ENERGY
TECHNOLOGY
CONSULTANTS, INC.

U.S. DEPARTMENT OF ENERGY
INNOVATIVE CLEAN COAL TECHNOLOGY
DEMONSTRATION PROJECT

ADVANCED WALL-FIRED LOW NOx COMBUSTION DEMONSTRATION PROJECT REVIEW

JANUARY 30, 1992

DOE PITTSBURGH ENERGY TECHNOLOGY CENTER

PITTSBURGH, PA

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PROJECT TEST OBJECTIVES

- DEMONSTRATE PERFORMANCE OF THREE NOX CONTROL TECHNOLOGIES IN A STEP-WISE MANNER
  - ADVANCED OVERFIRE AIR
  - LOW NOx BURNERS
  - LNB + AOFA
- DETERMINE SHORT-TERM NOx EMISSION TRENDS
  - UNDER STEADY-STATE TEST CONDITION
  - ALLOWS EXTRAPOLATION OF RESULTS TO OTHER SIMILAR UNITS
- DETERMINE DYNAMIC LONG-TERM NOx EMISSION CHARACTERISTICS
  - UNDER NORMAL LOAD DISPATCH CONDITIONS
  - ALLOWS DETERMINATION OF NORMAL NOx VARIABILITY
  - ALLOWS DETERMINATION OF ACHIEVABLE NOx EMISSIONS
- DETERMINE AFFECTS OF LOW NOx COMBUSTION ON OTHER PARAMETERS
  - BOILER EFFICIENCY
  - BOILER STEAMING PERFORMANCE
  - ESP PERFORMANCE

PROJECT TEST TYPES

- **DIAGNOSTIC**

  SHORT-TERM STEADY-STATE CONDITIONS

  ONE TO THREE HOUR DURATION

  ESTABLISH EMISSION TRENDS

- **PERFORMANCE**

  SHORT-TERM STEADY-STATE CONDITIONS

  TEN TO TWELVE HOUR DURATION

  ESTABLISH PERFORMANCE LEVELS

  LOI, TPM, PSIZE, EFFICIENCY, ETC.

