACES



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TYPICAL FIELD HAND CONTROLLER



**PNEUMATIC HAND
CONTROL DEVICES
PLACED THROUGHOUT
PLANT**

**LEGACY FROM STAFF
INTENSIVE DESIGN
STRATEGIES OF THE
PAST**

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**TYPICAL INTERNAL
CONTROL BOARD
CONDITION**

**30+ YEARS OF
HARDWARE AND WIRING
INSTALLATIONS**

**PNEUMATIC AND
ELECTRICAL DEVICES**

**OVERCROWDED AND
DIFFICULT TO WORK IN**

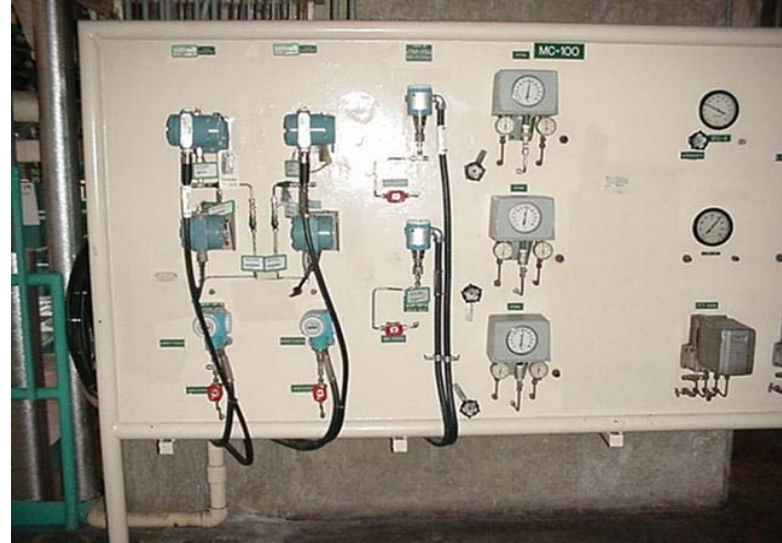


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MAINTENANCE
TRAINING FACILITY
USED AS TEST BED
FOR PCS FIELDBUS
DEVICES



