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NERVA TEST OPERATIONS

Nuclear Rocket Development Station

P. O. BOX 2027, JACKASS FLATS, NEVADA-89028

26 May 1967

NTO-M-15555

Dr. W. O. Wetmore, Manager, NRO
Aerojet-General Corporation
Post Office Box 15847
Sacramento, California, 95813

Attention: J. R. DaVolio

Subject: Support Operational Requirements Document for
NES Design Demonstration Test Phase II,
NTO-I-0223, Revision A, External Review Draft.

Dear Dr. Wetmore:

Attached is the external review draft of the subject SORD
for your review and comment. Please submit your comments
to H. Henze, Supervisor, ETS-1 Test Planning, by 1 June 1967.

Very truly yours,

N. E. Erickson, Manager
NERVA Test Operations

WLM:NEE:dsa

Enclosure

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NTO-I-0223

REVISION A

SUPPORT OPERATIONAL
REQUIREMENTS DOCUMENT
FOR
NES DESIGN DEMONSTRATION TEST
PHASE II

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EXTERNAL ISSUE

MAY, 1967

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APPENDIX A: NES DESIGN DEMONSTRATION TESTS PHASE II
MEASUREMENT AND CONTROL REQUIREMENTS

LIST OF FIGURES

- Figure 1: NES Design Demonstration Test Summary
- Figure 2: Test Compartment Arrangement
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- Figure 11: Area Security Map

1.0 INTRODUCTION

1.1 GENERAL

- 1.1.1 Phase I of the NERVA Exhaust System (NES) Design Demonstration test represented the first operation of the NES Duct and all duct subsystems at simulated engine operating conditions using the temporary engine compartment. Although it was impractical to simulate actual engine temperatures, these tests demonstrated the performance capabilities and structural integrity of the NES by flowing cold gaseous nitrogen at mass flow rates and pressures required for equivalent engine thrust conditions.
- 1.1.2 The Phase II test program will integrate into the NES system for the first time the Engine Test Compartment (ETC). Figure 2 shows the ETC arrangement. Due to facility limitations, the test program will be conducted at approximately the NERVA engine intermediate power level condition which is above the duct "pull-in" point utilizing first gaseous nitrogen and then gaseous hydrogen as the primary fluid. The effects of excessive engine test compartment (ETC) seal leakage and excessive turbine exhaust flow will be investigated. In addition, the thermal radiation on the Test Stand from the exhaust plume will be investigated.

2.0 TEST OBJECTIVES

The primary purpose of Phase II of the NES Design Demonstration Test Program is to integrate the Engine Test Compartment (ETC) into the Nuclear Exhaust System, to verify the duct dynamics using gaseous hydrogen and to evaluating exhaust plume thermal radiation effects on the test stand.

2.1 NEPN-I - LOSS OF STEAM TEST

- 2.1.1 Evaluate repressurization rate of the ETC under various conditions of primary flow when the steam generators are shutoff simultaneously and individually.
- 2.1.2 Evaluate the ETC seal leakage under various operating conditions by shutting off the seal actuator and buffer gas GN_2 supply.

2.2 NEP-V - GN_2 PRIMARY FLOW TEST

- 2.2.1 Evaluate ETC "pull-down" characteristics during a 12 second startup ramp to 210 psia primary nozzle pressure.
- 2.2.2 Evaluate the effect of excess turbine exhaust and excess seal leakage on ETC pressure and primary nozzle separation at 210 psia primary chamber pressure using gaseous nitrogen.
- 2.2.3 Verify that one steam generator prohibits back flow into the ETC during the shutdown of the primary flow in 13 seconds.
- 2.2.4 Verify ETC inerting procedures prior to and after primary flow conditions.

2.3 NEP-VI - GH_2 PRIMARY FLOW TEST

- 2.3.1 Evaluate ETC "pull-down" characteristics during the 6 second ramp to 210 psia primary chamber pressure.
- 2.3.2 Evaluate the NES dynamic performance at 210 psia primary chamber pressure using gaseous hydrogen with design turbine exhaust flow rate and normal seal leakage.

- 2.3.2.1 Determine recirculation effects between the primary nozzle and turbine nozzle in the volume of space between the primary nozzle and the turbine exhaust nozzle and line.
- 2.3.3 Evaluate the ETC "drop-out" characteristics during a 6 second shutdown ramp.
- 2.3.4 Evaluate the thermal radiation heating effects on the test stand during all conditions of hydrogen flow.
- 2.3.5 Verify ETC inerting procedures prior to and after primary flow conditions.

2.4 SECONDARY OBJECTIVES

These objectives will be evaluated during each test:

- 2.4.1 Verify proper operation of Flare Stack FS-5002.
- 2.4.2 Verify effectiveness of the Steam Line modifications.
- 2.4.3 Evaluate the NES duct drain valve remote operational capability.
- 2.4.4 Evaluate the NES duct drain coolant tubes discharge circuit modification.
- 2.4.5 Evaluate the effect on ETC coolant flow from duct and steam generator water demands.
- 2.4.6 Evaluate the effectiveness of the constant propellant bleed modification incorporated into the SGS.
- 2.4.7 Evaluate the ability of the $O_2 - H_2$ permanent ETC analyzer system to operate at reduced pressures.
- 2.4.8 Verify ETC S-2 remote electrical connector panels (CP-1, CP-2, NCP-3) continuity during Phase II testing.