- **LONG-TERM**

  DYNAMIC CONDITIONS DICTATED BY DISPATCHER

  FIVE MINUTE DATA CAPTURE

  ESTABLISH STATISTICAL EMISSION CHARACTERISTICS

- **VERIFICATION**

  SHORT-TERM STEADY-STATE CONDITIONS

  ONE TO THREE HOUR DURATION

  ESTABLISH EMISSION TRENDS

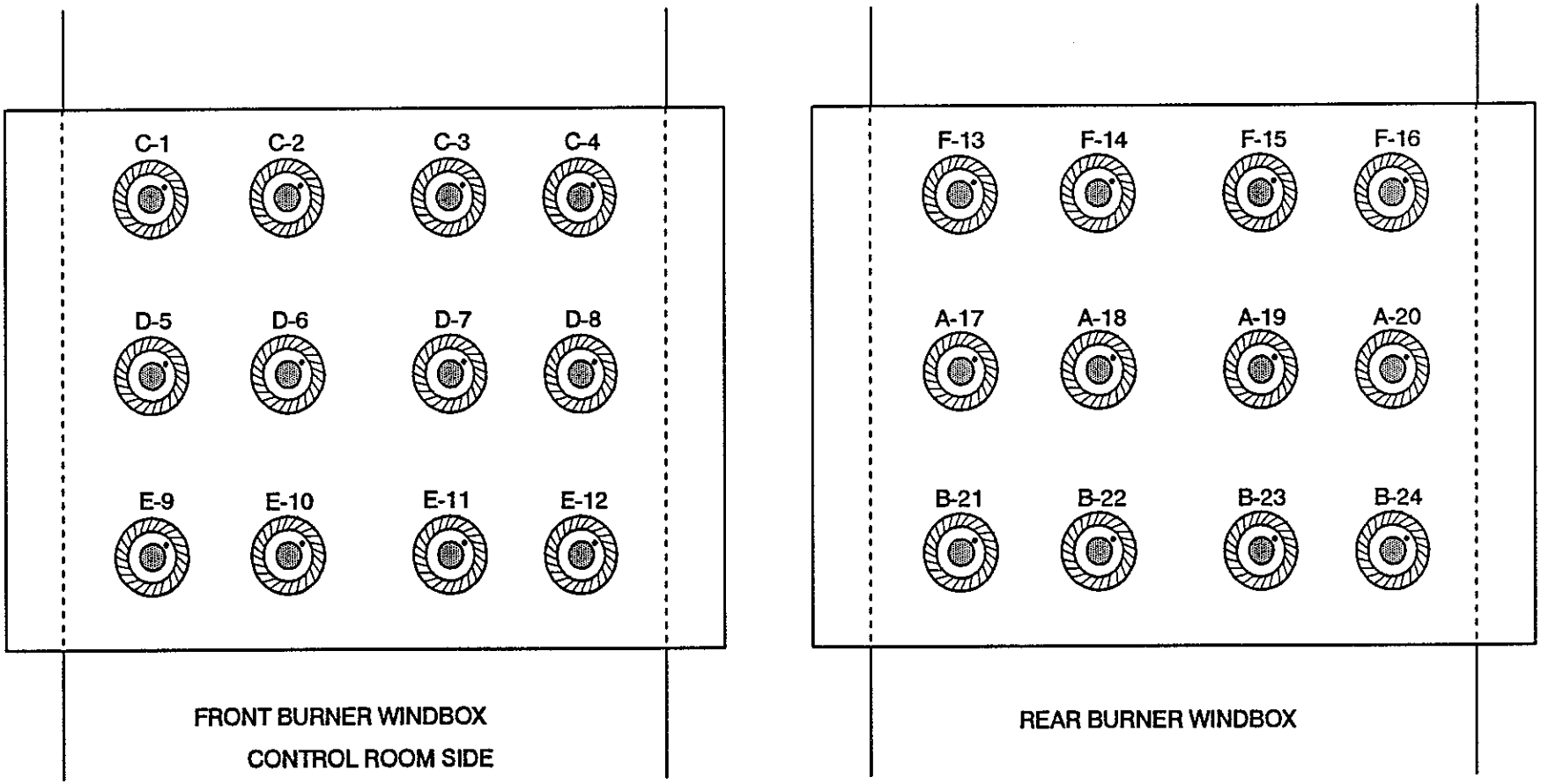
  DETERMINE OPERATIONAL CONSISTENCY

PHASE 1

BASELINE EMISSION CHARACTERIZATION

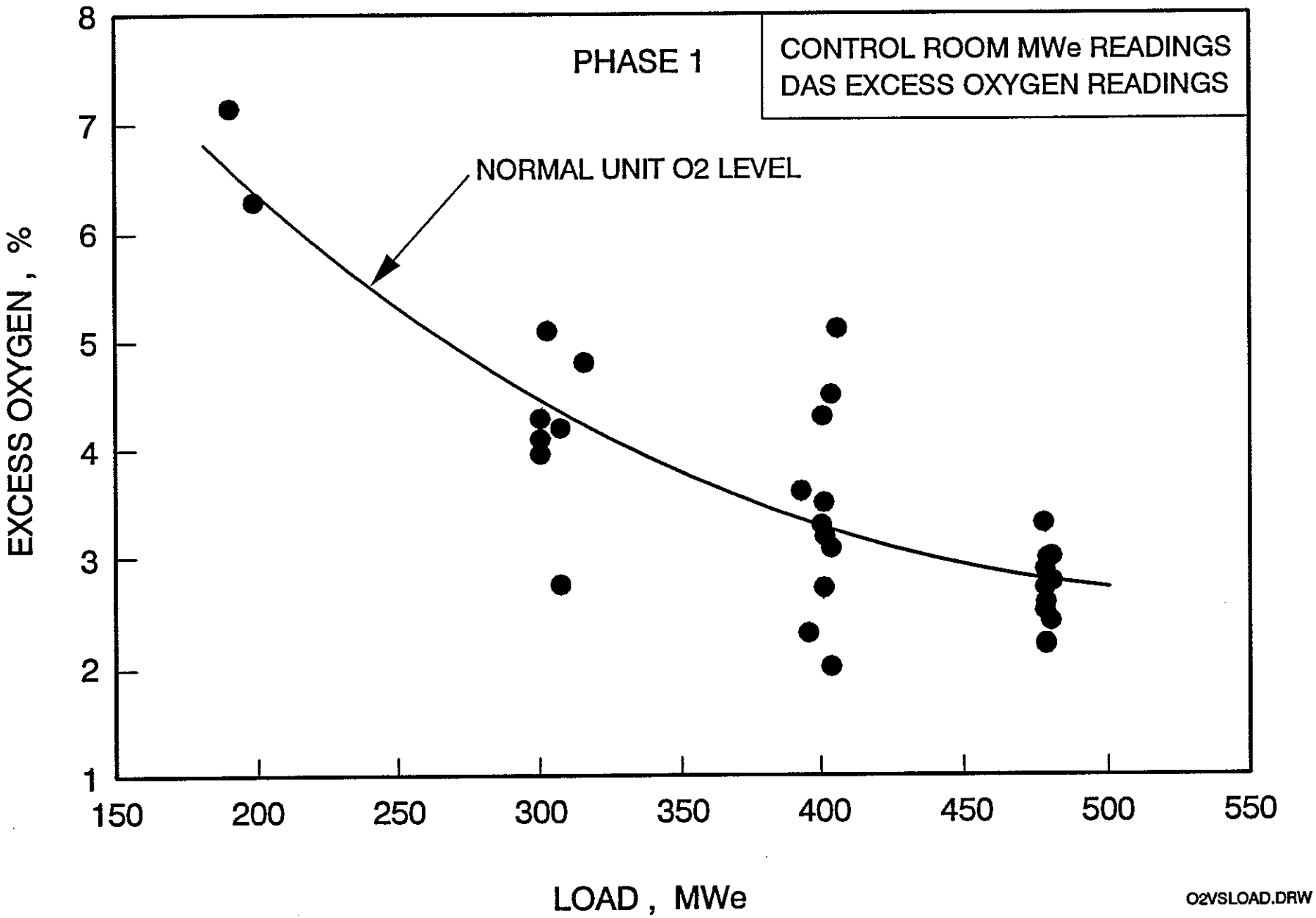
SHORT-TERM DATA
LONG-TERM DATA

HAMMOND UNIT 4 BURNER MATRIX



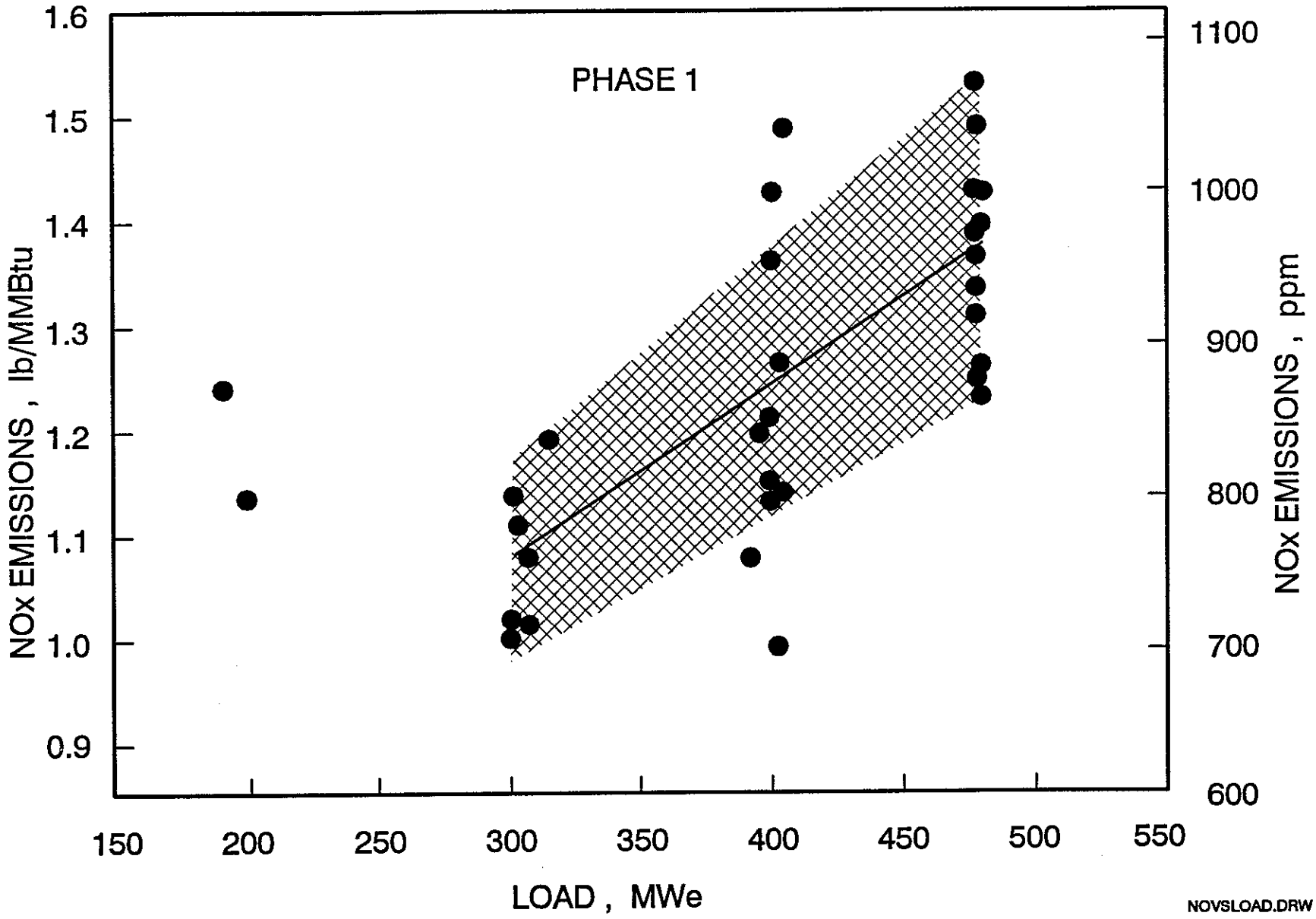
REGMATRX.DRW

HAMMOND UNIT 4 OXYGEN LEVELS TESTED



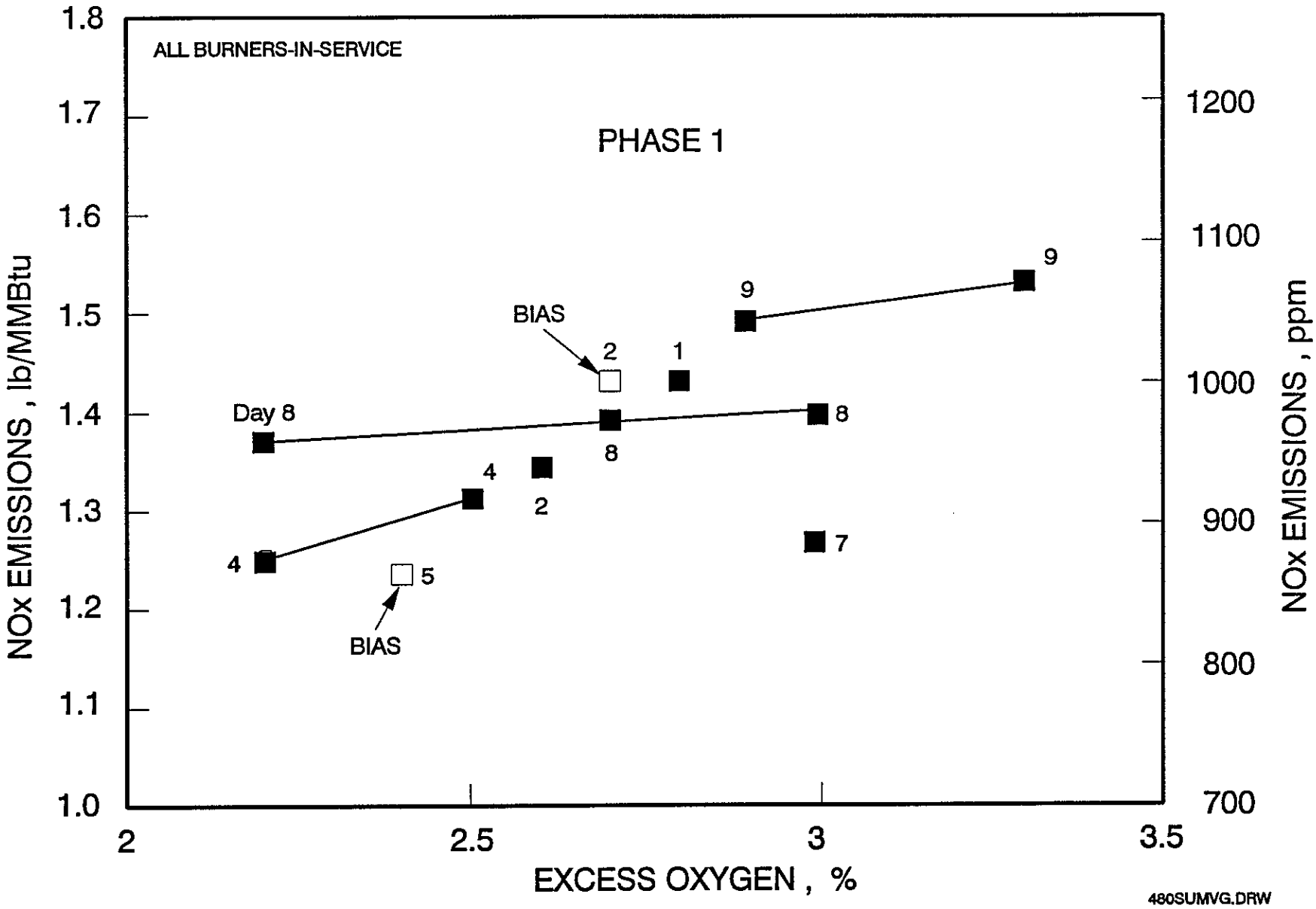
O2VSLOAD.DRW

HAMMOND UNIT 4 NITRIC OXIDE MEASUREMENTS

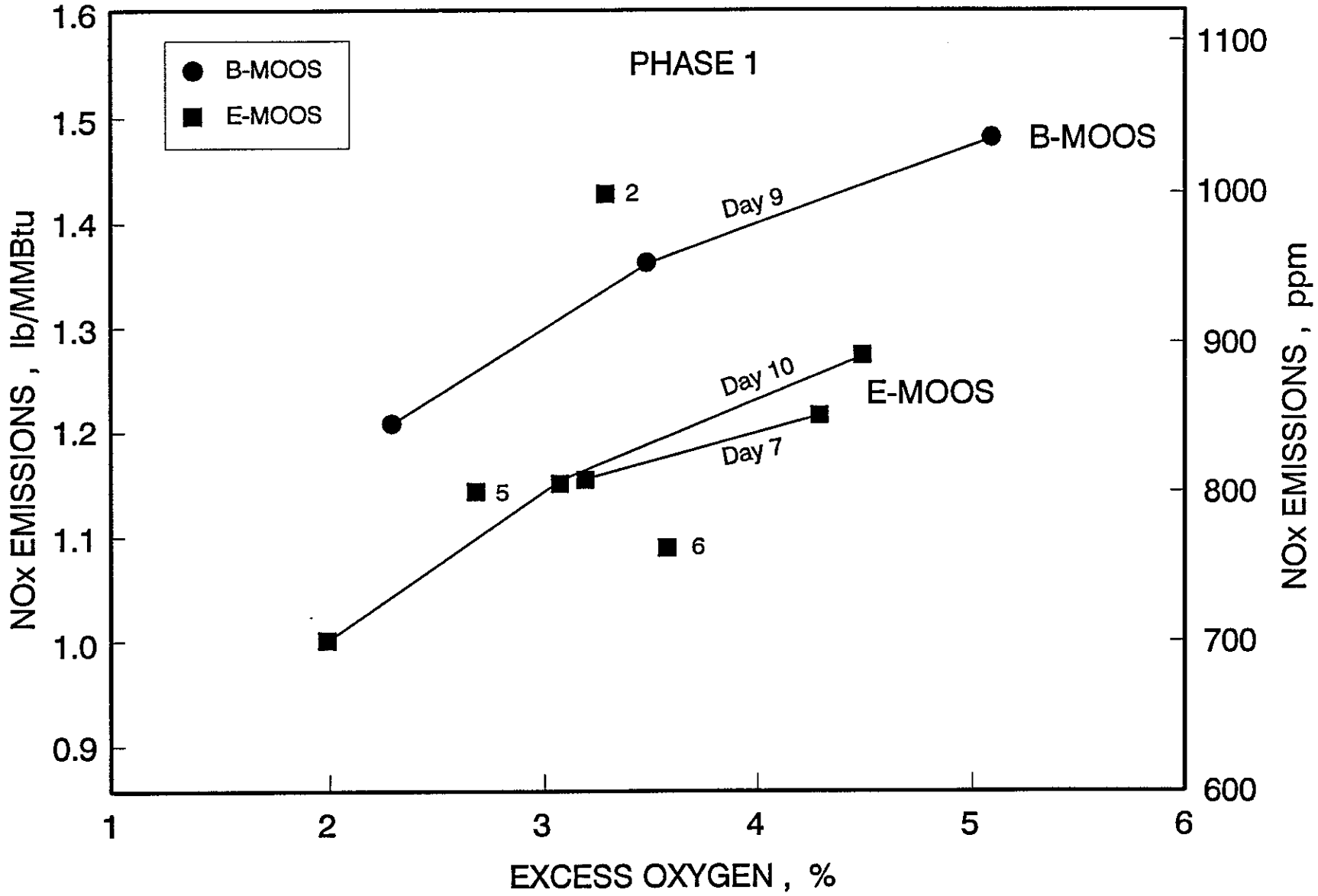


NOVSLOAD.DRW

NOx CHARACTERIZATION @ 480 MWe NOMINAL LOAD

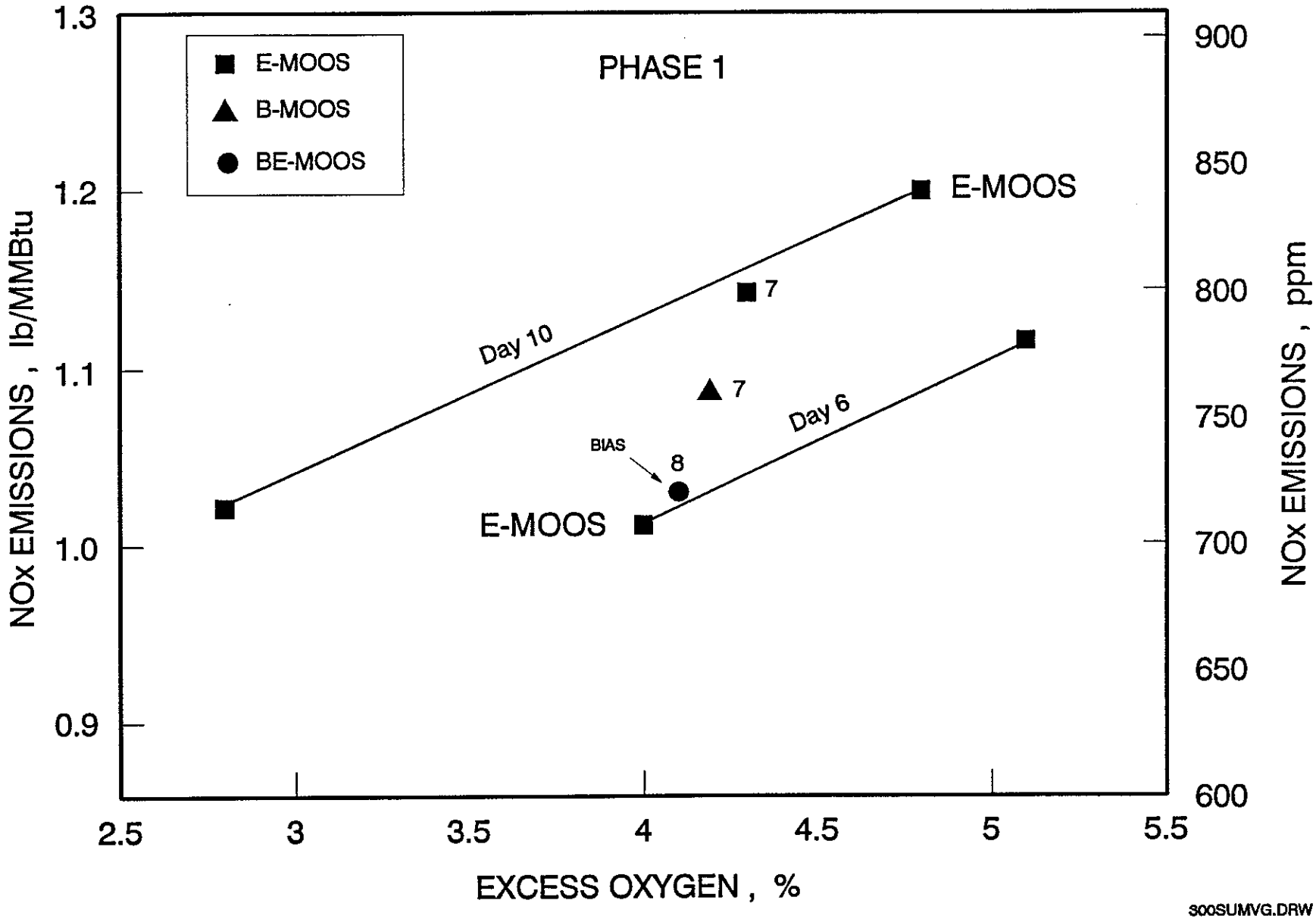


NOx CHARACTERIZATION @ 400 MWe NOMINAL LOAD

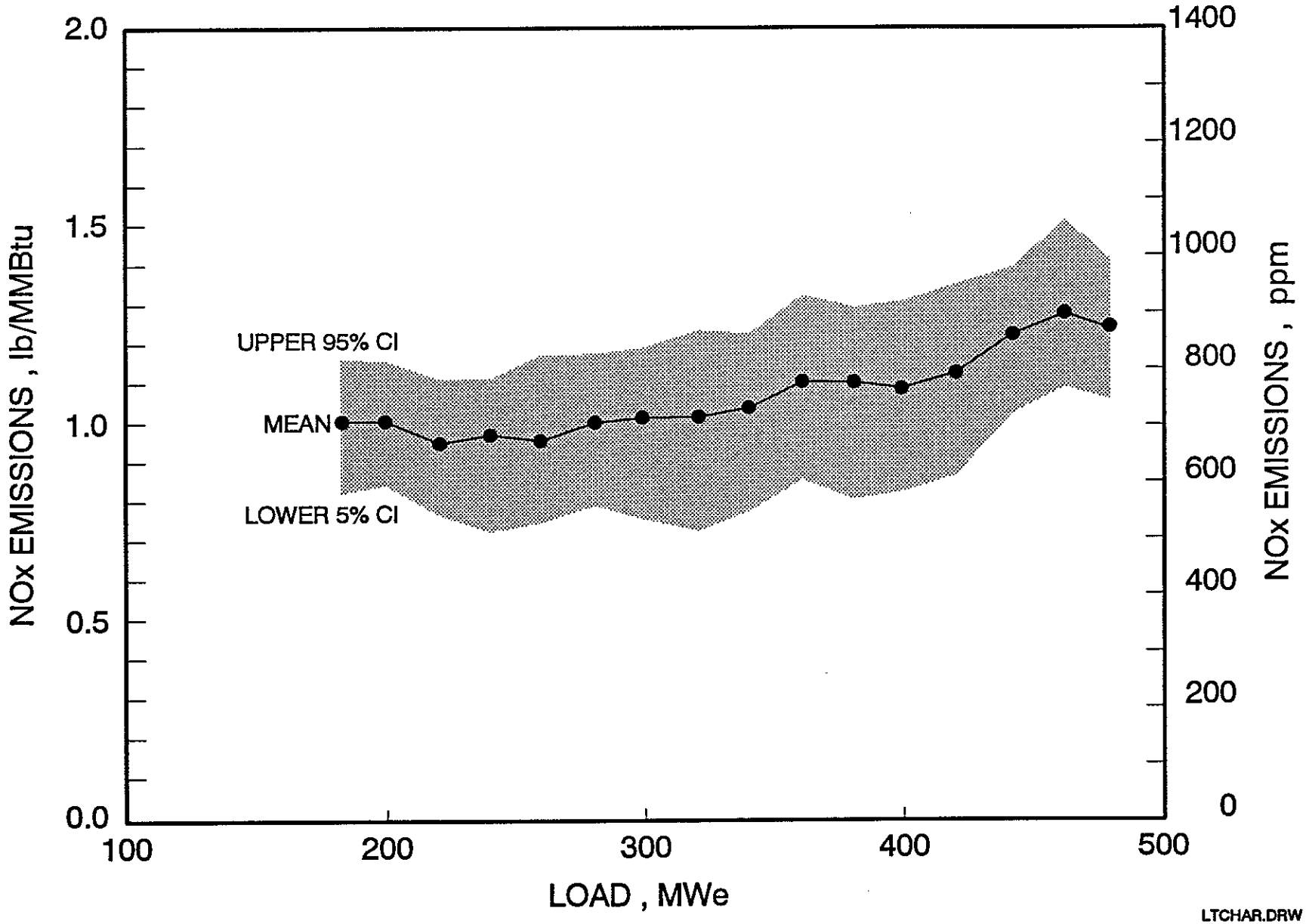


400SUMVG.DRW

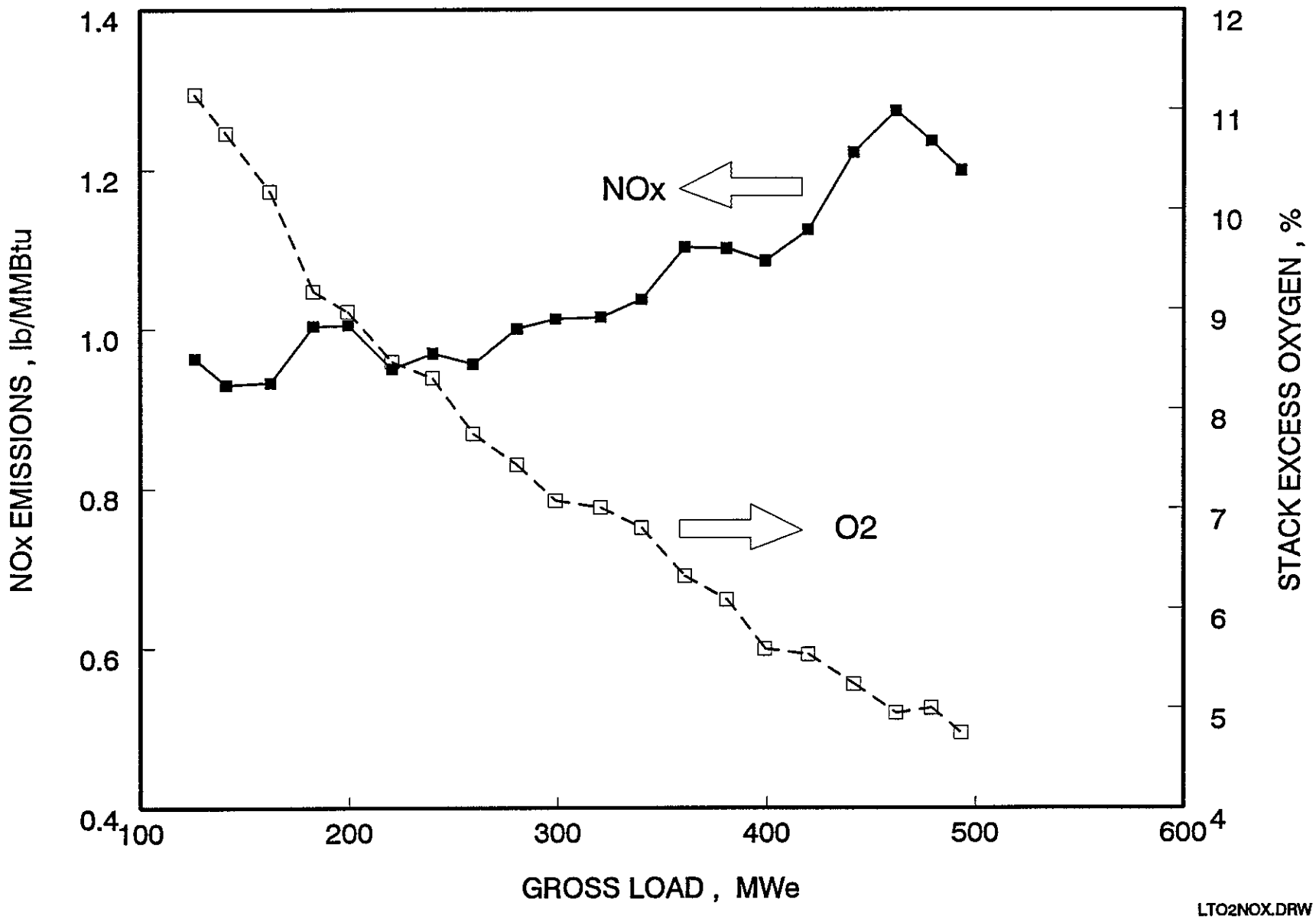
NOx CHARACTERIZATION @ 300 MWe NOMINAL LOAD