DEVELOPMENT OF
GRAPHICAL USER
INTERFACE A JOINT
EFFORT BY VENDOR
AND OCONEE



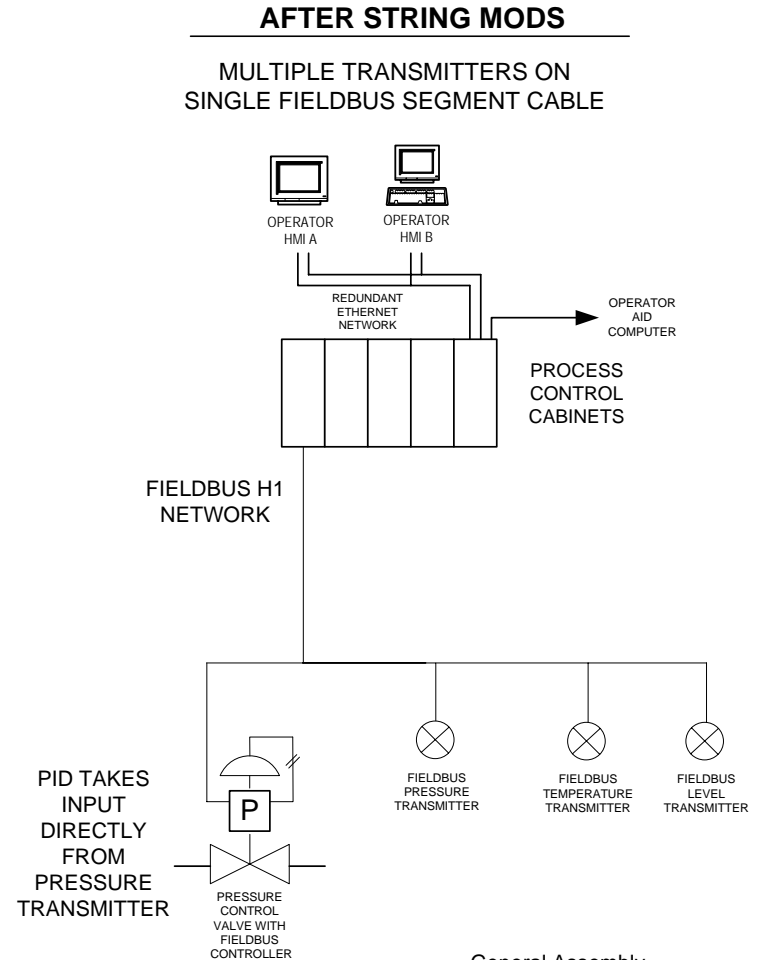
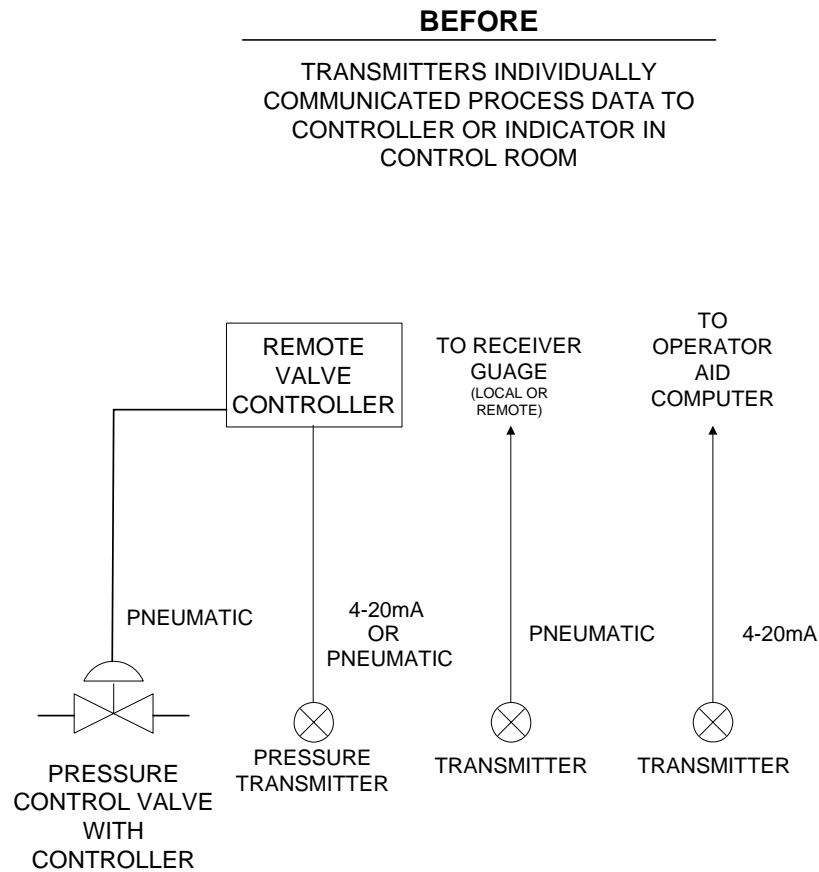
ADDITIONAL
TESTING
PERFORMED ON
OTHER VENDOR'S
FIELDBUS DEVICES





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STRING MODS INSTRUMENT STRING UPGRADE