3.0 TEST DESCRIPTION

3.1 GENERAL

- 3.1.1 A summary description of the three tests to be conducted is presented in Figure 1.
- 3.1.2 Schematics of the flow system are shown in Figures 3, 4, 5 and 6.
- 3.1.3 For NEPN-I and NEP-V, GN₂ primary flow, purge flow and simulated seal leakage will be supplied by three (3) GN₂ storage vessels and one (1) supply header 1-GN-8".
- 3.1.4 For NEP-VI, GH₂ primary flow will be supplied by three (3) GH₂ storage vessels and two (2) headers, 106-He-6" and 1-GH-6".
- 3.1.5 During the flow tests, the primary nozzle chamber pressure will be the controlling parameter and will be indicated on the temporary NES console (TNC) meters. Primary flow is controlled by PCV-449 through a feedback loop from PT-905 and PT-906, auctioned to select the highest primary chamber pressure. The valve controller includes a ramp generator for automatic startup and shutdown.
- 3.1.6 At full engine chamber pressure of 550 psia, the design turbine exhaust is 7.0 lb/sec. In this document when design turbine exhaust is specified at lower primary chamber pressures, the turbine exhaust flow rate shall be proportionally reduced.

- 3.1.7 Turbine exhaust flow will be supplied by GH_2 stored in the high pressure Dewar (V-5002). The GH_2 will flow through line 4-LH-6 inch to the turbine nozzle utilizing PCV-472 for control. Flow as a function of chamber pressure is presented in Figure 7.
- 3.1.8 Gaseous nitrogen for ETC inerting and simulated seal leakage will be supplied from line 1-GN-8 inch. The flow will be indicated by flow elements FE-426 and FE-427 and controlled by PCV-621 and PCV-447.
- 3.1.9 During all tests the hydrogen will be flared at the duct exit by FS-5002.
- 3.1.10 Cooling water will flow through the duct during each test.
- 3.1.11.1 Design flow is specified as 38000 GPM.
- 3.1.11.2 Minimum flow is specified as 4300 GPM.
- 3.1.11 Prior to the introduction of GH_2 , the O_2 concentration within the ETC shall be reduced to $3\frac{1}{2}\%$ or less. The temporary O_2 analyzers will be used to monitor the O_2 concentration during the test.
- 3.1.12 Prior to permitting the re-entry of air into the ETC, the GH_2 concentration shall be reduced to 2% or less.
- 3.1.13 ETC pressure shall be monitored throughout each test. Should the pressure rise sharply toward one (1) atmosphere during primary flow, the test shall be terminated.

3.1.14 In order to evaluate the effect on the test stand when hydrogen is being exhausted from the NES duct and burned, special instrumentation will be provided and will include surface temperature measurements, hydrogen monitoring sensors, radiometers and calorimeters.

3.1.15 Instrumentation will be provided to measure the various thermal aspects of the burning exhaust plume from the NES duct. The thermal radiation will be measured with various radiometers, calorimeters and thermocouples. The plume geometry, size, and spatial location will be determined by infrared photography. To determine the wind effect, smoke pots, photographed with color motion picture cameras, will be provided. The locations, color and number of the smoke bombs are as follows:

a. Vault opening plane

(1) Vault door bottom

(a) Vault door lower edge right-red smoke "pot".

(b) Vault door lower edge left-green smoke "pot".

(2) Top of light standard or first level of stairway from ditch floor - white smoke "pot" both sides.

(3) Vault opening (suspended units)

(a) Five feet below vault ceiling and nine feet each side of duct centerline -

- (3) Vault opening (suspended units) CONT'D
 - (a) CONT'D
 - purple smoke "pot" both sides.
 - (b) Thirty feet below vault ceiling and eight feet each side of duct centerline - orange smoke "pot" both sides.
 - (c) Plane at end of concrete ditch side walls - one green smoke "pot" on each side about 20 feet up on the gunited ditch sides.
 - (d) Plane at end of ditch rails - one white smoke "pot" on each side about 20 feet up on the gunited ditch sides.

3.1.16 Instrumentation for measuring wind velocity and air temperature will be provided.

The locations will be as follows:

- (a) Adjacent to the white smoke "pots" described in Paragraph 3.1.15.
- (b) On the duct centerline, between the green smoke "pots" described in Paragraph 3.1.15.
- (c) On the duct centerline, between the purple smoke "pots" described in Paragraph 3.1.15.
- (d) Adjacent to the orange smoke "pots" described in Paragraph 3.1.15.

3.2 NEPN-I- LOSS OF STEAM TEST

- 3.2.1 The ETC will be inerted and 1.5 lb/sec GN_2 purge flow will be established.
- 3.2.2 After inerting the ETC and duct, the duct cooling circuit flow will be brought to minimum flow conditions.
- 3.2.3 The SGS will be started and brought up to full steam condition using a standard startup procedure. The steam temperature will be controlled at $1460^{\circ}\text{R} \pm 50^{\circ}\text{R}$.
- 3.2.4 One steam generator module will be shutdown and 10 seconds later the second steam generator module will be shutdown.
- 3.2.5 The steam generators will be restarted as described in 3.2.3.
- 3.2.6 After two SGS modules have been brought to full steam, the ETC seal actuator and buffer zone supply valve will be closed. After 30 seconds, the valve will be opened.
- 3.2.7 The steam generator modules will then be shutdown simultaneously.
- 3.2.8 The steam generators will be restarted as described in 3.2.3.
- 3.2.9 The ETC GN_2 purge flow will then be increased to 5 lb/sec.
- 3.2.10 The steam generator modules will then be shutdown simultaneously; after which the ETC purge flow will be reduced to 1.5 lb/sec.
- 3.2.11 Operation of FS-5002 will be terminated.
- 3.2.12 The steam generators will be restarted as described in 3.2.3.
- 3.2.13 Primary flow will be ramped to a Pc of 120 psia in 7 seconds.
- 3.2.14 One burner of FS-5002 will be relit during the 120 psia hold.
- 3.2.15 The steam generator modules will then be shutdown simultaneously; after which the ETC purge flow will be increased to 20 lb/sec.