PHASE 1 LONG-TERM NOx CHARACTERIZATION

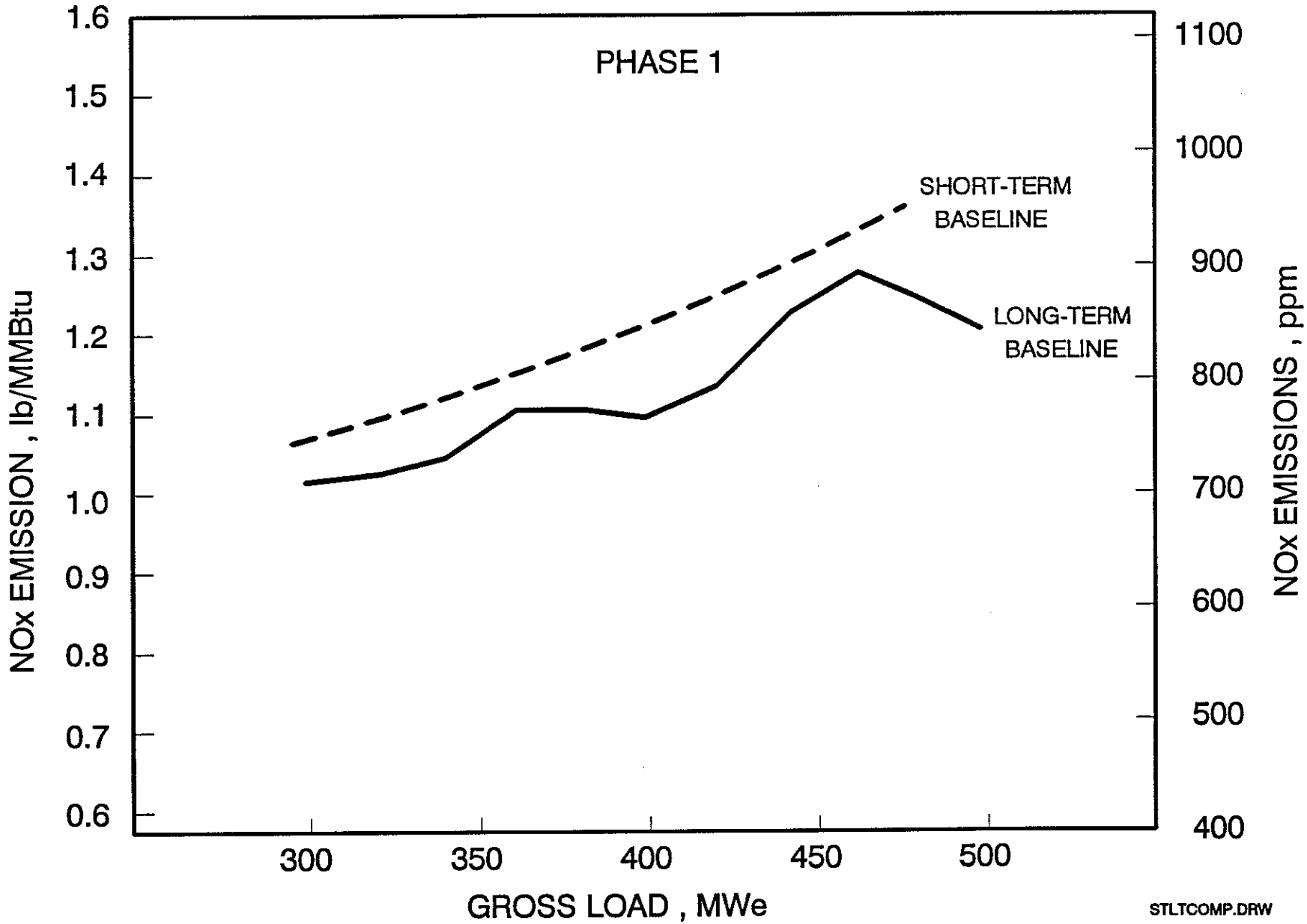


PHASE 1 LONG-TERM NOx CHARACTERISTICS



COMPARISON OF EMISSION RESULTS

LONG-TERM VERSUS SHORT-TERM



MAJOR PHASE 1 CONCLUSIONS

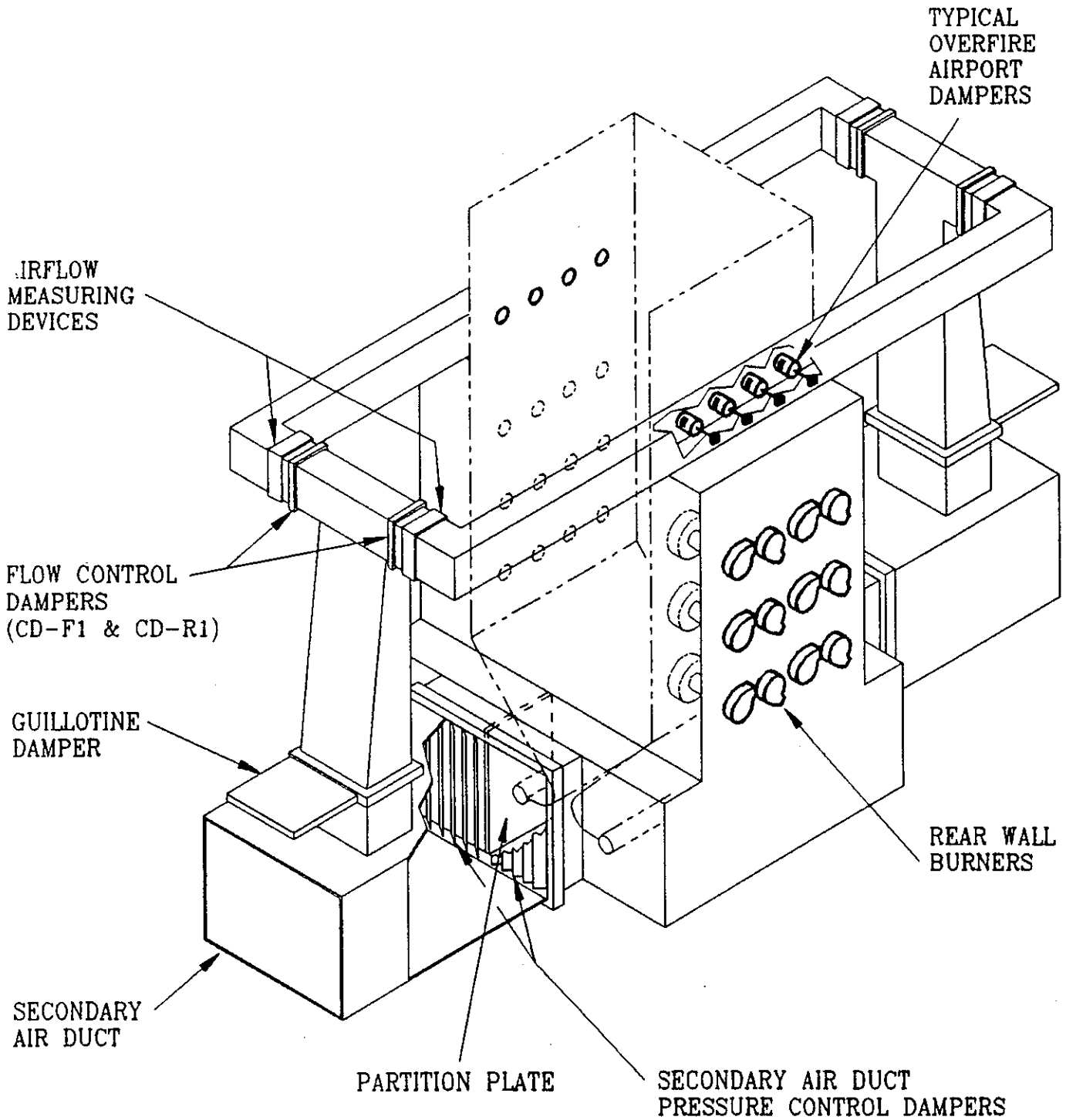
- LONG-TERM AVERAGE NOx EMISSIONS RANGED FROM 0.9 TO 1.3 LB/MMBTU
- SHORT- AND LONG-TERM NOx DATA MODERATELY VARIABLE
- SHORT-TERM NOx TRENDS WERE REPEATABLE
- LONG- AND SHORT-TERM TRENDS COMPARED WELL