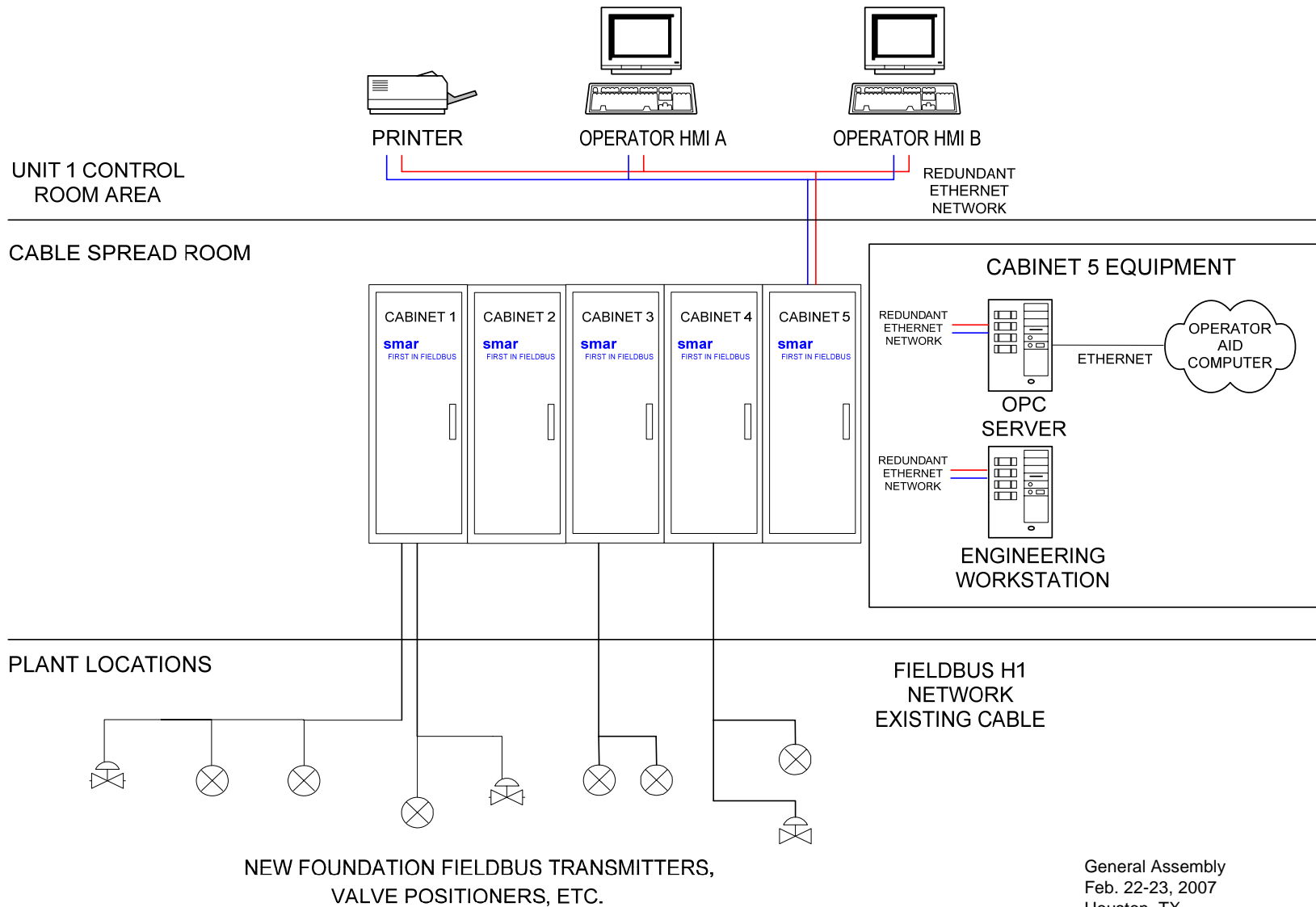


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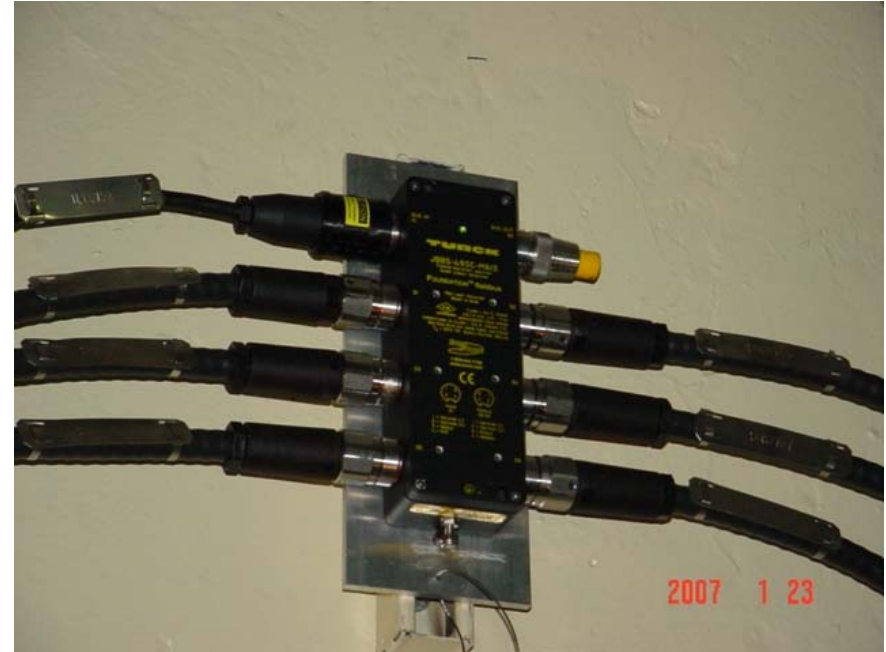
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NEW FOUNDATION FIELDBUS TRANSMITTERS,
VALVE POSITIONERS, ETC.



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FIELD BUS NETWORK
CABLES USE DISTRIBUTION
TERMINATIONS STRATEGICALLY
LOCATED IN PLANT

MODIFIED END CONNECTORS TO
FIT ARMORED CABLES



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FISHER DVC VALVE POSITIONERS INSTALLED ON 6 VALVES FOR PID CONTROL. 5 NEW CONTROLLER FACE PLATES ON HSI.