- 3.2.16 The primary flow will then be decreased to zero psig using a 3 second shutdown ramp.
- 3.2.17 The purge flow will be reduced to 1.5 lb/sec and the ETC seal actuator and buffer zone supply valve will be closed.
- 3.2.18 The steam generator will be restarted as described in 3.2.3.
- 3.2.19 Primary flow will be ramped to a P_c of 180 psia in 8 seconds, held for 10 seconds and ramped to zero psig in 4 seconds. Primary flow will then be ramped to 50 psia in 3 seconds.
- 3.2.20 The steam generator modules will then be shutdown simultaneously; after which the ETC purge flow will be increased to 10 lb/sec.
- 3.2.21. The primary flow will then be decreased to zero psig in 3 seconds, and ETC purge flow will then be terminated.
- 3.2.22 The run profile is shown in Figure 8.

3.3 NEP-V GN₂ PRIMARY FLOW TEST

- 3.3.1 After inerting the ETC and duct, the duct cooling circuit flow will be brought to design flow conditions.
- 3.3.2 The SGS will be started and brought up to full steam condition using a standard startup procedure. The steam temperature will be controlled at $1460^{\circ}\text{R} \pm 50^{\circ}\text{R}$.
- 3.3.3 When the ETC pressure has stabilized, an inerting GN₂ flow of 1.5 lb/sec will be introduced into the simulated TSA-UTS and the smoke pots initiated.

- 3.3.4 Primary GN_2 flow will be ramped to a P_c of 210 psia in 12 seconds. After completion of the off-design turbine exhaust, simulated seal leakage flow rates and shutdown of one of the two steam generator modules at full steam, primary flow will be ramped to 0 psig in 13 seconds.
- 3.3.5 After achieving a P_c of 210 psia, GH_2 turbine exhaust flow will be ramped to 15 lb/sec in 5 seconds and reduced to design conditions within 5 seconds. Design turbine exhaust flow will be terminated when the 30 lb/sec seal leakage has been established.
- 3.3.6 After achieving the design turbine exhaust flow, the seal leakage (purge) will then be increased from 1.5 lb/sec to 30 lb/sec in approximately 5 seconds maintained for 5 seconds, then reduced to 1.5 lb/sec in approximately 5 seconds.
- 3.3.7 The single steam generator module operation will be terminated after the ETC hydrogen concentration has been reduced to 2%. The duct flow will be reduced to minimum flow conditions at the conclusion of the primary flow test and terminated at the completion of steam generator operation.
- 3.3.8 The run profile is shown in Figure 9.

3.4 NEP-VI - GH_2 PRIMARY FLOW TEST

- 3.4.1 After inerting the ETC and duct, the duct cooling circuit flow will be brought to minimum flow conditions.

- 3.4.2 The SGS will be started and brought to full steam conditions with the steam temperature being controlled at $1460^{\circ}\text{R} \pm 50^{\circ}\text{R}$.
- 3.4.3 While the ETC pressure is stabilizing, design flow conditions will be established in the duct cooling circuit, an inerting GN_2 flow of 1.5 lb/sec will be introduced into the simulated TSA-UTS.
- 3.4.4 Primary GH_2 flow will be established at 210 psia using a 6 second startup ramp held for a minimum of 10 seconds or tailoff and ramped to zero psig in 6 seconds. Eight seconds after achieving steady-state condition, the smoke "pot" system will be initiated.
- 3.4.5 Design turbine exhaust flow will be established throughout the period of primary flow approximating the primary flow startup and shutdown ramps.
- 3.4.6 Steam Generator operation will be terminated after the ETC hydrogen concentration has been reduced to 2% by purging. The duct flow will be reduced to minimum flow conditions at the conclusion of the primary flow test and terminated at the completion of the steam generator operation.
- 3.4.7 The run profile is shown in Figure 10.

4.0 TEST LIMITS

<u>FUNCTION</u>	<u>CONDITION</u>	<u>ACTION</u>
ETC Pressure	Increase sharply toward 1 Atmosphere during Run.	Terminate Primary and Turbine Exhaust Flows. Purge if Hydrogen was Flowing.
Primary Chamber Pressure	Exceeds 550 psia	Switch PCV-449 to "Manual" and reduce pressure. If PCV-449 does not close in manual, turn "Fast Shutoff" on Function Generator Panel.
ETC O ₂ Concentration	Greater than 3-1/2% by volume.	Continue GN ₂ purge and increase as required.
Propane Flow	Decrease to 90% of nominal flow after steady-state.	Terminate Primary and Turbine Exh. Flows, initiate purge and shutdown SGS.
Propane Manifold Temperature	Exceeds 525°R	Terminate Primary and Turbine Exhaust Flows, initiate purge and shutdown SGS.
Module Chamber Pressure	Exceeds 160 psig	Terminate Primary and Turbine Exhaust Flows, initiate purge and shutdown SGS.
Steam Line Temperature	Exceeds 1760°R	Terminate Primary and Turbine Exhaust Flows, initiate purge and shutdown SGS.
Combustion Chamber Coolant Water Jacket Outlet Temp.	660°R	Terminate Primary and Turbine Exhaust Flows, initiate purge and shutdown SGS.
Plenum Coolant Water Jacket Outlet Temperature	660°R	Terminate Primary and Turbine Exhaust Flows, initiate purge and shutdown SGS.