PHASE 2

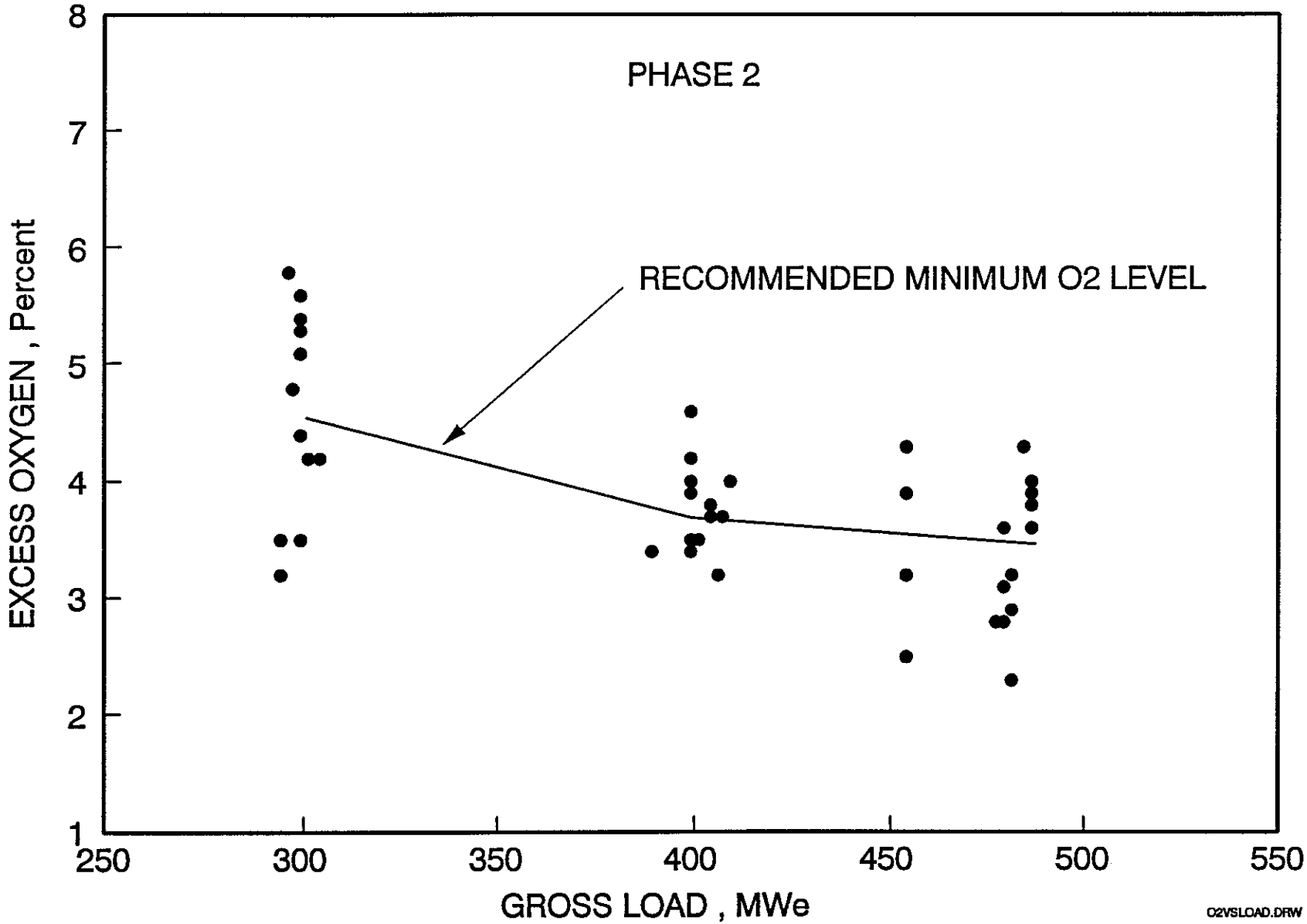
AFOA RETROFIT EMISSION CHARACTERIZATION

SHORT-TERM DATA
LONG-TERM DATA

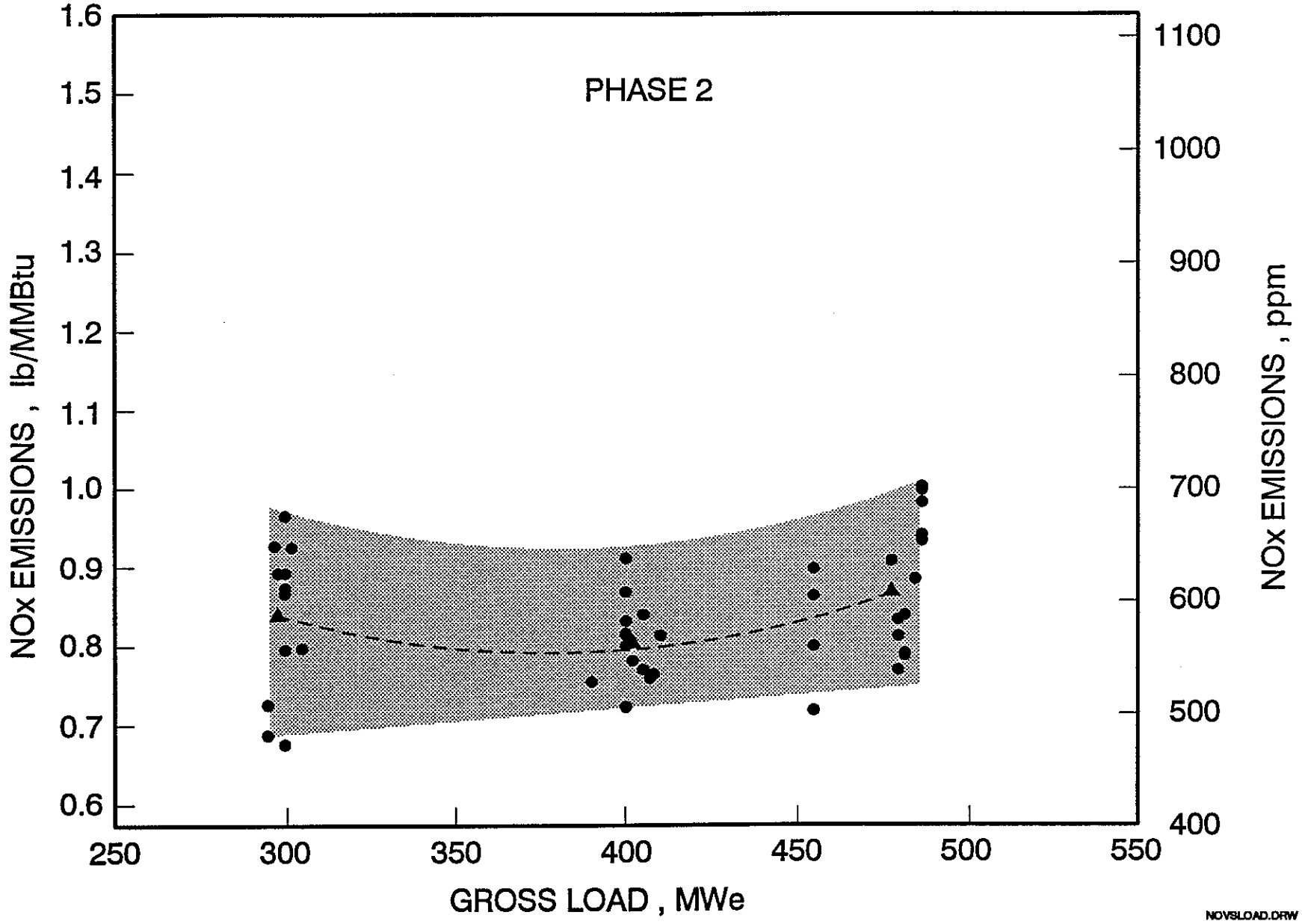
FIGURE 2-1 SCHEMATIC OF ADVANCED OFA



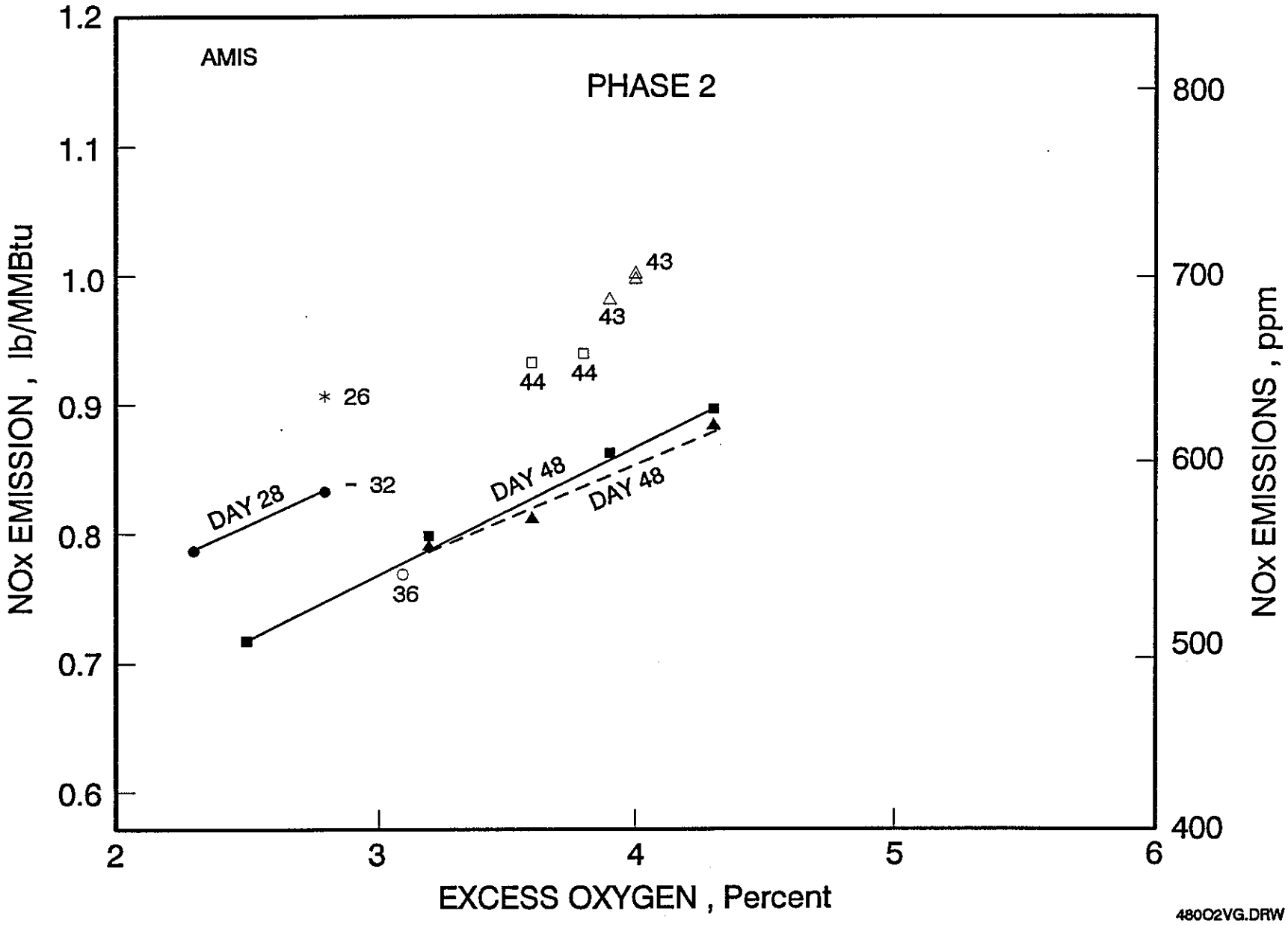
EXCESS OXYGEN LEVELS TESTED



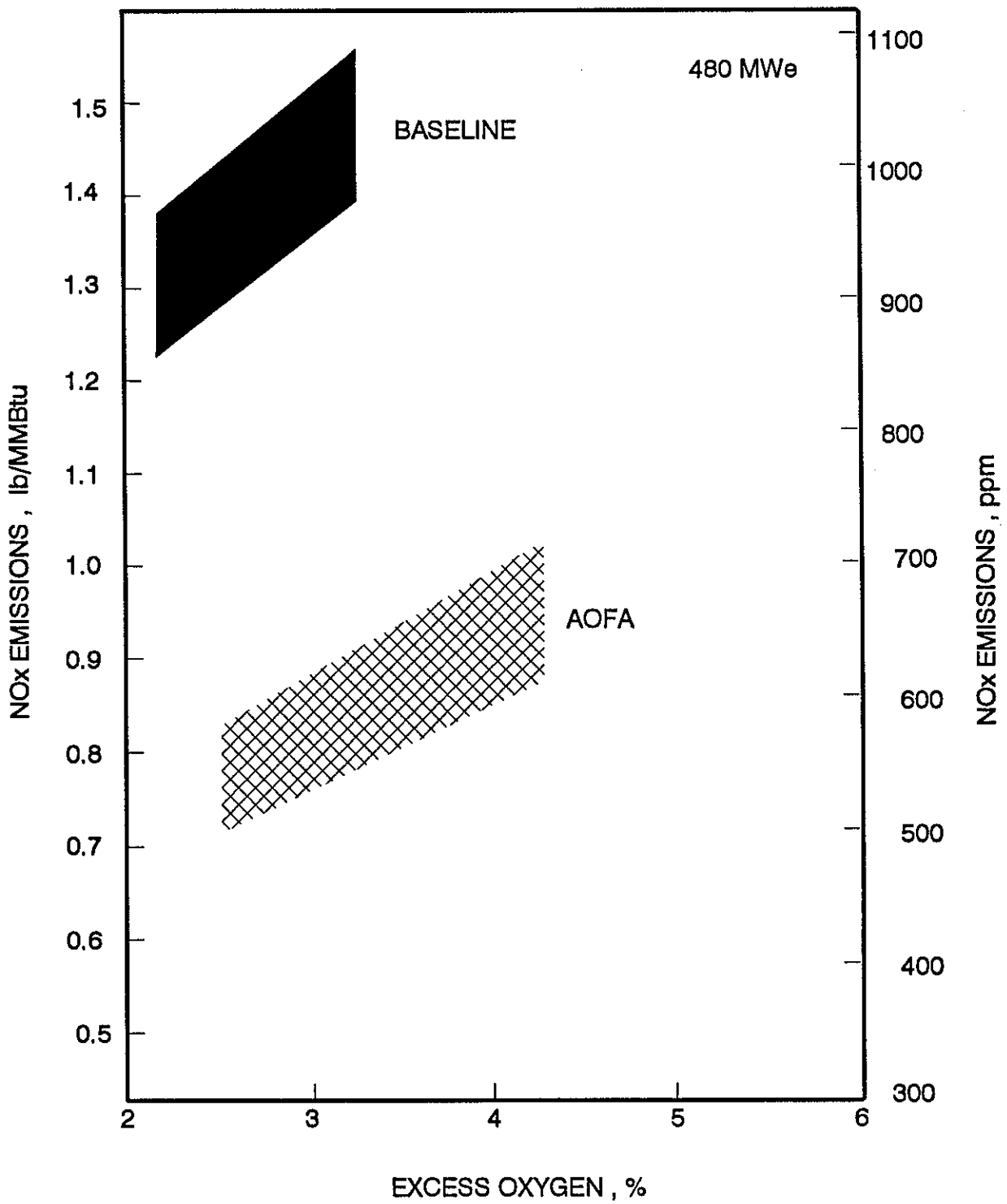
HAMMOND UNIT 4 NITRIC OXIDE MEASUREMENTS