MAGNETROL GW RADAR REPLACEMENT FOR OBSOLETE FISHER DISPLACER LEVEL XMTR.



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**NEWLY INSTALLED
PROCESS CONTROL
SYSTEM CABINETS IN
CABLE SPREADING
ROOM**

**5 CABINETS
500-640 DROP CAPABLE
SIGNIFICANT EXPANSION
CAPABILITY INSTALLED
MILD ENVIRONMENT
LOCATION**

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**ENGINEERING
WORKSTATION
LOCATED HERE**

**REDUNDANT 120 VAC
UPS LOCATED HERE. 208
SINGLE PHASE INPUTS
USED**

**NETWORK INTERFACE
TO PLANT COMPUTER**



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FRONT VIEW OF PCS FLAT PANEL HSI



**VERTICAL BOARD AFTER
RECORDER REMOVAL AND
FLAT PANEL HSI
INSTALLATION**





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**ORIGINAL PNEUMATIC
“PEANUT” GAGES
ABANDONED IN PLACE**

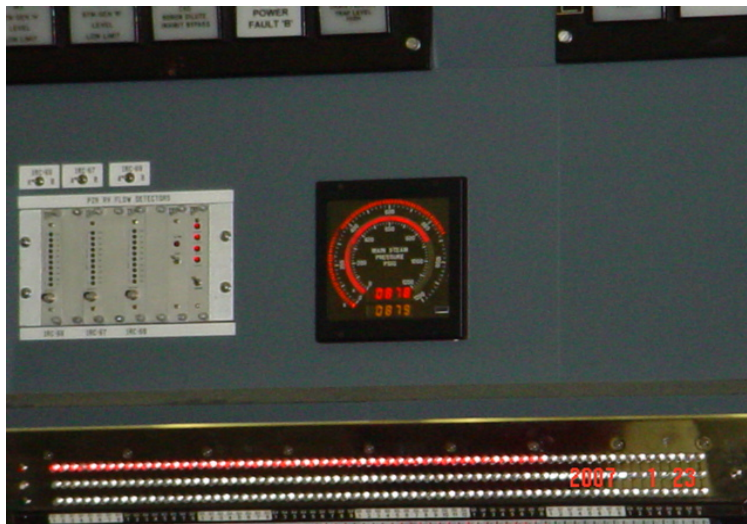
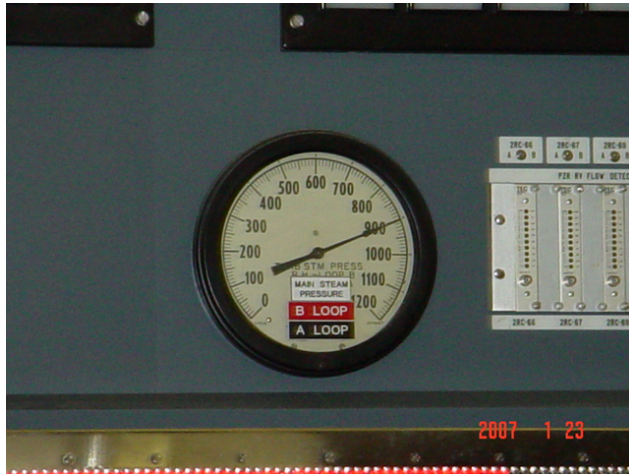


**BEKA
associates**

**REPLACED WITH FFB
DISPLAYS**



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CONVERSION OF CONTROL ROOM DEVICES FROM ANALOG TO FIELDBUS

HUMAN FACTORS CONSIDERATIONS

OPERATIONS CONCENSUS AND BUY-IN REQUIRED TO SMOOTH INSTALLATION

DOCUMENTATION OF CONCENSUS IMPERATIVE

ANALOG TO DIGITAL TRANSITION ISSUES ABOUND

“ARTHRITIS VS ACNE”



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SUMMARY

- **INCREASE IN I&C UPGRADES AT NUCLEAR PLANTS OVER THE NEXT 10 – 20 YEARS**
- **OBSOLESCENCE, PLANT IMPACT & CORPORATE FISCAL STRATEGY WILL DICTATE UPGRADE PRIORITY**
- **AS ALWAYS - NEED FOR WELL PLANNED & INTEGRATED UPGRADE STRATEGY**
- **VENDOR & PLANT PARTNERING IMPERATIVE FOR SUCCESS**
- **PLACE FOR NEW NUCLEAR PLANT APPLICATION**
 - **NUCLEAR IS NOT OFF LIMITS**
- **FIELDBUS HAS A DEFINITE ROLE IN ALL POWER GENERATION**