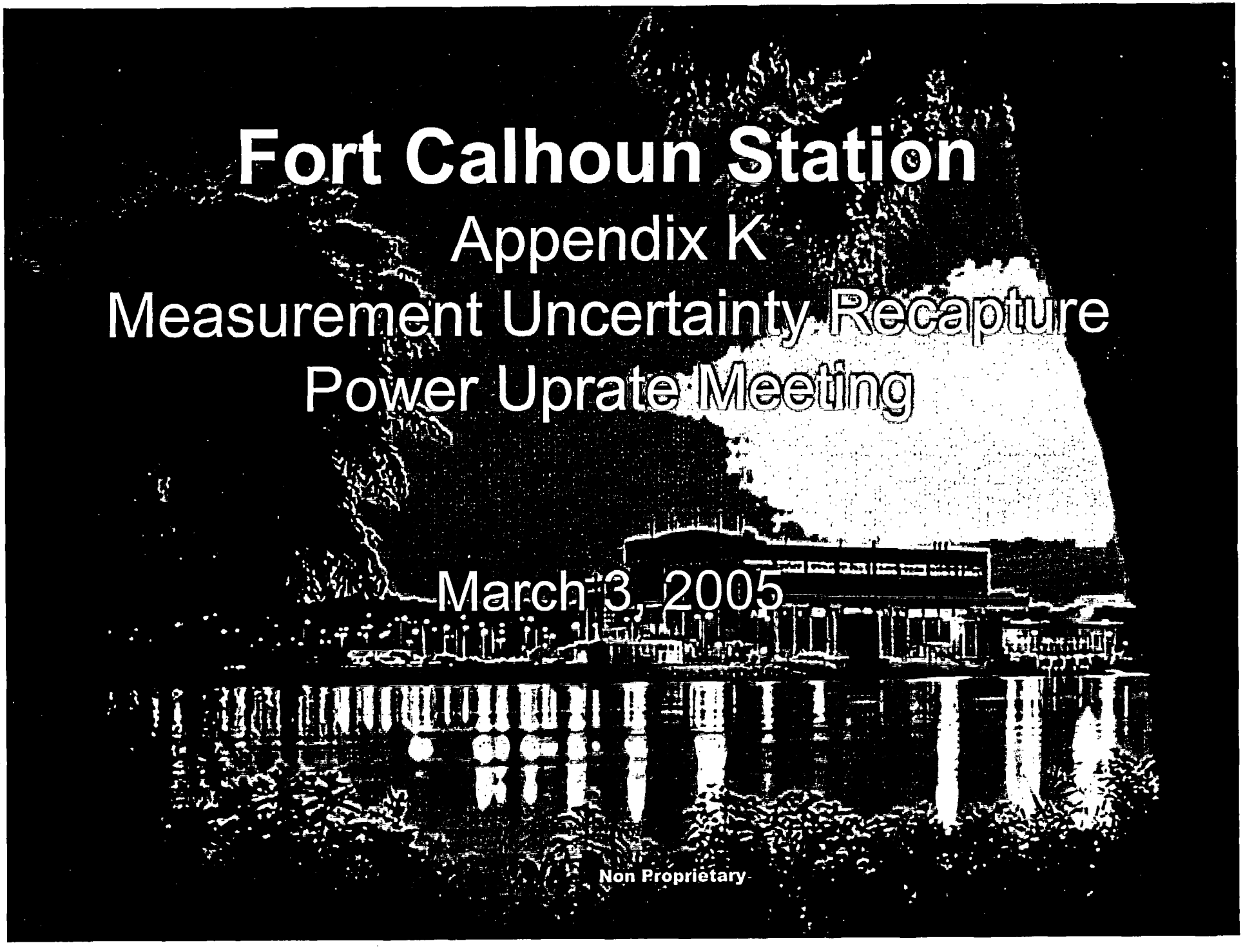
Fort Calhoun Station
Appendix K
Measurement Uncertainty Recapture
Power Uprate Meeting
March 3, 2005
Non Proprietary