5.0 SAFETY REQUIREMENTS

- 5.1 The area surveillance and warning system will be operating during each test.
- 5.2 All zones of the Fire Protection System will be completely automated prior to testing.
- 5.3 The NRDS Fire Department will have hoses charged in the ETS-1 Facility prior to testing.
- 5.4 Remote combustible gas and oxygen detectors in all areas shall be operating and calibrated prior to each test.
- 5.5 The safety requirements for steam generator testing are specified in NTO-SOP-0068.
- 5.6 The ETS-1 tunnel blast valve shall be unlocked prior to testing.
- 5.7 ETS-1 Lock and Tag procedures will be in force as applicable.
- 5.8 All areas of potentially reduced oxygen content shall be cleared for access prior to personnel entry by the Safety member of the re-entry team.
- 5.9 Area Control will be as shown in Figure 11.
- 5.10 All units of the ventilation system will be operating normally prior to testing.

6.0 TEST SCHEDULE

The tests are currently schedule for June 1967.

7.0 STATUS BOARD AND AREA CONTROL

- 7.1 A Status Board will be established for each run and will assume control of the facility at 1600 on R-2. Input to the Status Board will be submitted to Test Planning by R-7 Day.
- 7.2 Area Control will be established at 0800 hours of each R-Day per Figure 11.

8.0 PRODUCT ASSURANCE

- 8.1 Before the start of testing, it shall be verified that current calibrations exist for all test equipment.
- 8.2 Product Assurance shall document the serial numbers of the SGS main stage injectors, ignitors and combustion chambers.
- 8.3 Product Assurance shall maintain a discrepancy log for all systems utilized in the conduct of this test series. (NTO-A-0013).
- 8.4 Following each test, a complete visual examination shall be made of the entire duct inside and out. Particular attention shall be given to inspection of the weld of the primary section inner shell to the lower end cap. In addition, this weld shall be dye penetrant inspected following completion of the Phase II test program.
- 8.5 Prior to ETC initial closure all fasteners within the compartment shall be inspected, tested and certified as being adequately torqued and "shake proof." A "shake proof" fastener is defined as a properly tensioned fastener that has been either lock "washered," cotter pinned, safety wired, cemented, welded, bolt thread deformed on double nut "locked" to prevent separation of fastener components in a vibration environment.
- 8.6 A thorough inspection of the ETC shall be performed to insure that the compartment is devoid of any loose objects.

9.0 OPERATIONAL REQUIREMENTS

9.1 CONTROL POINT

The following consoles and their associated equipment will be operational for the conduct of Phase II of the NES Design Demonstration Tests:

Test Director	Gas Fill and Service
Test Conductor	Electrical Power
Temporary NES	Lead Safety Engineer

Test Stand Engineer	Lead Instrument Engineer
Assistant Stand Engineer	Digital Data
Lead Facility Engineer	Remote Recorder
Facility Engineer Right	Television
Facility Engineer Left	Remote Installation - Control System Engr.

9.2 FACILITY AND TEST STAND

The following systems and their associated equipment will be operational for the conduct of Phase II of NES Design Demonstration Tests

Gas fill and Storage System

Gas Distribution System

Gaseous Helium Purge System

Steam Generator System

Fire Protection System

Area Surveillance and Warning System

Utility and Process Water Systems

Duct Exhaust Igniter System

NES Duct Support Systems

Combustible Gas Detection System (H_2/C_3H_8)

Oxygen Detection System

Facility H_2/O_2 Detection System.

9.3 FLUID REQUIREMENTS

9.3.1 NEPN-L

V-3201, 3202, 3203 pressurized to 2475 ± 25 psig with GN_2

Utility water tank minimum level of 15 feet. Process water tank minimum level of 48 feet; Propane tank (V-3401) minimum level of 12000 gallons; Liquid oxygen storage tank (V-2801) Minimum level of 20000 gallons.

9.3.2 NEP-V

V-3201, 3202, 3203, pressurized to minimum of 2475 psig with GN_2 ; Utility water tank minimum level of 15 feet; Process water tank minimum level of 48 feet; Propane tank (V-3401) minimum level of 12000 gallons; Liquid oxygen storage tank (V-2801) minimum level of 20000 gallons; V-5002 pressurized to 1000 ± 50 psig with GH_2 .

9.3.3 NEP-VI

V-3201, 3202, 3203, pressurized to minimum of 2000 psig with GN_2 ; V-3207, 3208, 3209 pressurized to minimum of 2475 psig with GH_2 ; Utility water tank minimum level of 15 feet. Process water tank minimum level of 22 feet. Propane tank (V-3401) minimum level of 12000 gallons. Liquid oxygen storage tank (V-2801) minimum level of 20000 gallons. V-5002 pressurized to a minimum of 350 psig with GH_2 .