NOx CHARACTERIZATION @ 480 MWe NOMINAL LOAD

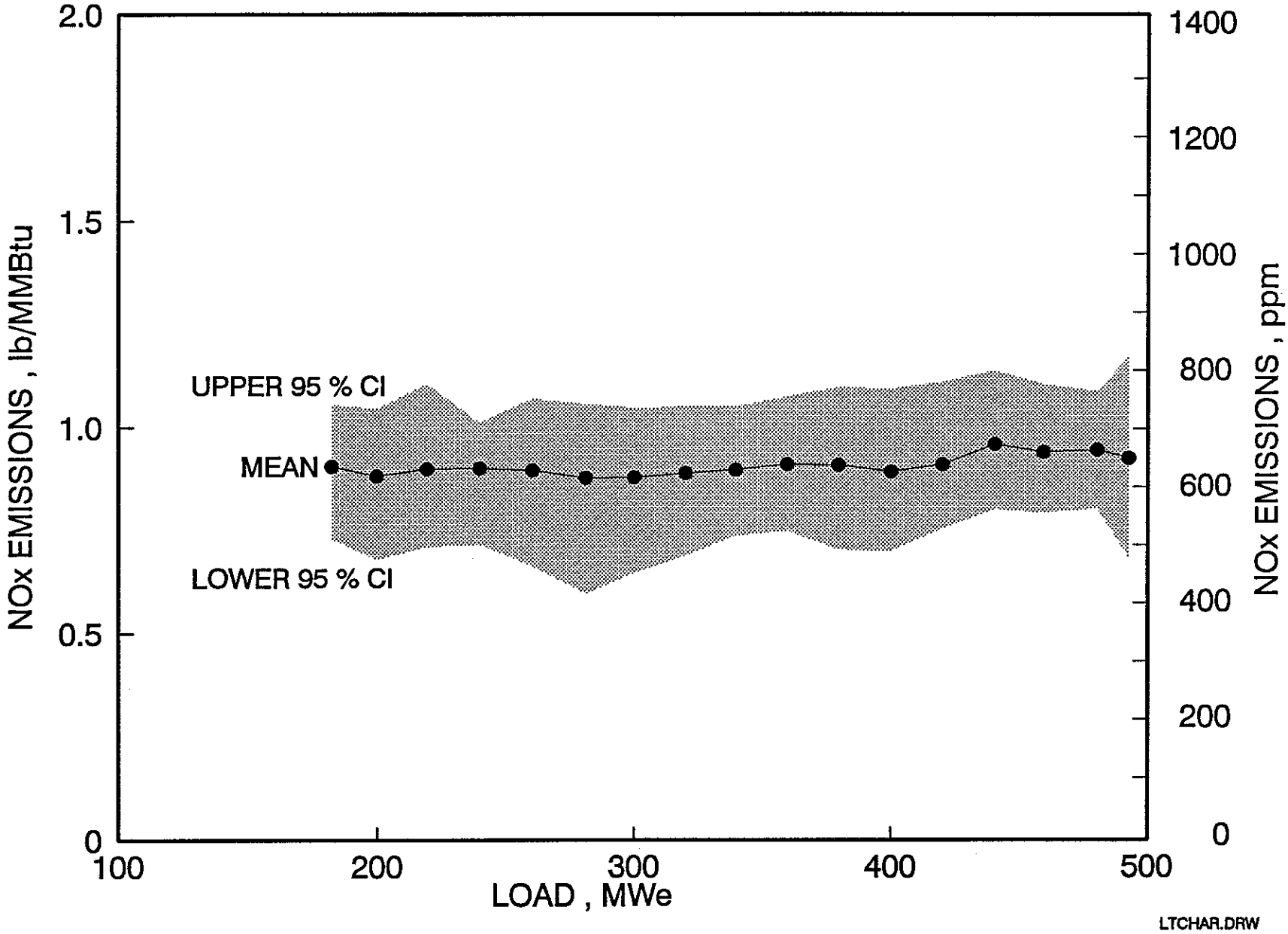


COMPARISON OF NOx SENSITIVITIES
BASELINE VS AOFA

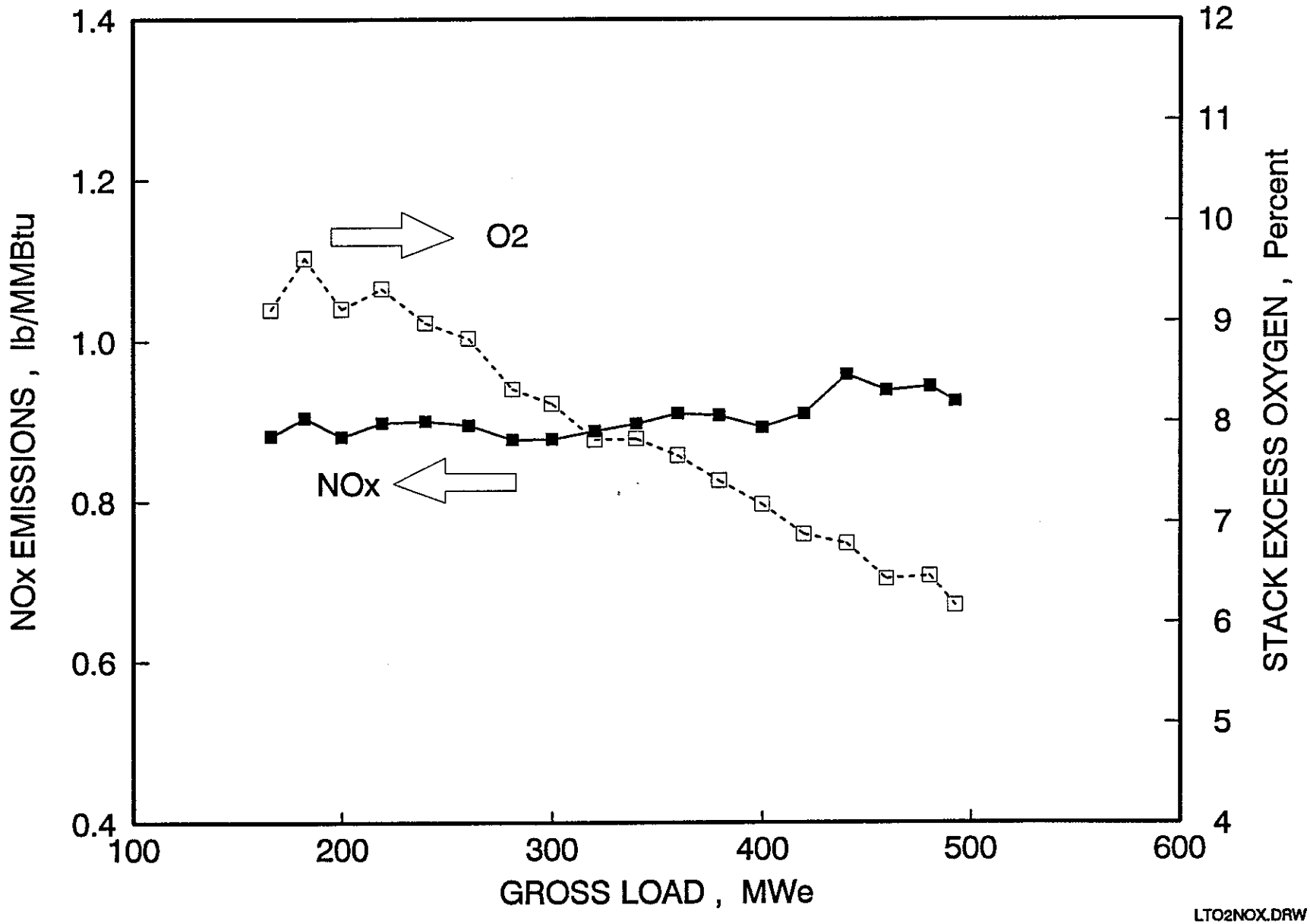


STNOCOMP.DRW

PHASE 2 LONG-TERM NOx CHARACTERIZATION

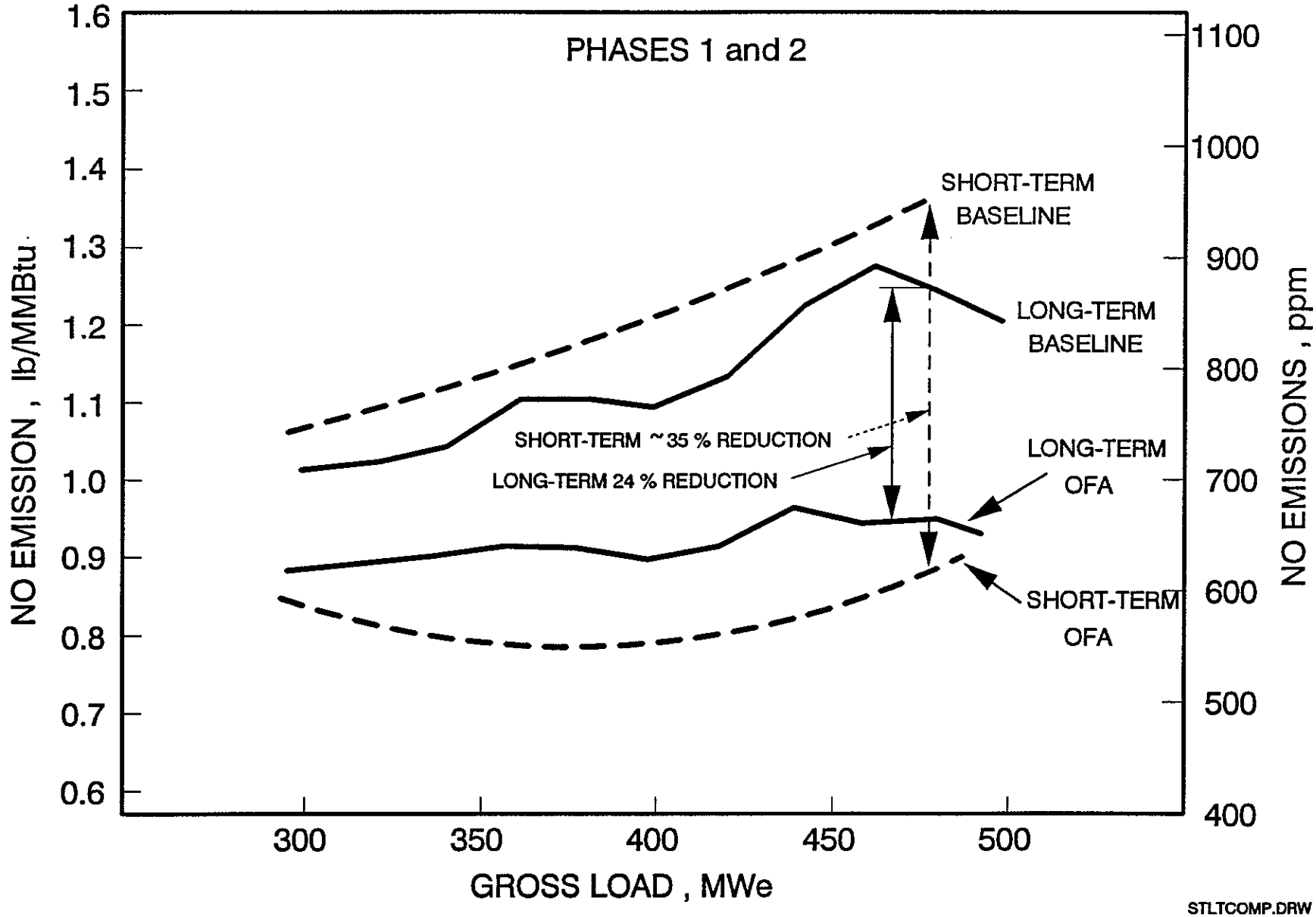


PHASE 2 LONG-TERM NOx CHARACTERISTICS



COMPARISON OF EMISSION RESULTS

LONG-TERM VERSUS SHORT-TERM



MAJOR PHASE 2 CONCLUSIONS

- SHORT-TERM NOx EMISSIONS RANGED FROM 0.85 TO 0.95 LB/MMBTU

- NOx EMISSION LESS VARIABLE THAN PHASE 1

- SHORT-TERM NOx TRENDS WERE REPEATABLE

- LONG- AND SHORT-TERM TRENDS COMPARED WELL

  LONG-TERM DATA HIGHER THAN SHORT-TERM

- LONG-TERM NOx REDUCTIONS LESS THAN SHORT-TERM

  FULL-LOAD SHORT-TERM REDUCTION APPROX 35 %

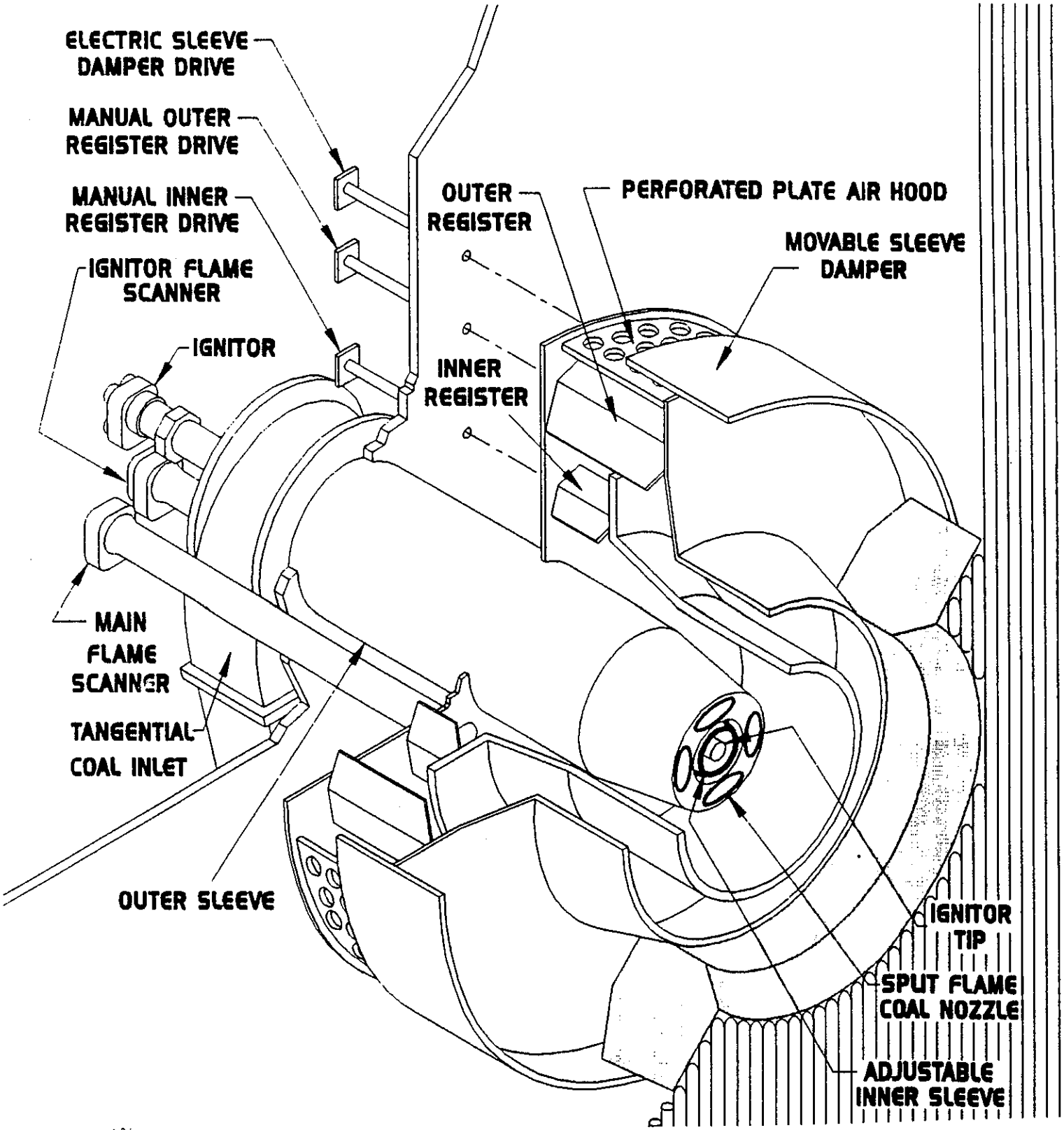
  FULL-LOAD LONG-TERM REDUCTION APPROX 24 %