Purpose of Meeting

- **Discuss identification and resolution of difficulties encountered in implementing the previously requested/approved Ft. Calhoun Station (FCS) Appendix K Measurement Uncertainty Recapture (MUR) power uprate**
- **Discuss the schedule for OPPD's revised License Amendment Request (LAR) to increase licensed power level**
  - Approximately a 1.5% increase from 1500 MWt to 1522 MWt
  - The proposed MUR power uprate continues to be based on the W/AMAG ultrasonic flow measurement (UFM) technology documented in CENPD-397-P-A, Rev. 1

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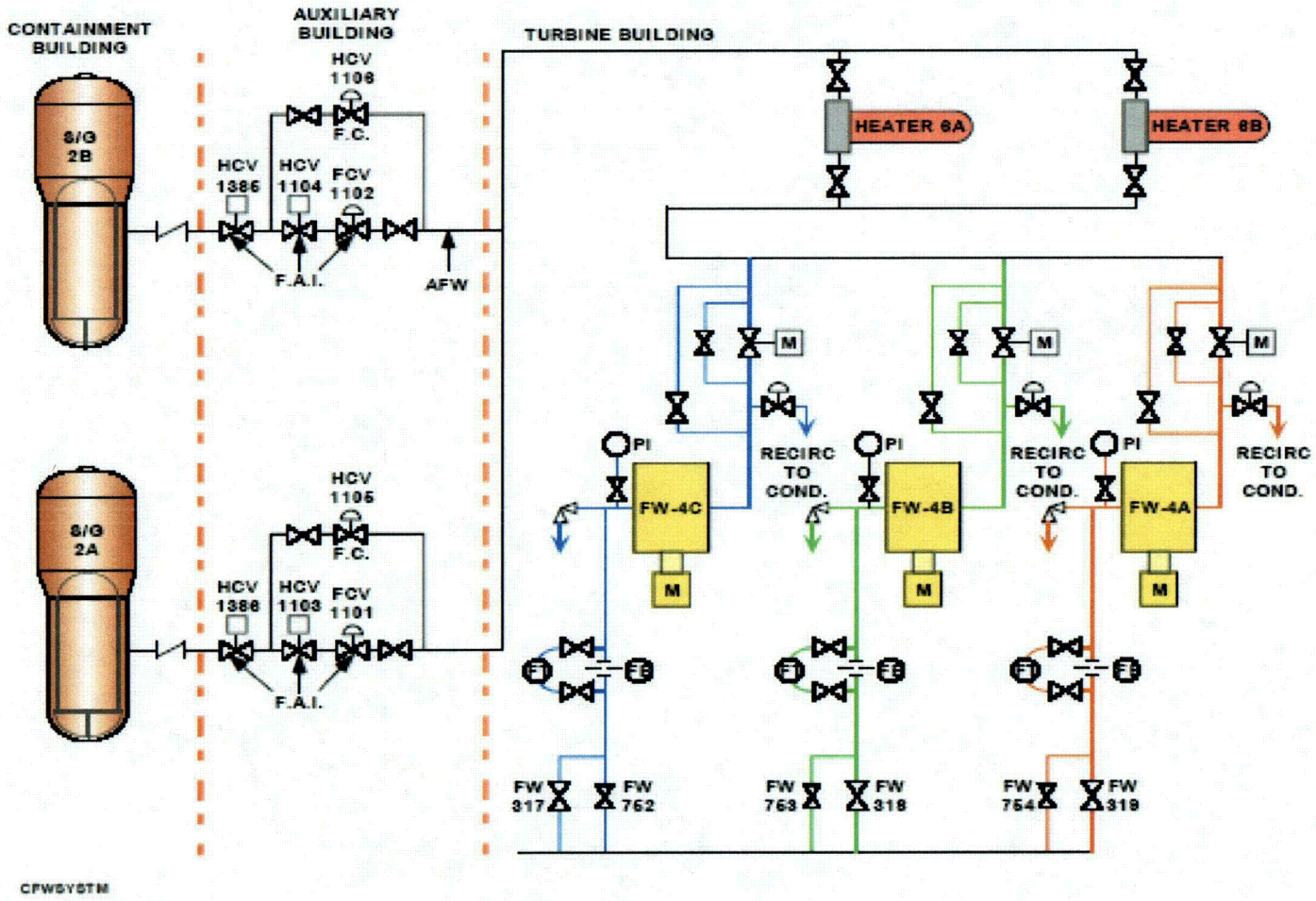
Agenda