9.4 TELEVISION REQUIREMENTS

9.4.1 Television coverage will be required for test observation and surveillance of the facility for safety considerations. The following television cameras will be used to monitor this test:

<u>Monitor No.</u>	<u>Camera No.</u>	<u>Location</u>	<u>Observation</u>
1	3 (Infrared)	W. of Ditch	NES Duct, Flare Stack
2	13	N.E. of Steam Generator	SG Enclosure
3	1	N. of Ditch	NES Duct, Duct Vault

CONT'D

<u>Monitor No.</u>	<u>Camera No.</u>	<u>Location</u>	<u>Observation</u>
4	20	N. of LOX Dewar	LO ₂ Tank, Pipeline, Bottle Shed
5	6	Top of 3801 LH ₂ Storage	East Face of Test Stand and Mix Station
6	9	Pipe Vault	Steam Line Lower Elbow
7	11 (infrared special effects)	Top of Test Stand	Exhaust Plume
8	10	In Duct Vault	Duct
	9.4.2	Other cameras will be operational in the event substitution is required. Auxiliary illumination of the SGS enclosure, duct vault, and pipe vault will be provided by search lights and flood lamps.	
	9.4.3	Kinescope capability will be available during all phases of the test operation.	
9.5	<u>COMMUNICATIONS</u>		
	9.5.1	The ETS-1 communication system will be operation and audio tape recording of selected trunk lines will be required.	
	9.5.2	RF communications will be required.	
9.6	<u>PHOTOGRAPHIC SUPPORT REQUIREMENTS</u>		
	9.6.1	Two high speed cameras, 16 mm 200 frames per second (FPS) for 18 seconds, will be used to record any movement of the steam line during startup and shutdown transients.	
	9.6.2	Four color cameras, 16 mm 24 FPS for 10 minutes, will be used. One will be located to view the steam generator enclosure; two will be placed in the drainage ditch to view the smoke pots, and the other will be	

9.6.2 (CONT'd)

placed to view the side of the exhaust plume.

9.6.3 Two infrared cameras, 70 mm 5 FPS for 8 minutes, will be used to view the exhaust plume.

9.6.4 Still photographs shall be taken to show details of any portion of the NES which fails during testing.

9.7 MEASUREMENT AND CONTROL REQUIREMENTS

The requirements are specified in Appendix "A".

10.0 REPORT REQUIREMENTS

A preliminary report will be issued following completion of Phase II of the NES Design Demonstration Test Program.

TEST		TEST SYSTEMS REQUIRED								
No.	Description	Duct H ₂ O Coolant		Simulated GN ₂ Excess Leakage	GH ₂ Turbine Exhaust		Primary Flow			
							Fluid (1)		Start Ramp	Stop Ramp
		Low	Design		Design	Excess	GN ₂	GH ₂		
NEPN-I	Loss of Steam	X		X			X			
NEP-V	Primary Flow P _c =210 psia		X	X		X	10 Sec. Min.		12 sec	13 sec
NEP-VI	Primary Flow P _c =210 psia		X		X			10 Sec. Min.	6 Sec.	6 Sec.

NOTES: (1) Numbers indicated are steady state P_c periods.

FIGURE 1, TEST SUMMARY

FIG-2 ENGINE TEST COMPARTMENT
 ARRANGEMENT WITH PERMANENT
 AND TEMPORARY GAS
 ANALYZERS INSTALLED

(MT) - DENOTES TEMPORARY O₂
 PROBE LOCATIONS

ETS-1
Schematic for NES Design Demonstration
Test Phase II

Figure 6, Steam Generator Flow Schematic

NOTE:
1. STEAM GENERATOR UNITS 2 & 3 ARE IDENTICAL TO UNIT 1; COMPONENTS ARE NUMBERED THE SAME WITH A SUFFIX FOR UNIT (i.e. PT-40-1 IS IN UNIT 1, PT-40-2 IS IN UNIT 2, etc.)