PHASE 3

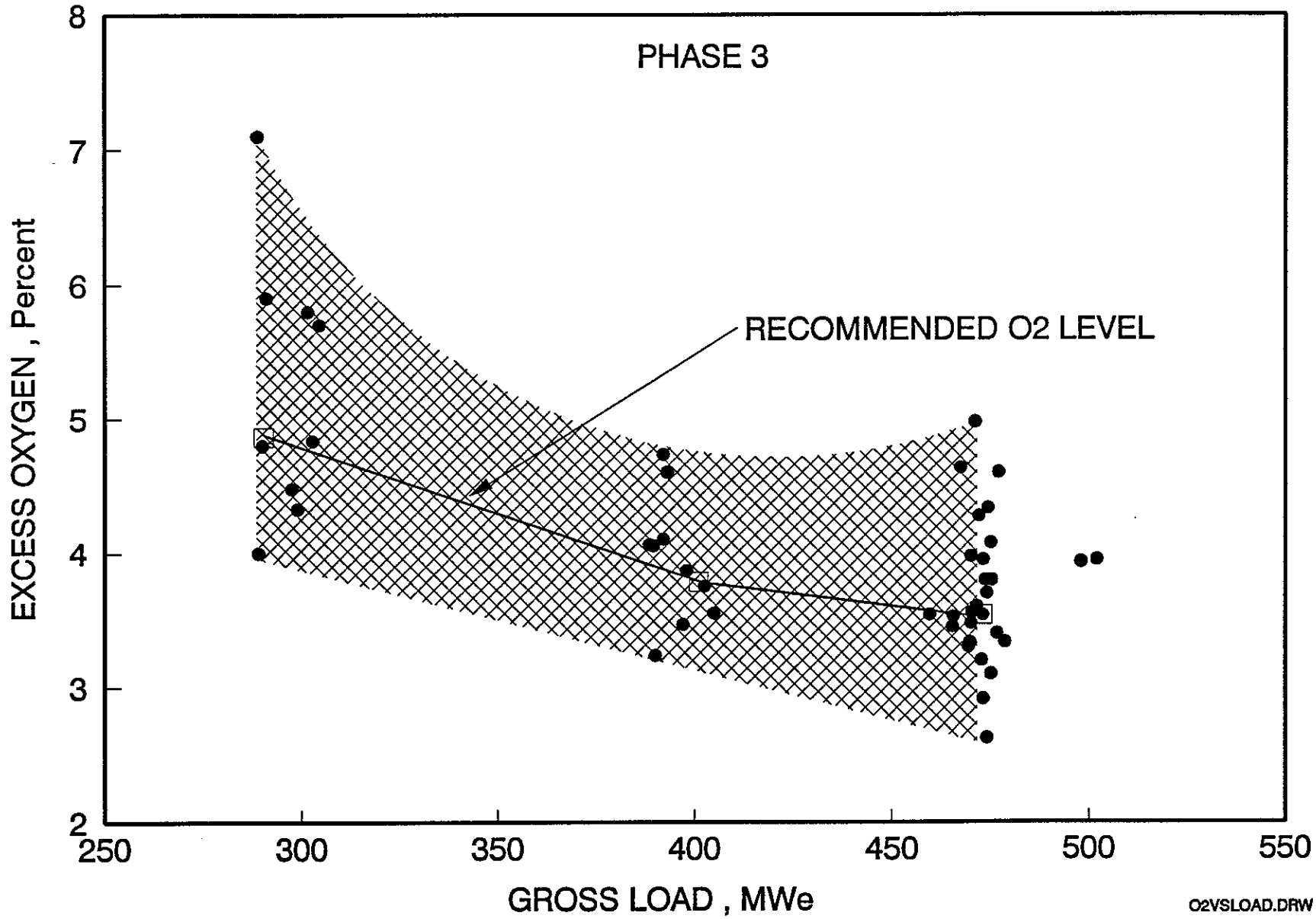
LNB RETROFIT EMISSION CHARACTERIZATION

SHORT-TERM DATA
LONG-TERM DATA

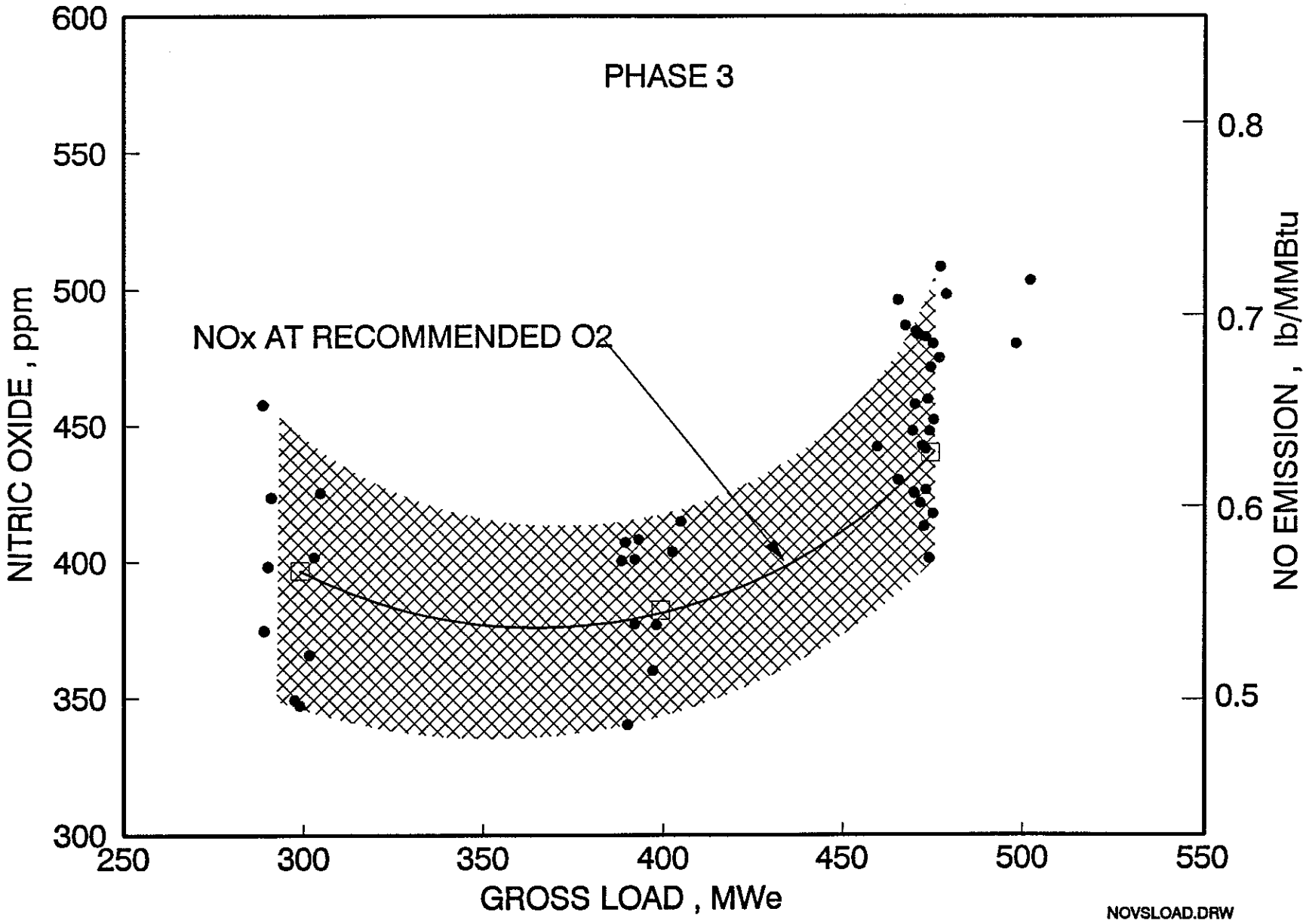
FIGURE 2-2 ILLUSTRATION OF CFSF BURNER



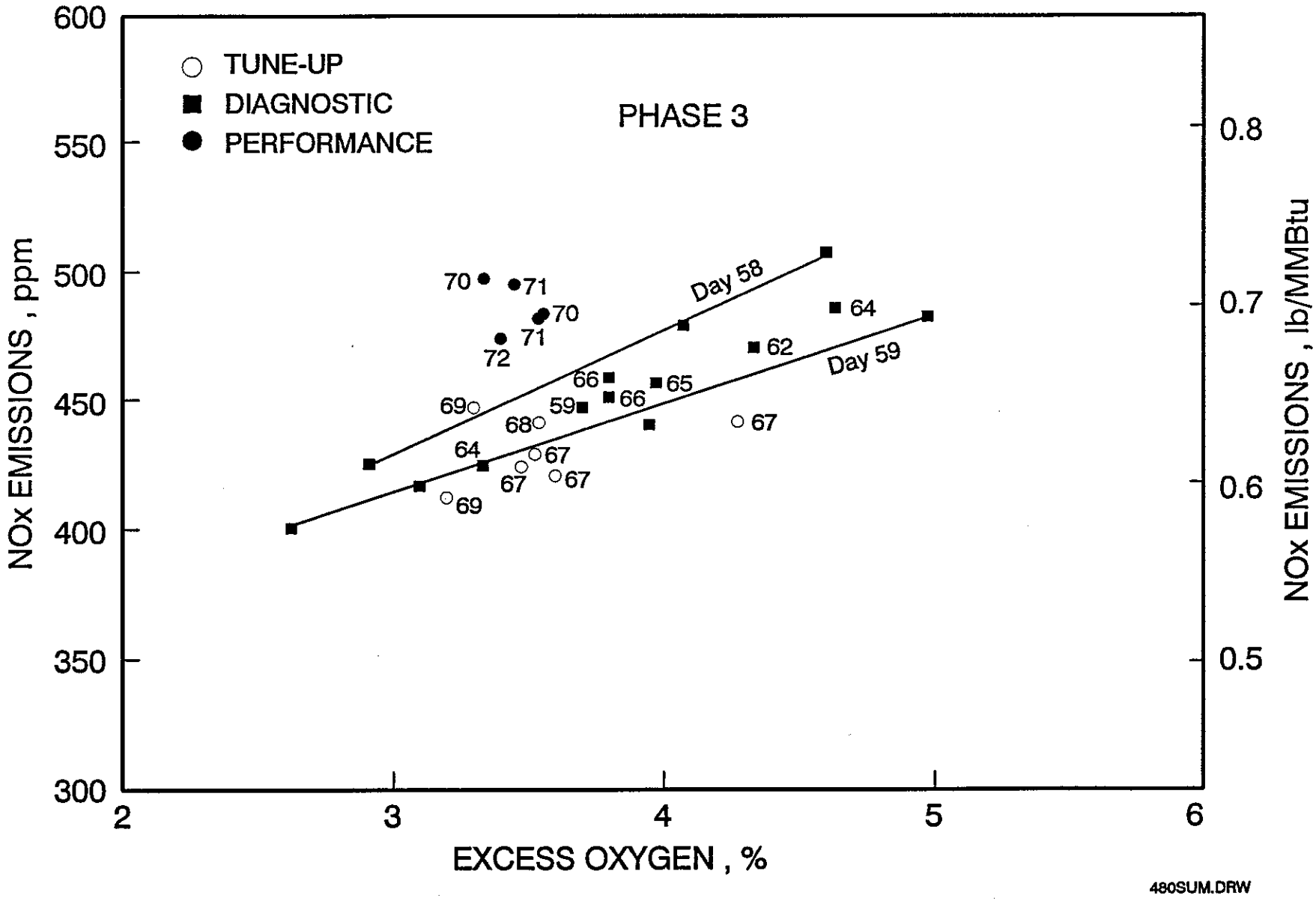
SUMMARY OF EXCESS OXYGEN LEVELS TESTED



SUMMARY OF NITRIC OXIDE MEASUREMENTS

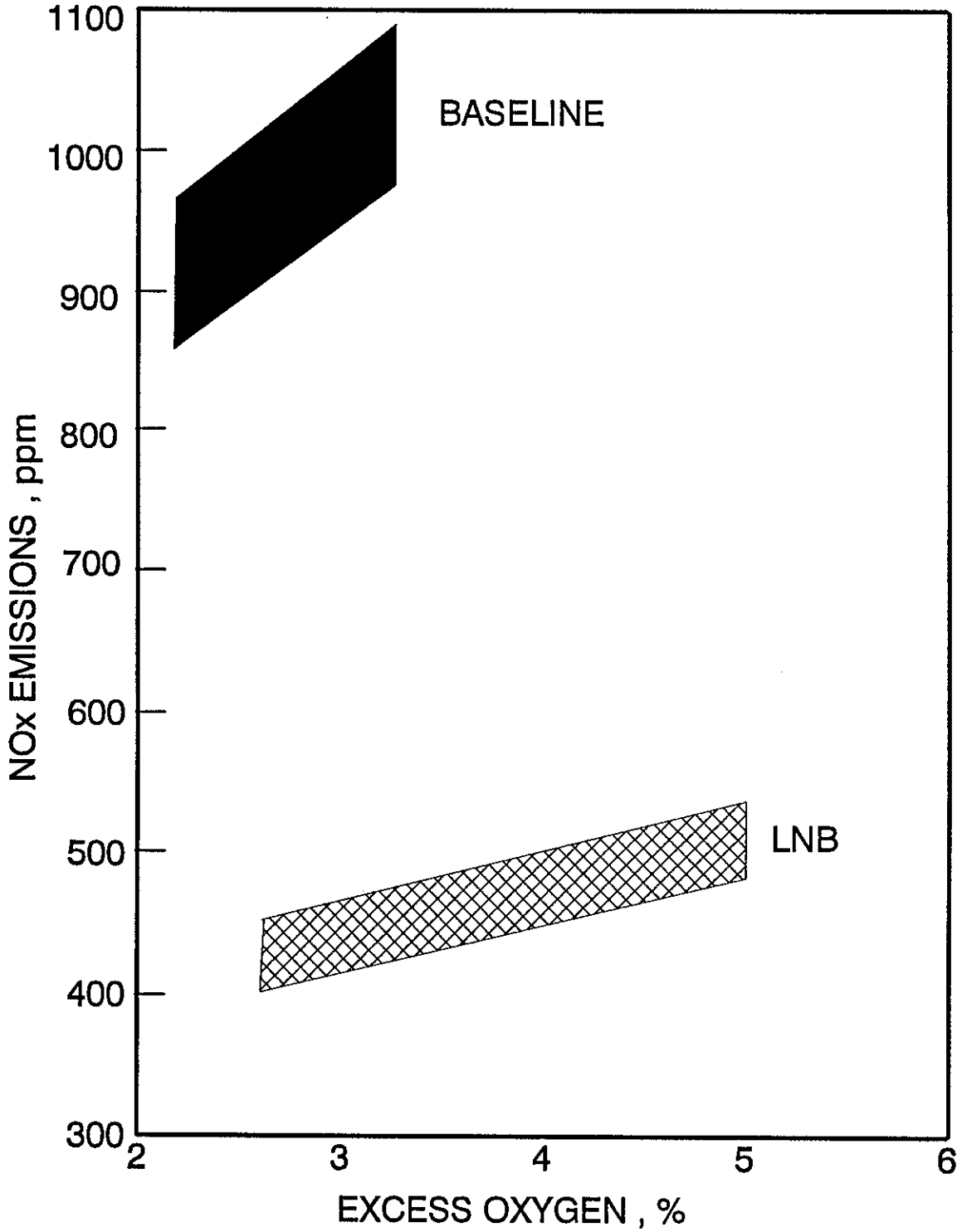


NOx CHARACTERIZATION @ 480 MWe NOMINAL LOAD



COMPARISON OF NOx SENSITIVITIES

BASELINE VS LNB



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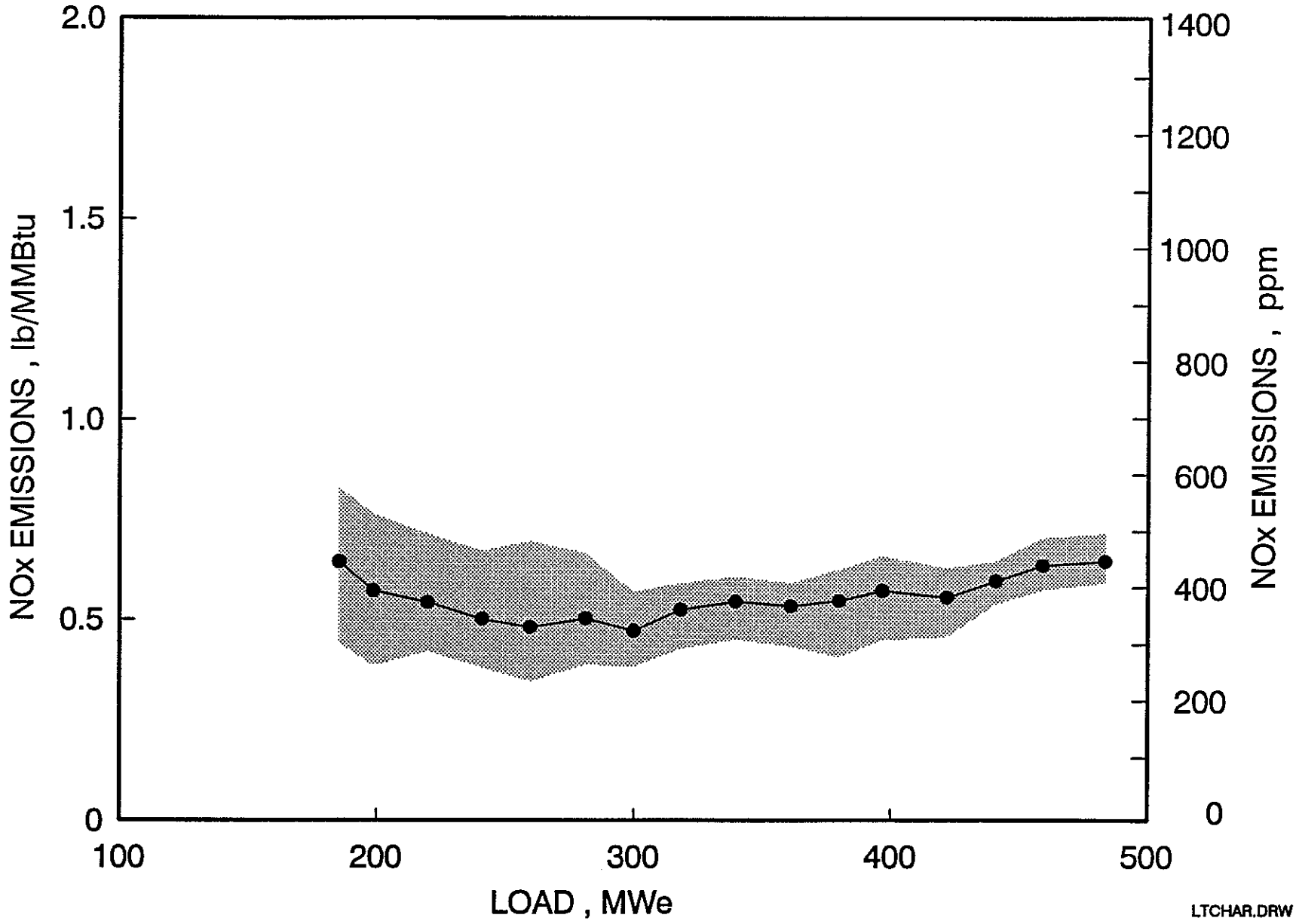
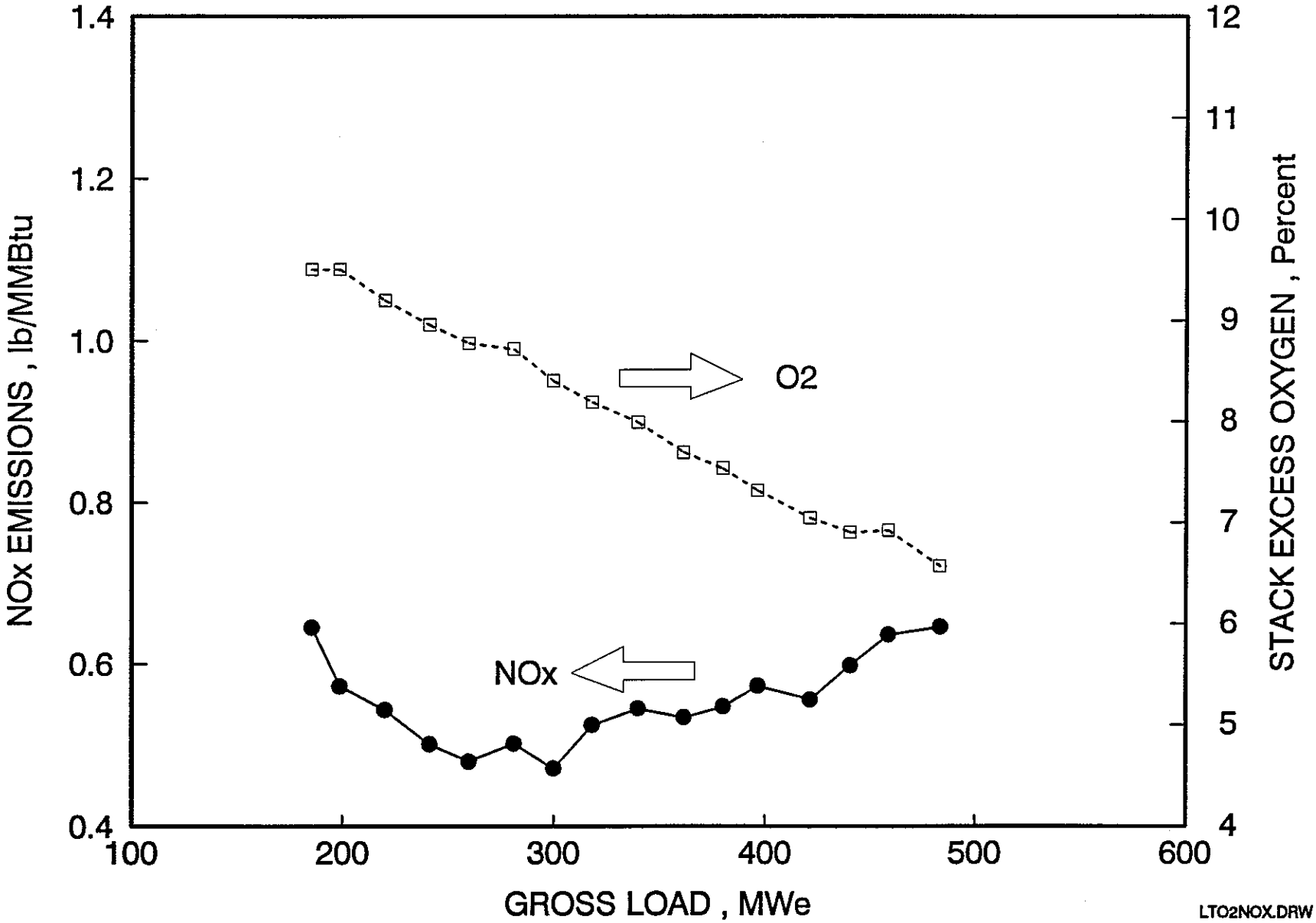
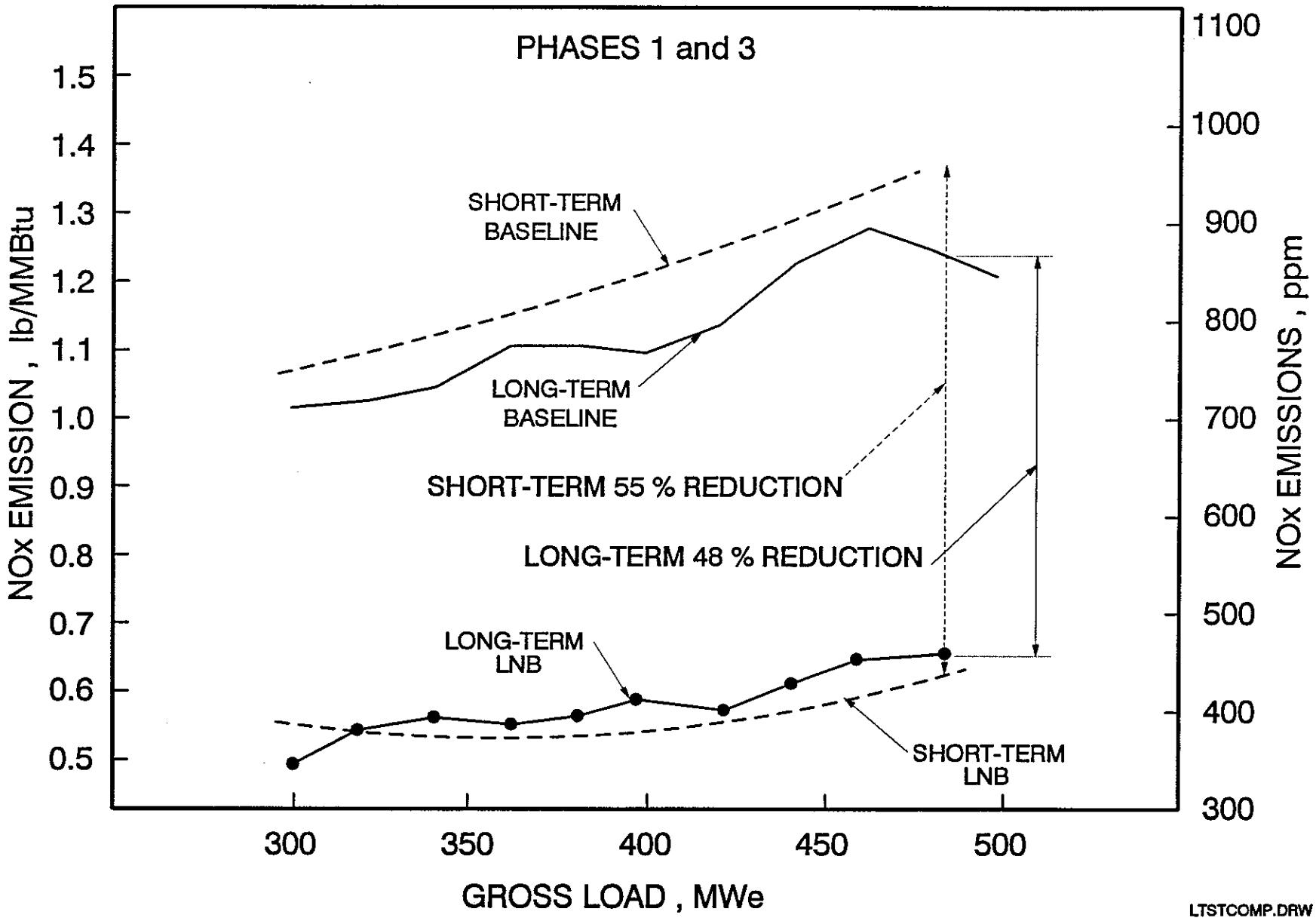
PHASE 3 LONG-TERM NOx CHARACTERIZATION



PHASE 3 LONG-TERM NOx CHARACTERISTIS



COMPARISON OF EMISSION RESULTS
LONG-TERM VERSUS SHORT-TERM



LTSTCOMP.DRW

MAJOR PRELIMINARY PHASE 3 CONCLUSIONS

- LONG-TERM NOx EMISSIONS RANGED FROM 0.45 TO 0.65 LB/MMBTU

- NOx EMISSION LESS VARIABLE THAN FOR PHASES 1 AND 2

- SHORT-TERM NOx TRENDS WERE VERY REPEATABLE

- LONG- AND SHORT-TERM TRENDS COMPARED EXTREMELY WELL

  LONG-TERM DATA CLOSE TO SHORT-TERM DATA

- LONG-TERM NOx REDUCTIONS LESS THAN SHORT-TERM

  FULL-LOAD SHORT-TERM REDUCTION APPROX 55 %

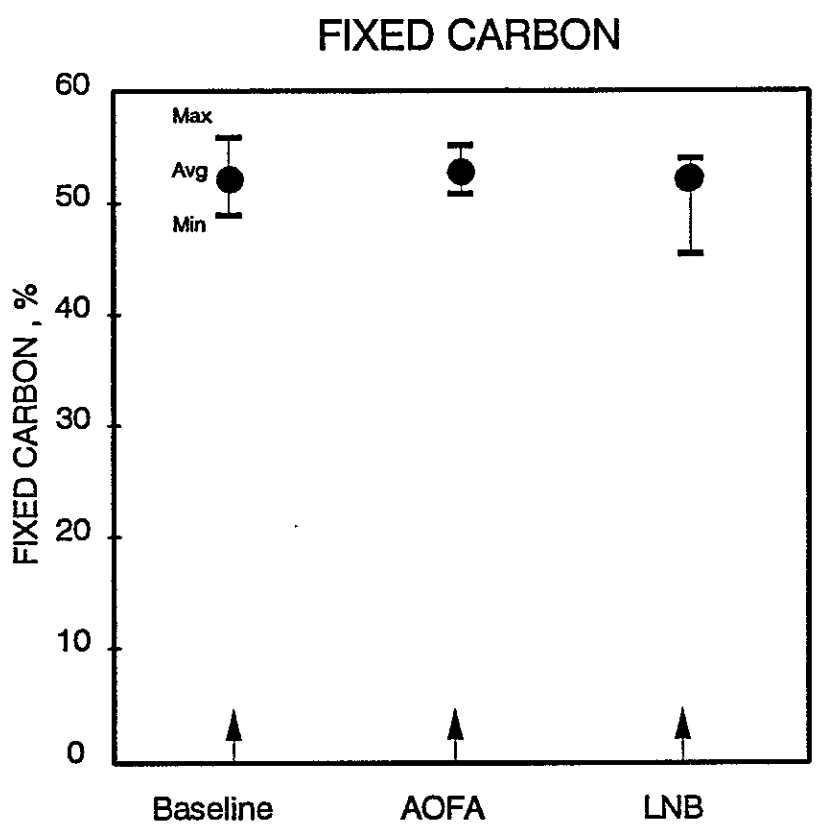
  FULL-LOAD LONG-TERM REDUCTION APPROX 48 %