- Background
- Discuss Resolution of Implementation Difficulties
- Discuss Revised License Amendment Request
- Schedule
- Conclusion

Background – Ft. Calhoun Feedwater System



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Licensing Background

- **August 28, 2003, OPPD submitted a revised MUR Power Uprate LAR**
  - 1500MWt → 1524MWt or a 1.60% increase
- **January 16, 2004, NRC Amendment No. 224 issued to License and Technical Specifications increasing the licensed rated power to 1524 MWt**
- **May 2004, OPPD requested and NRC approved an exigent license amendment to return the newly authorized FCS power level from 1524 MWt back to the prior 1500 MWt power level**

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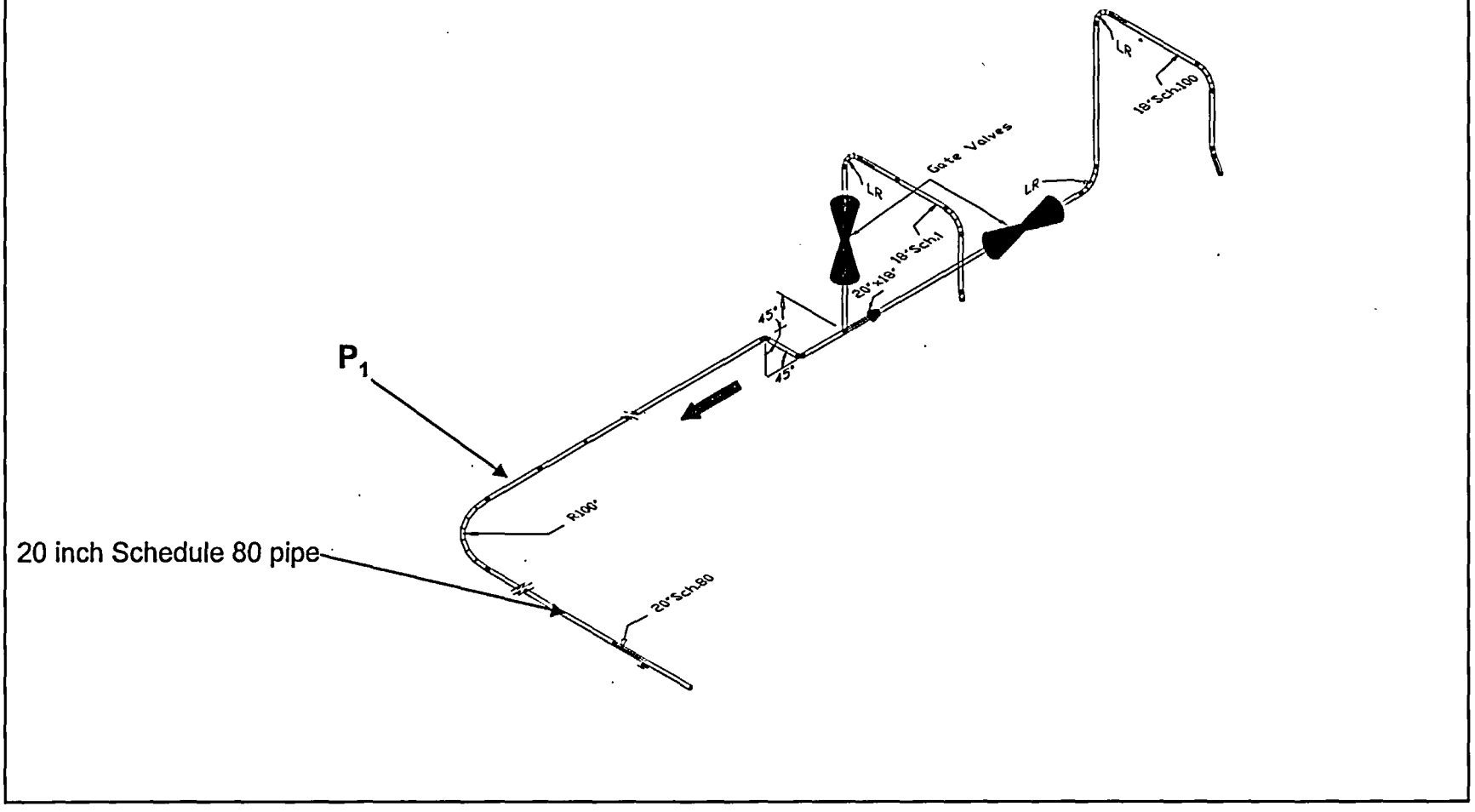
Background – Initial Installation