Figure 7, Flow Curve, NES/DDT Turbine Exhaust Assembly

PRESSURE, PSIA

FLOW, LB/SEC

NES DESIGN DEMONSTRATION TESTS
APPROX. FLOWS & PRESSURES VS TIME

TEST NO. NEP N-1
FIG. NO. 8

PRESSURE, PSIA

FLOW, LB/SEC

NES DESIGN DEMONSTRATION TESTS
APPROX. FLOWS & PRESSURES VS TIME

PRESSURE, PSIA

FLOW, LB/SEC

NES DESIGN DEMONSTRATION TESTS
APPROX. FLOWS & PRESSURES VS TIME

Figure 11. Area Security Map

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
KT003..FPE H2 CON ETC CHAN 1	0-10 MV	7	X
KT004..MFPE H2 CON ETC CHAN 2	0-5 0-100%		X X LFE
KT004..FPE H2 CON ETC CHAN 2	0-10 MV	8	X
KT700..FPF OXYGEN CONCENTRATION 1	0-5 0-25 %	1	X
KT701..FPF OXYGEN CONCENTRATION 2	0-5 0-25 %	2	X X TN18
KT702..FPF OXYGEN CONCENTRATION 3	0-5 0-25 %	3	X
KT703..FPF OXYGEN CONCENTRATION 4	0-5 0-25 %	4	X
KT704..FPF OXYGEN CONCENTRATION 5	0-5 0-25 %	5	X
KT705..FPF OXYGEN CONCENTRATION 6 6	0-5 0-25 %	6	X
KT706..FPF OXYGEN CONCENTRATION 7	0-5 0-25 %	7	X
KT707..FPF OXYGEN CONCENTRATION 8	0-5 0-25 %	8	X X TN19
KT708..FPF OXYGEN CONCENTRATION 9	0-5 0-25 %	L8	X X TN20
KT709..FND H2 CONC. DUCT VLT	0-4(		X 13
KT710..FND H2 CONC DUCT VLT	0-4(		14
KT711..FND H2 CONC DUCT VLT	0-4(		15
KT712..FND H2 CONC DUCT VLT	0-4(		16
KT713..FND H2 CONC DUCT VLT	0-4(		17
KT714..FND H2 CONC DUCT VLT	0-4(		18
L1001..FSG LO V-2801 TNK LVL	0-10PSID		X FL

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- *	*A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
KN601X.	FND WIND VEL RT WHT POT XAX.	0-50MPH		X
KN601Y.	FND WIND VEL RT WHT POT YAX.	0-50MPH		X
KN602W.	FND WIND VEL DCT CL GRN POT WA	0-50MPH		X
KN602X.	FND WIND VEL DCT CL GRN POT XA	0-50MPH		X
KN602Y.	FND WIND VEL DCT CL GRN POT YA	0-50MPH		X
KN603W.	FND WIND VEL DCT CL PUR POT WA	0-50MPH		X
KN603X.	FND WIND VEL DCT CL PUR POT XA	0-50MPH		X
KN603Y.	FND WIND VEL DCT CL PUR POT YA	0-50MPH		X
KN604W.	FND WIND VEL LF ORGE POT WAX.	0-50MPH		X
KN604X.	FND WIND VEL LF ORGE POT XAX.	0-50MPH		X
KN604Y.	FND WIND VEL LF ORGE POT YAX.	0-50MPH		X
KN605W.	FND WIND VEL RT ORGE POT WAX.	0-50MPH		X
KN605X.	FND WIND VEL RT ORGE POT XAX.	0-50MPH		X
KN605Y.	FND WIND VEL RT ORGE POT YAX.	0-50MPH		X
KT001.	MFPE 02 CON ETC CHAN 1	0-5 0-25 %		X X LFE
KT001.	MFPE 02 CON ETC CHAN 1	0-10 MV	5	X
KT002.	MFPE 02 CON ETC CHAN 2	0-5 0-25 %		X X LFE
KT002.	MFPE 02 CON ETC CHAN 2	0-10 MV	6	X
KT003.	MFPE H2 CON ETC CHAN 1	0-5 0-100%		X X LFE

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
HT901..	FND SECT 1 MIDSPAN SPT RING	0-15 G	X
HT902..	FND SECT 1 MIDSPAN SPT RING	0-15 G	X
HT903..	FND SECT 1 MIDSPAN SPT RING	0-15 G	X
HT904..	FND ELBOW H2O JACKET-FRONT	0-15 G	X
HT905..	FND ELBOW H2O JACKET-FRONT	0-15 G	X
HT906..	FND ELBOW H2O JACKET-FRONT	0-15 G	X
HT907..	FND SECT 3 H2O INLET M	0-15 G	X
HT908..	FND SEC3 H2O INLT MNFLD	0-15 G	X
HT909..	FND SEC3 H2O INLT MNFLD	0-15 G	X
HT910..	FND REAR TRUN MIDSPAN	0-15 G	X
HT911..	FND REAR TRUN MIDSPAN	0-15 G	X
HT912..	FND REAR TRUN MIDSPAN	0-15 G	X
HT913..	FND FRONT TRUN MIDSPAN	0-15 G	X
HT914..	FND FRONT TRUN MIDSPAN	0-15 G	X
HT915..	FND FRONT TRUN MIDSPAN	0-15 G	X
KN600W.	FND WIND VEL LF WHT POT WAX.	0-50MPH	X
KN600X.	FND WIND VEL LF WHT POT XAX.	0-50MPH	X
KN600Y.	FND WIND VEL LF WHT POT YAX.	0-50MPH	X
KN601W.	FND WIND VEL RT WHT POT WAX.	0-50MPH	X

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
GG903..FND	SECT 1 FRONT-MIDSPAN	0-1000	X
GG904..FND	SECT 1 REAR-MIDSPAN	0-1000	X
GG905..FND	SECT 1 FRONT-BOTTOM	0-1000	X
GG908..FND	ELBOW H2O JKT-REAR-TOP	0-1000	X
GG911..FND	SECT3 MIDSPAN-TOP	0-1000	X
GG913..FND	SEC3-45DEG ELBOW-TOP	0-1000	X
GG914..FND	SEC3-45DEG ELBOW-BOTTOM	0-1000	X
HT001..FND	DCT SEC1 SEAL TABLE-1X VIB	0-15 G	X
HT002..FND	DCT SEC1 SEAL TABLE-2Y VIB	0-15 G	X
HT003..FND	DCT SEC1 SEAL TABLE-3Z VIB	0-15 G	X
HT004..FND	DCT SEC2 ELB-1X VIB	0-15 G	X
HT005..FND	DCT SEC2 ELBOW-2Y VIB	0-15 G	X
HT006..FND	DCT SEC2 ELBOW-3Z VIB	0-15 G	X
HT007..FND	DCT SEC3 MDSPAN-1X VIB	0-15 G	X
HT008..FND	DCT SEC3 MDSPAN-2Y VIB	0-15 G	X
HT009..FND	DCT SEC3 MDSPAN-3Z VIB	0-15 G	X
HT826..FSG	TEMP OUTLET R045	400-600R	X
HT827..FSG	ACCMTRS FOR STEAM LN-1	20G	X
HT828..FSG	ACCMTRS FOR STEAM LN-2	20G	X