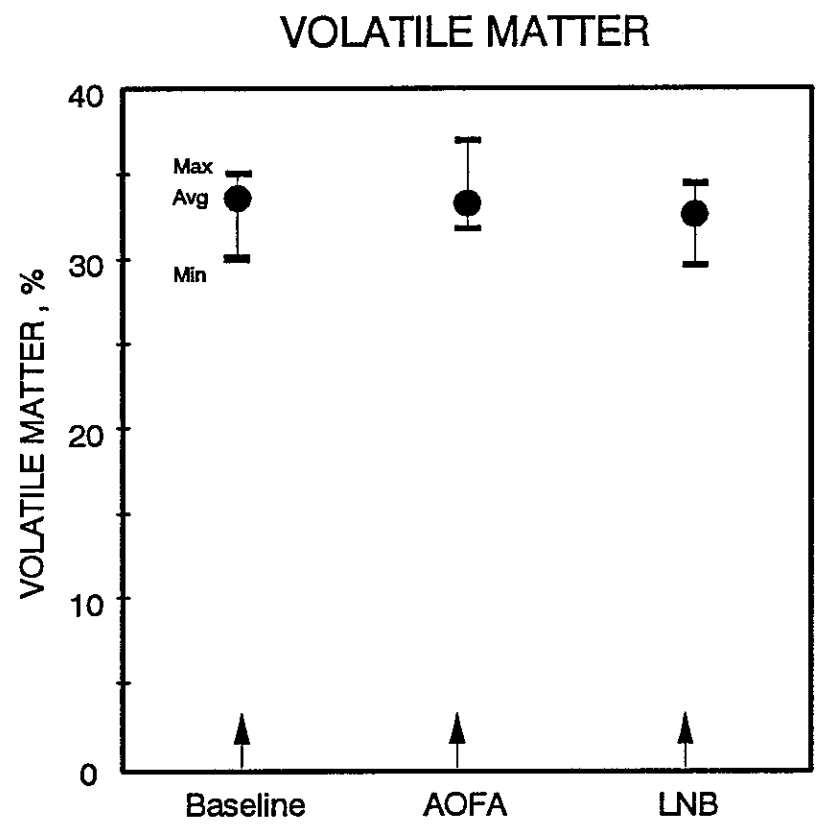
COMPARISON OF

COMBUSTION RETROFIT

EFFECTIVENESS

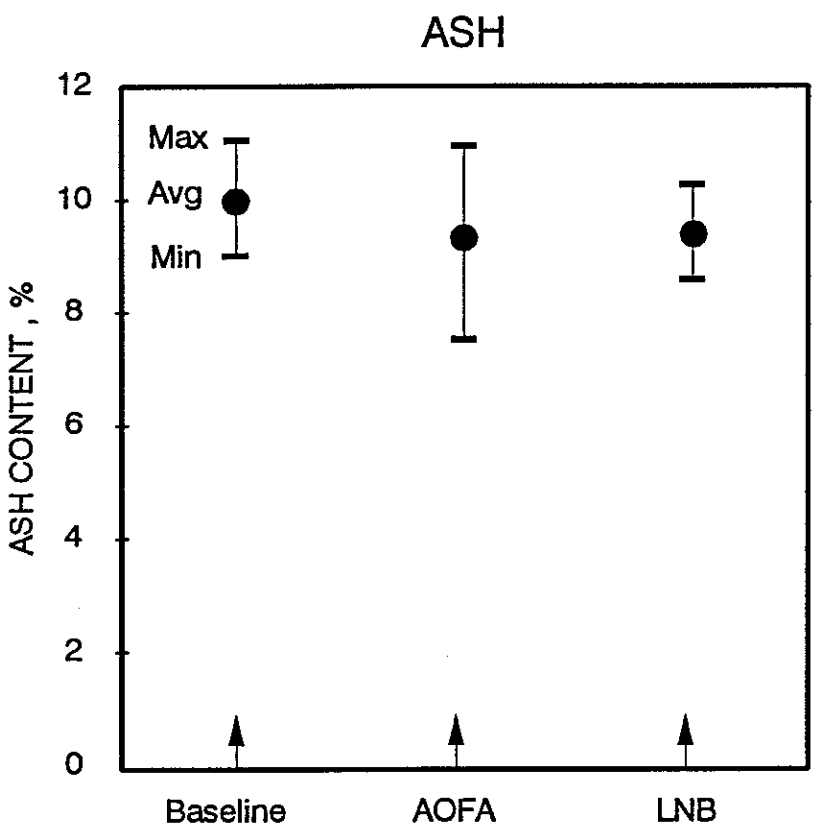
COAL PROPERTY COMPARISON

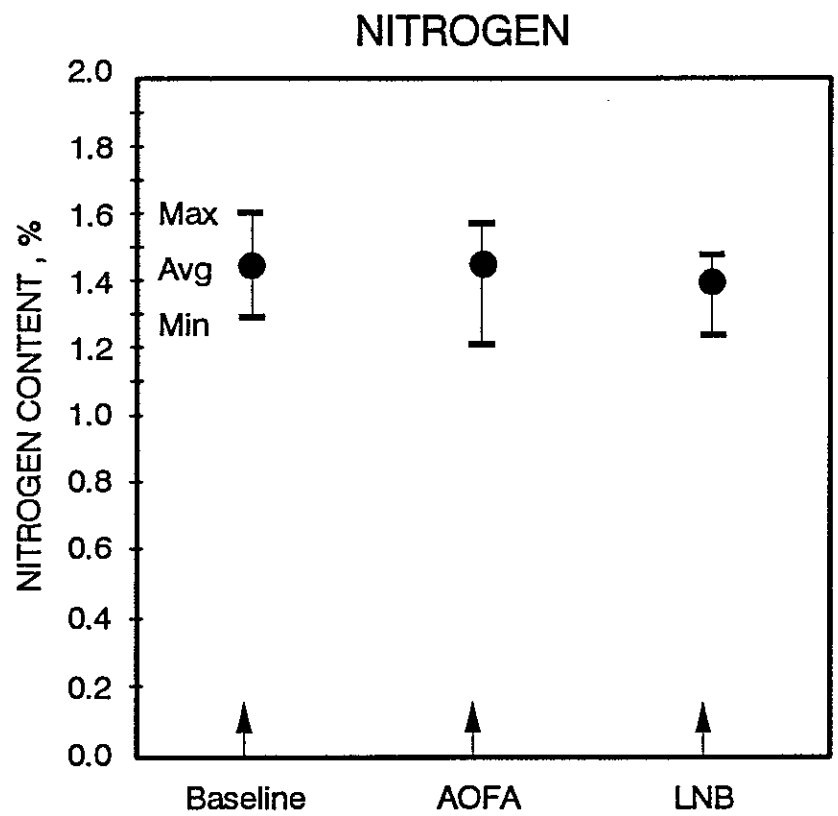




FC-VM.DRW

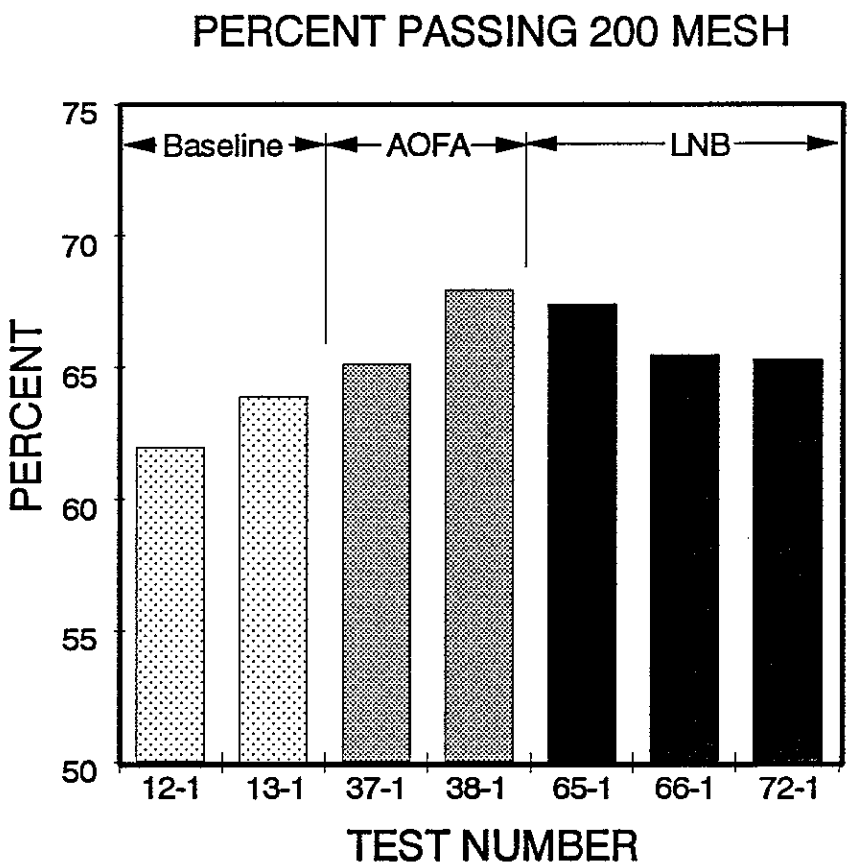
COAL PROPERTY COMPARISON

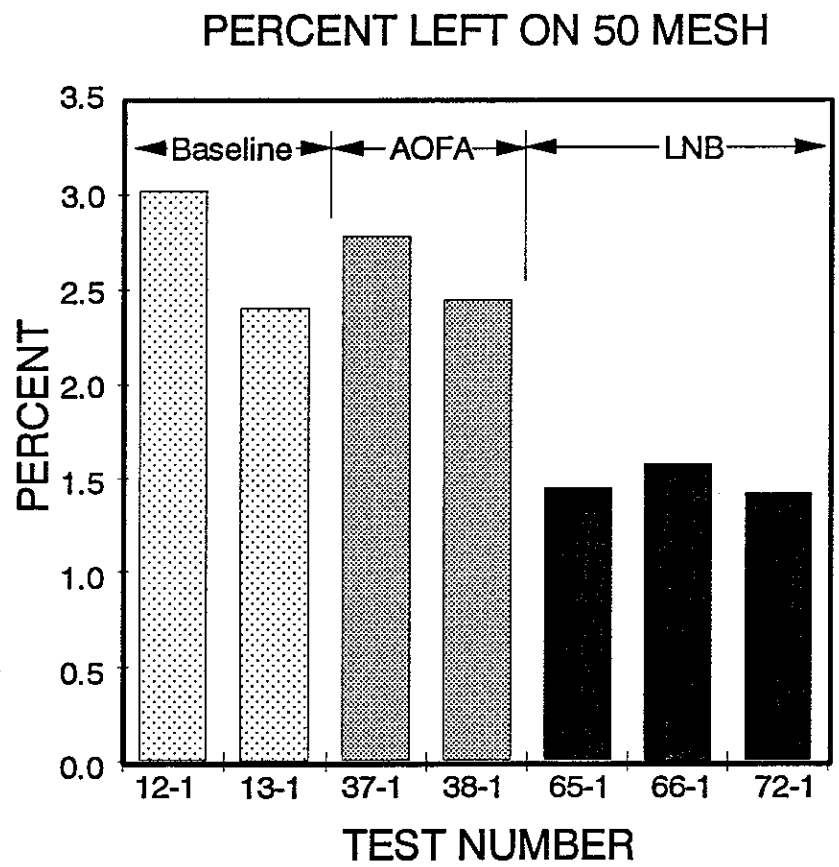




ASH-NIT.DRW

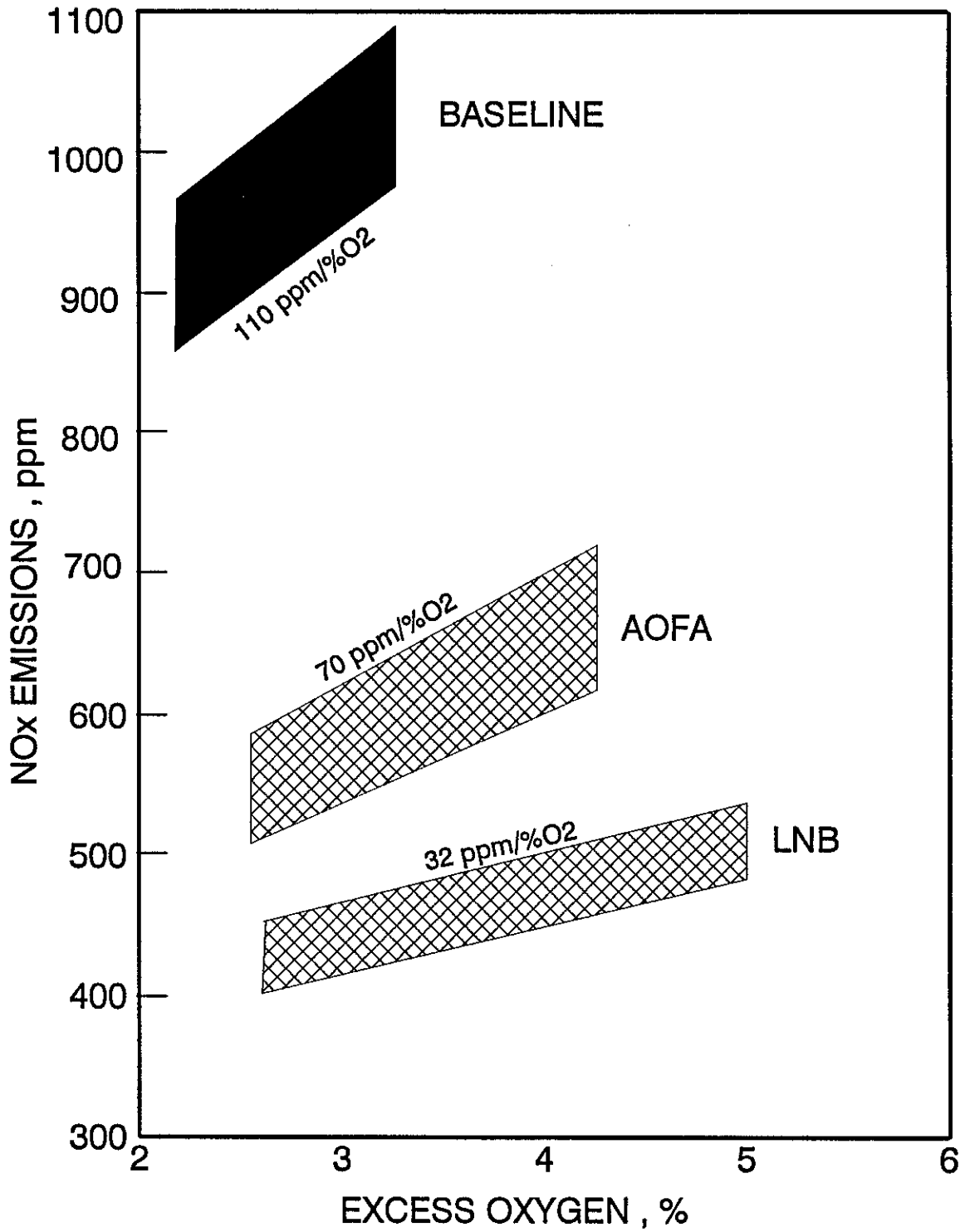
MILL PERFORMANCE COMPARISON



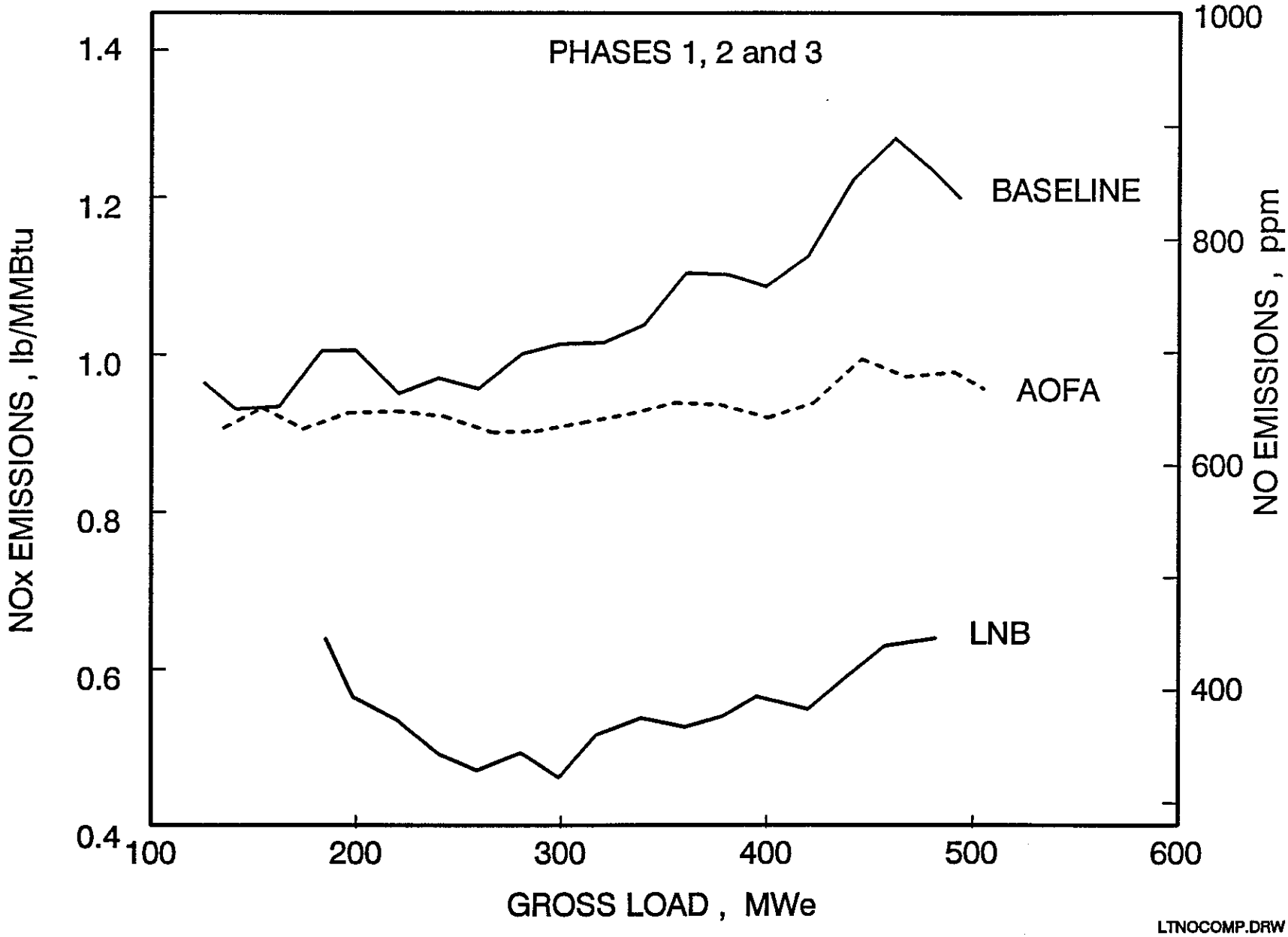