- **A Mounting/Transducer Support Frame (M/TSF) with two meters was installed on the main feedwater header at a location selected by Westinghouse**
  - Location ~ 46 L/D downstream of an in-plane 45° elbow (P_1 on schematic)
  - The two meters were positioned at different radial locations on the bracket.
- **A step change in the venturi flow correction factor (C_f) was observed when the operating feedwater pump combination was rotated in late 2003**
  - $C_f = W_{CROSSFLOW} / W_{VENTURI}$
- **The value of C_f was determined to be dependent on which combination of feedwater pumps was running (i.e., A+B, A+C or B+C)**

FCS Feedwater System Schematic



Background – Installation Considerations

a, b

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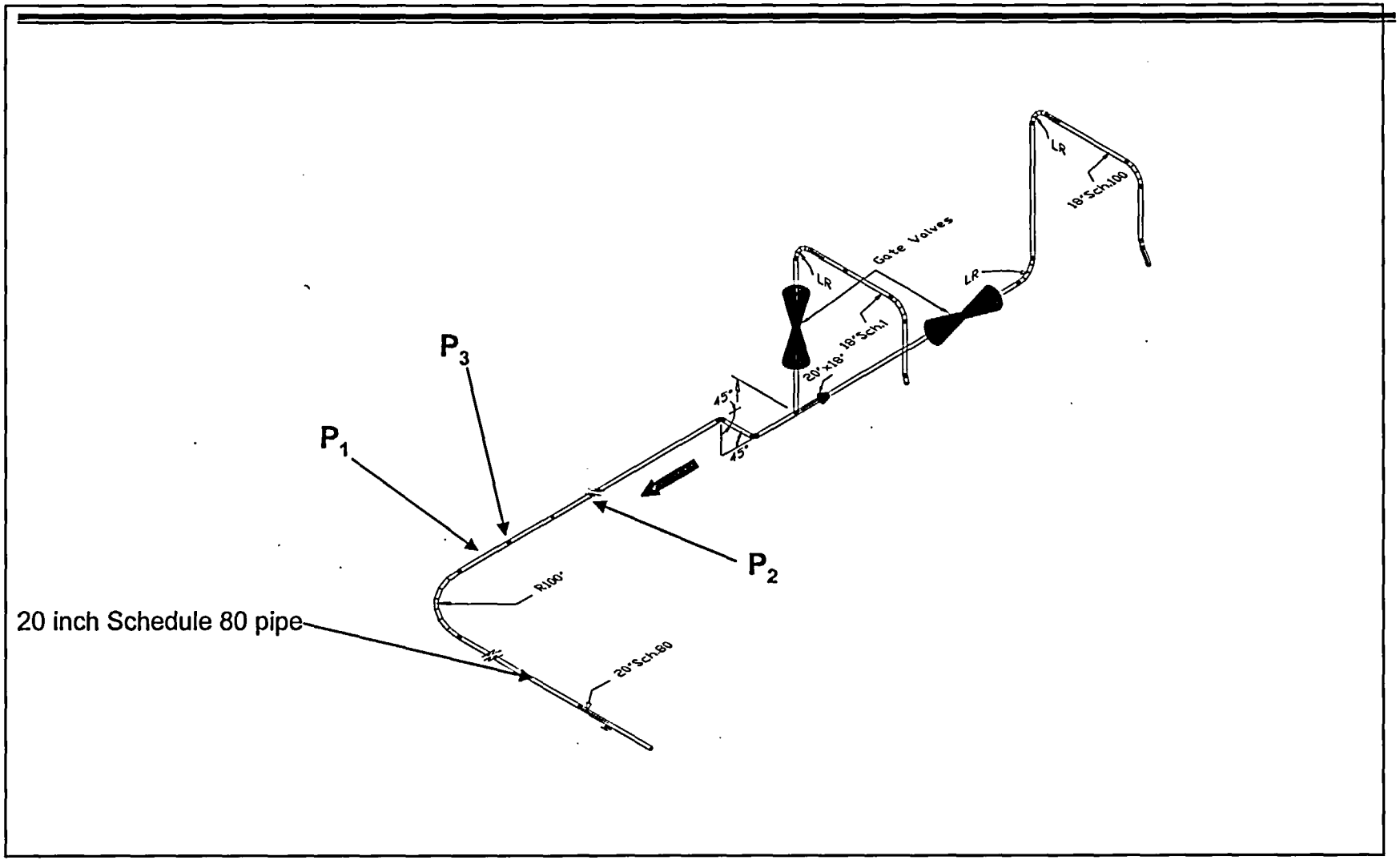
Selection of Meter Location