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
FT406Y.FSG	SG3 H2O VNTR DP(FLW)	0-250PSID	X 5 X X FL
FT409W.FSG	SG1 3RD ST L02 VNTR PR-FLW	0-500PSIG	X 3 X X FL
FT409X.FSG	SG2 3RD ST L02 VNTR PR-FLW	0-500PSIG	X 3 X X FL
FT409Y.FSG	SG3 3RD ST L02 VNTR PR-FLW	0-500PSIG	X 3 X X FL
FT428..FSG	SG1 L02 FLOW RATE	0-500CPS	X X
FT701..FSG	FUEL FLOW RATE	0-500CPS	X 8 X
GG004..FND	DCT REAR LT TRUN STR	0-1500	X B29RI
GG005..FND	DCT RT REAR TRUN STR	0-1500	X B30RI
GG006..FND	DCT FRNT LT TRUN STR	0-1500	X B31RI
GG007..FND	DCT FRNT RT TRUN STR	0-1500	X B32RI
GG011..FND	DCT SEC2 CONE BOT STR	0-1500	X B35RI
GG012..FND	DCT SEC2 CONE RS STR	0-1500	X
GG013..FND	DCT SEC2 CONE TOP STR	0-1500	X B36RI
GG015..FND	DCT SEC3 BOT STR	0-1500	X B38RI
GG016..FND	DCT SEC3 RS STR	0-1500	X
GG017..FND	DCT SEC3 TOP STR	0-1500	X B39RI
GG018..FND	DCT SEC3 LS STR	0-1500	X
GG019..FND	DCT SEC3 FWD HOR TRUSS STR	0-1500	X
GG901..FND	SECT 1 FRONT-TOP	0-1000	X

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R * * * *A*B*C*D*E*F*FC*CS	*R *D*D*D*E*F*S * * * *W* * *SOLE	*S*L*M*CON- * * * *SOLE
DI006..	FSS SHLD S2/S5 POS	0-6 IN		X	X RIC
F.426..	FPF FLO FE426 AT 60 F (CAL)	0-40 PPS		R1 X	X TN27
F.427..	FPF FLO FE427 AT 60F (CAL)	0-6 PPS		R2 X	X TN30
FI030..	FWS WATER FLOW METER DELTA P	0-10PSID		L4 X	
FI031..	FWS DCT H2O SPLY-PART 12IN LN	0-5 PSID		X	X LF
FI032..	FWS DCT H2O SPLY-TOTAL	0-5 PSID	6	X	X LF
FI054..	FND DCT SEC1 LT H2O IN FLO	0-50 PSID		X X	X LF
FI055..	FND DCT SEC1 RT H2O IN FLO	0-50 PSID		X X	X LF
FI056..	FND DCT SEC 2 RT CLG H2O IN FL	0-25PSID		X X	X LF
FI057..	FND DCT SEC2 LF CLG H2O IN FLO	0-25PSID		X X	X LF
FI058..	FND DCT SEC3 LT CLG H2O IN FLO	0-50 PSID		X X	X LF
FI059..	FND DCT SEC3 RT CLG H2O IN FLO	0-50 PSID		X X	X LF
FI060..	FND DCT SEC2 JKT H2O IN FLO	+5 PSID		X	X LF
FI087..	FND SEC3 CLNG H2O-3IN LN	0-1000CPS	5	X	
FI405W..	FSG SG1 3RD STG PRO VNTR P-FLW	0-500PSIG	X 6	X	X FL
FI405X..	FSG SG2 3RD STG PRO VNTR P-FLW	0-500PSIG	X 6	X	X FL
FI405Y..	FSG SG3 3RD STG PRO VNTR P-FLW	0-500PSIG	X 6	X	X FL
FI406W..	FSG SG1 H2O VNTR DP(FLW)	0-250PSID	X 5	X	X FL
FI406X..	FSG SG2 H2O VNTR DP(FLW)	0-250PSID	X 5	X	X FL

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL *	CHANNEL TITLE	* MEAS *	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- *
* NUMBER *		* RANGE *	* * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
CP447..F50 PRG TEST FLOW CNTL (1#)	0-100 %		X X P TN
CP449..RLC NES PRIMARY FLOW PCV-CTL	0-100PC		X X X P TN
CP472..RLC LH CD PCV-CTL	0-100PC		X X P TN TS
DF031..FND DCT H2O FLW CTL-POS 6	0-100PC		X X LF
DF032..FND DCT H2O FLW CTL-POS 20	0-100PC		X X LF
DF050..MRGN GN2 CD SYS FCV-VLV POS	0-100PC		X X X TS
DF423WMFSG SG1 H2O THROTTLE VLV-POS	0-100PC	X	X X FL
DF423XMFSG SG2 H2O THROTTLE VLV-POS	0-100PC	X	X X FL
DF423YMFSG SG3 H2O THROTTLE VLV-POS	0-100PC	X	X X FL
DP446..MF50 PRG TEST FLOW CNTL (2#)	0-100 %		X X X TN25
DP447..MF50 PRG TEST FLOW CNTL (1#)	0-100 %		X X X TN28
DP449..MRLC NES PRIMARY FLOW PCV-CTL	0-100PC		X X X TN
DP449..RRLC NES PRIMARY FLOW PCV-CTL			X
DP472..MRLC LH CD SYS-VLV POS	0-100PC		X X X TN32
DI001..FSS SHLD S1/S2 OTBD TOP POS	0-6 IN		X X RIC
DI002..FSS SHLD S1/S2 INRD TOP POS	0-6 IN		X X RIC
DI003..FSS SHLD S1/S2 OTBD BOT POS	0-6 IN		X X RIC
DI004..FSS SHLD S1/S2 INBD BOT POS	0-6 IN		X X RIC
DI005..FSS SHLD S1/S5 POS	0-6 IN		X X RIC