MILLCOMP.DRW

COMPARISON OF NOx SENSITIVITIES



COMPARISON OF RETROFIT TECHNOLOGY EFFECTIVENESS



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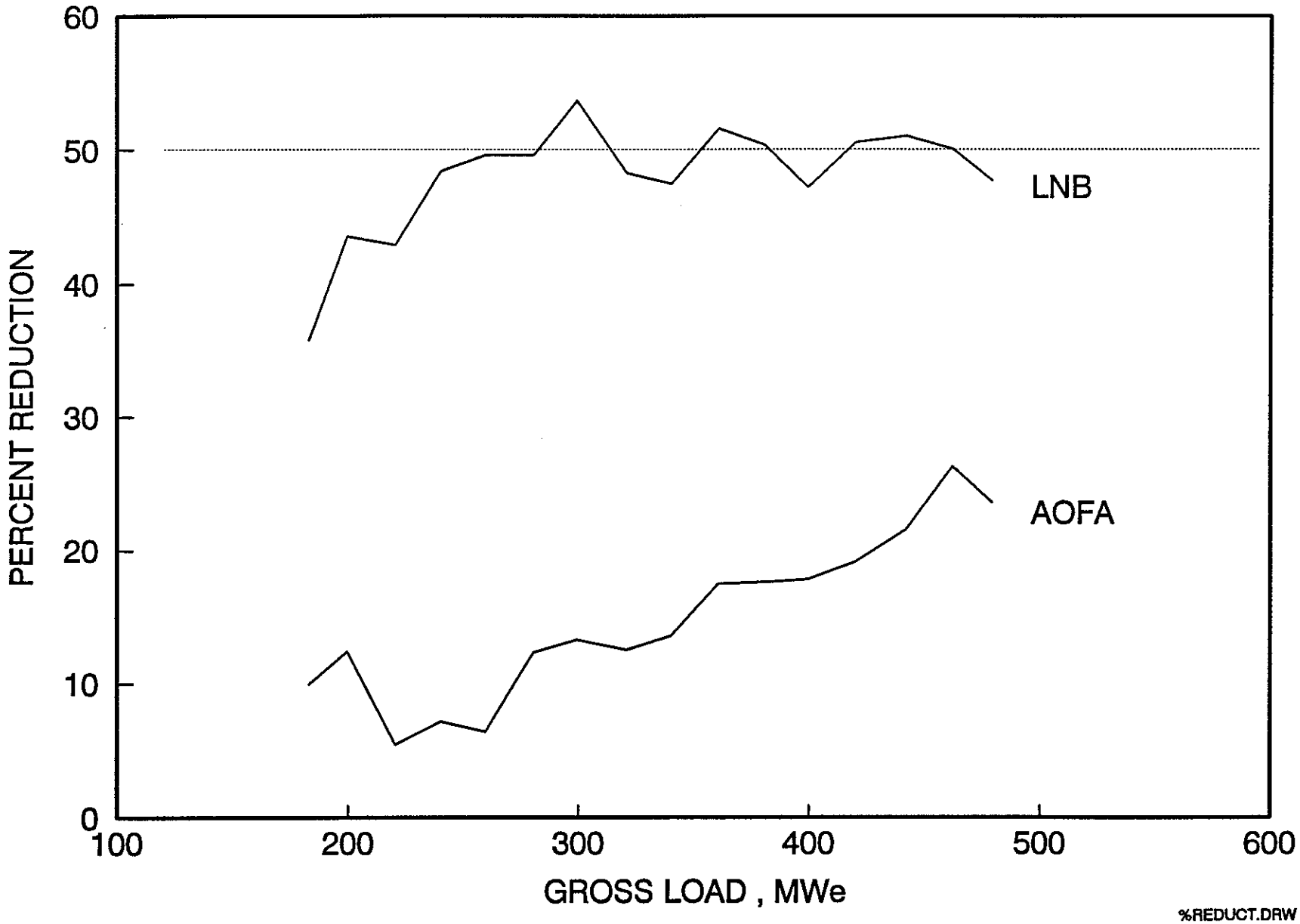
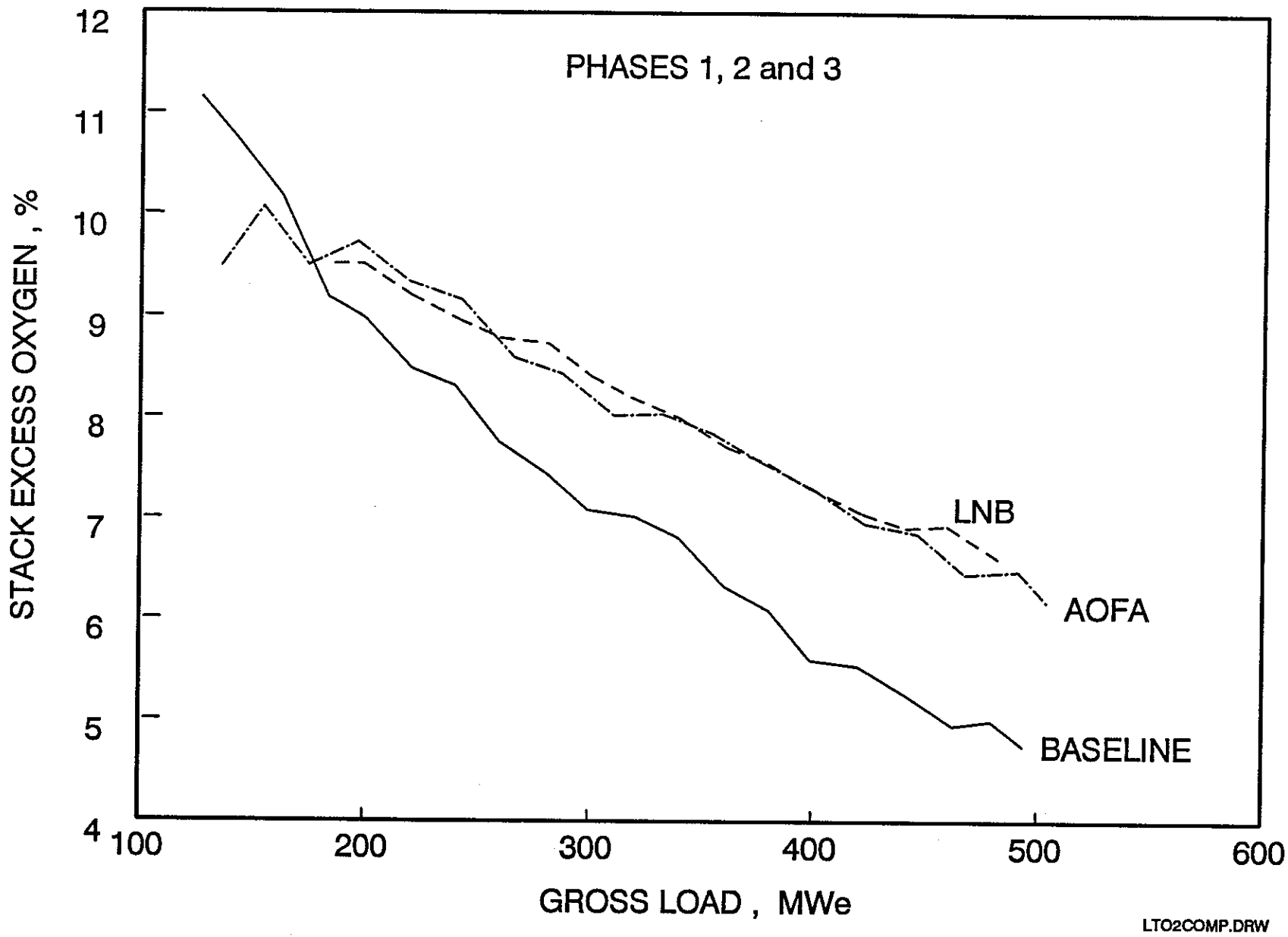
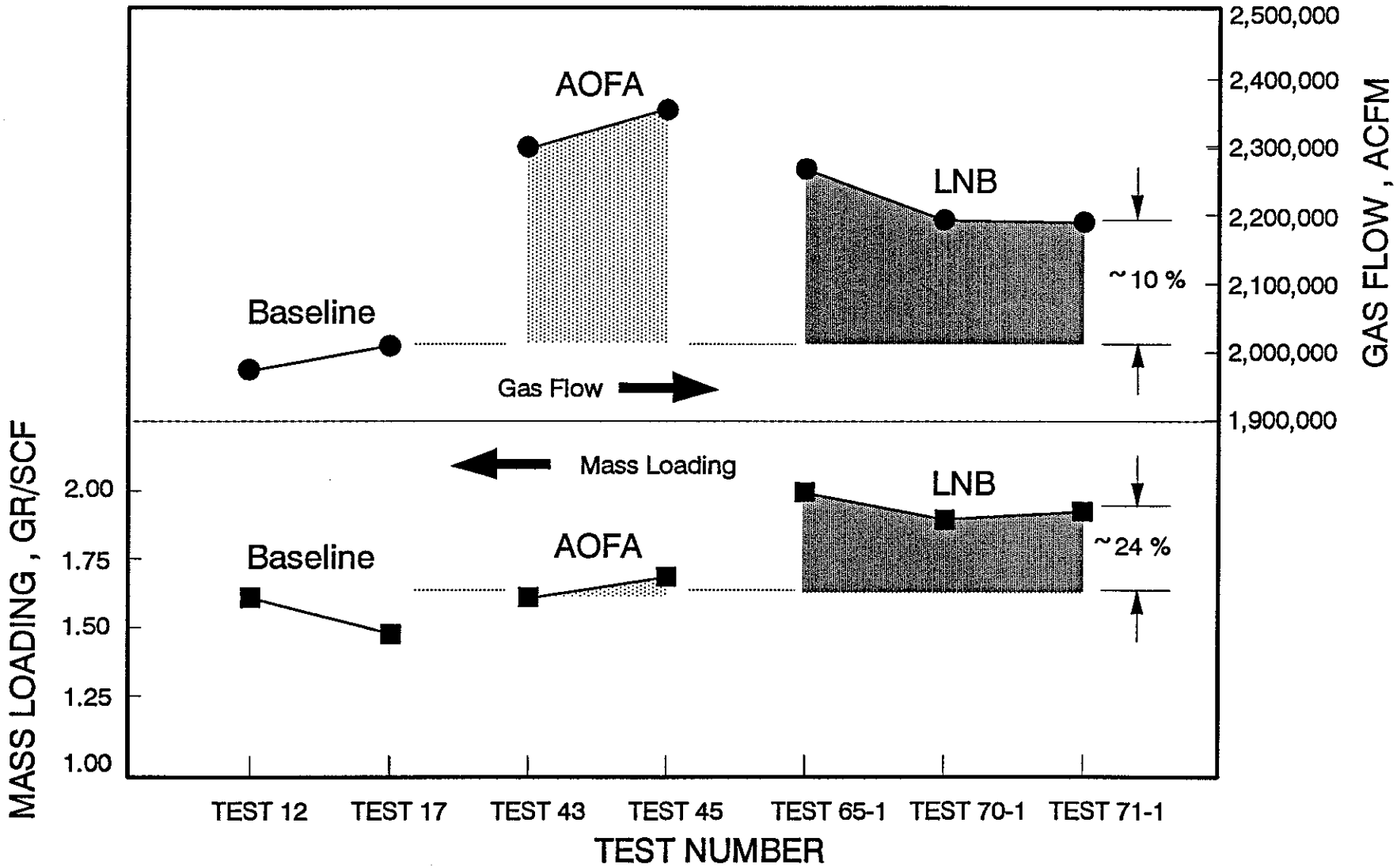


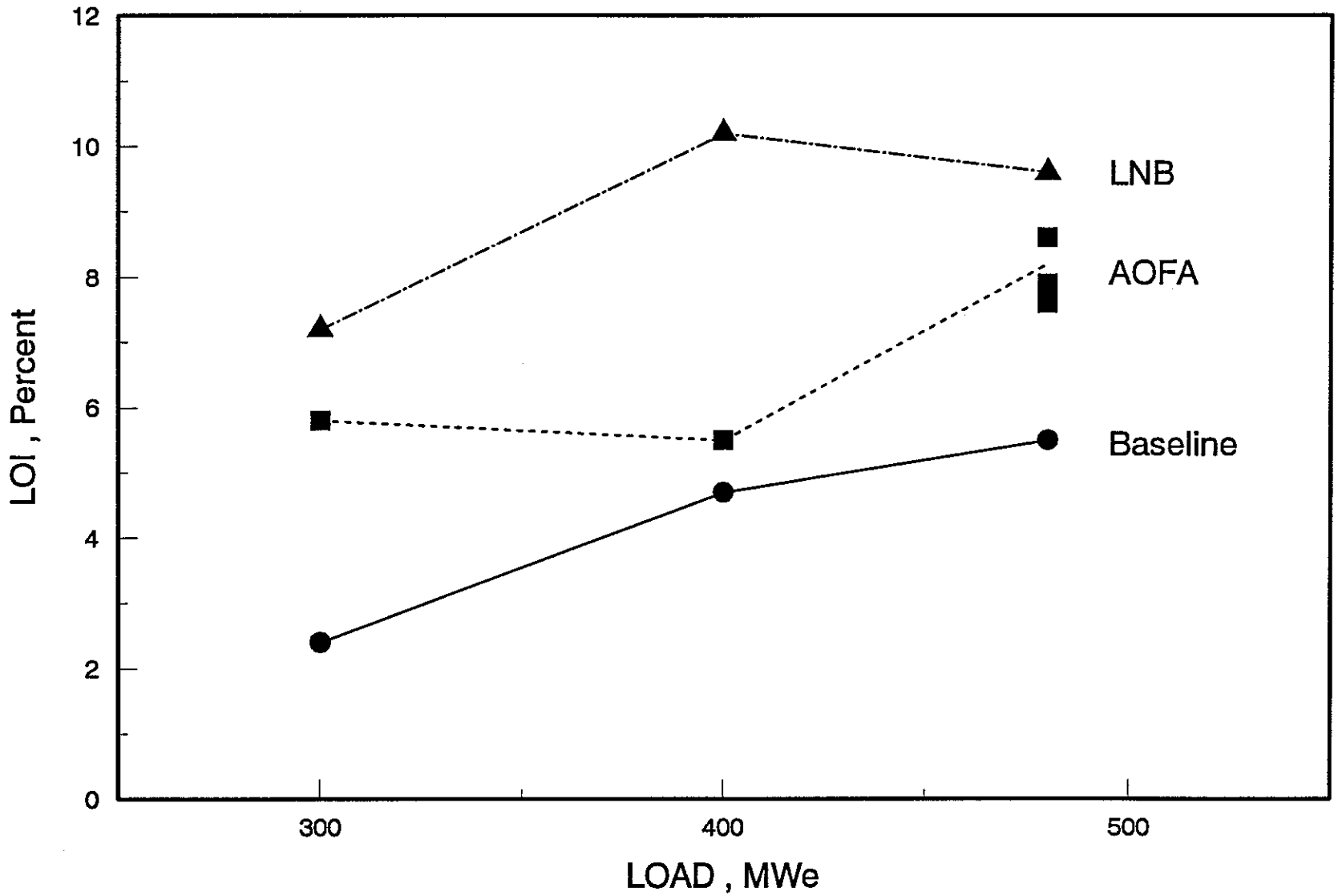
COMPARISON OF EXCESS OXYGEN LEVELS



ESP INLET CONDITIONS



FLYASH LOSS-ON-IGNITION



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