- Computational Fluid Dynamics calculations and FCS 1/3 scale testing predicted a stable velocity profile at the meter location P_1
- A flow anomaly affected the meters at location P_1
- Flow was shown to be stable at location P_2 and P_3

FCS Feedwater System Schematic



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Hydraulic Noise

- **Hydraulic noise was detected at FCS that affected the meters**
  - Noise caused by feedwater pumps and piping layout
- **Noise contamination is caused by pressure waves traveling up and down the feedwater system piping.**
  - Waves with frequencies between the low and high pass filter settings of CROSSFLOW affected the meter
- **Since the source of noise cannot be removed from the piping system, this problem must be resolved by filtering the CROSSFLOW signal to remove the noise contaminated portion of the signal**

Hydraulic Noise

a, b

FCS Hydraulic Noise Correction

a, b

CROSSFLOW monitoring and alarms

- **The CROSSFLOW system continuously monitors and alarms to:**
  - Ensure the continued applicability of the bias correction
  - Assure the proper pump combination bias is applied
  - Detect equipment failures
  - Detect configuration changes

Noise Remediation Method

[ ]a, b

- Remediation method reviews

FCS Noise Remediation Verification

- Noise was originally detected by a change in the venturi correction factor when the pump combination was changed

a, b

[ ]

Noise Remediation Methods

[ ]a, b

- Feedwater flow uncertainty changes from 0.39% to 0.51%
- Corresponding power uncertainty increases from 0.4 % to 0.5%

Revised License Amendment Request

- **The revised LAR is built upon the previous submittal of August 28, 2003 and requests an uprate of 1.5% to 1522 MWth**
- **Information has been added describing the location of the four permanently installed CROSSFLOW meters**
  - The second M/TSF will be used as redundant flow measurement resource as well as a vehicle for confirming flow profile stability in the future
    - Credit will only be taken for one of the four flow measurements. Information has been added to the LAR indicating that the noise contamination issue will be remediated using a filtering technique

[ ] a, b

Revised License Amendment Request

- **Other measures being implemented by OPPD**
  - Use of other plant parameters to independently corroborate plant power level derived from the CROSSFLOW determined C_f
    - Investigating use a software tool as an independent means to corroborate plant power level
  - The feedwater venturis will be recalibrated at the Alden Research Laboratory during the current refueling outage
    - The recalibrated and clean venturis will serve as another independent flow measurement for comparison to CROSSFLOW immediately following plant startup

Schedule and Implementation

- **Schedule**
  - Submit Revised MUR LAR — March 31, 2005
  - Requested Review Period — 90 days
  - Requested Implementation Period — 180 days
- **Plant implementation**
  - The 2005 refueling outage started Feb. 25, 2005 with a duration of ~55 days
  - Instrumentation will be placed in service during start-up from the refueling outage
  - The MUR uprate will be implemented following receipt of the NRC SER

Conclusions

- **The CROSSFLOW system implementation difficulties that caused OPPD to reverse its initial MUR power uprate initiative have been resolved**
- **The implementation difficulty was traced to two factors.**
  - Flow anomaly that affected meters at location P_1
  - Noise contamination associated with the feedwater pump combinations (i.e., A+B, A+C, B+C)
- **The flow profile stability was resolved by moving the M/TSF to a location upstream of the disturbance.**
    - A second M/TSF has been installed to confirm flow profile stability near the primary M/TSF location

Conclusions

[a,b]

- **OPPD plans to submit its revised MUR power uprate LAR by March 31, 2005**
  - Approximately a 1.5% increase from 1500 MWt to 1522 MWt
  - Discussion of noise remediation