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- *	*A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *				
BC701W.FSG	SG1 START SEQUENCE	NA		X	X			
MN L02 OPN	SG1 START SEQUENCE	NA			X			
MN PRO OPN	SG1 START SEQUENCE	NA			X			
BC701X.FSG	SG2 START SEQUENCE	NA		X	X			
MN L02 OPN	SG2 START SEQUENCE	NA			X			
MN PRO OPN	SG2 START SEQUENCE	NA			X			
BC701Y.FSG	SG3 START SEQUENCE	NA		X	X			
MN L02 OPN	SG3 START SEQUENCE	NA			X			
MN PRO OPN	SG3 START SEQUENCE	NA			X			
BS454..	PPV107 LOADING PRESS	500PSG					X	TS
BS480W.FSG	SG1 CMBUS CHBR PRESS SW	NA		X				
BS480X.FSG	SG2 CMBUS CHBR PRESS SW	NA		X				
BS480Y.FSG	SG3 CMBUS CHBR PRESS SW	NA		X				
CF050..RGN	GN2 CD SYS FCV-MAN CTL POT 0-100PC					X	X	P TS
CF423W.FSG	SG1 H2O THROTTLE VLV-CTL 0-100PC				X			P FL
CF423X.FSG	SG2 H2O THROTTLE VLV-CTL 0-100PC				X			P FL
CF423Y.FSG	SG3 H2O THROTTLE VLV-CTL 0-100PC				X			P FL
CP446..F50	PRG TEST FLOW CNTI (2#)	0-100 %				X	X	P TN

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *		
TE435X.FSG	SG2 STM DSCHG T1	492-2707			
TE435Y.FSG	SG3 STM DSCHG T1	492-2707			
TE436W.FSG	SG1 STM DSCHG T2	492-2707			
TE436X.FSG	SG2 STM DSCHG T2	492-2707			
TE436Y.FSG	SG3 STM DSCHG T2	492-2707			
TE437W.FSG	SG1 STM DSCHG T3	492-2707			
TE437X.FSG	SG2 STM DSCHG T3	492-2707			
TE437Y.FSG	SG3 STM DSCHG T3	492-2707			
TE438WPFSG	SG1 STM DSCHG AVG TEMP	492-2707		X	X FL
TE438XPFSG	SG2 STM DSCHG AVG TEMP	492-2707		X	X FL
TE438YPFSG	SG3 STM DSCHG AVG TEMP	492-2707		X	X FL
TE480..FSG	L02 BLEED TEMP	65-655R			X FL
TE534..FND	STM HDR TEMP	492-2707	X	X	X FL
TE776..FSG	STM LV SKIN TEMP T1	492-1660R		X	
TE777..FSG	STM LV SKIN TEMP T2	492-1660R		X	
TE778..FSG	STM LV SKIN TEMP T3	492-1660R		X	
TE779..FSG	STM LV SKIN TEMP T4	492-1660R		X	
TE780..FSG	STM LV SKIN TEMP T5	492-1660R		X	
TE781..FSG	STM LV SKIN TEMP T6	492-1660R		X	

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MLAS * RANGE	* 01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *		
TE158..	FND DCT SEC3 DRAIN H2O TEMP	492-711		X	B15RI
TE159..	FND STM HDR TEMP	490-2707R	X	L1 X	X TC10
TE164..	FND DCT SEC1 RT TRS H2O TEMP	492-711		X	
TE165..	FND DCT SEC1 LFT TRS H2O TEMP	492-711		X	
TE166..	FND DCT SEC3 UPR TRS STA 823	492-711		X	
TE167..	FND DCT SEC3 LWR TRS STA 823	492-711		X	
TE180..	FSS S1 TROUGH TEMP	492-935		X	X X X LFE
TE182..	FSS S1 TROUGH TEMP	492-935		X	X X X LFE
TE210..	FND DCT FLARE IG EXHST TEMP	NA			X FL
TE211..	FND DCT FLARE IG EXHST TEMP	NA			X FL
TE212..	FND DCT FLARE IG EXHST TEMP	NA			X FL
TE235..	FSS S2 TROUGH TEMP	492-935		X	X X X LFE
TE237..	FSS S2 TROUGH TEMP	492-935		X	X X X LFE
TE295..	FSS BOT TROUGH TEMP	492-935R		X	
TE298..	FSS BOT TROUGH TEMP	492-935		X	X X X LFE
TE299..	FSS BOT TROUGH TEMP	492-935		X	X X X LFE
TE302..	FSS BOT TROUGH TEMP	492-935		X	X X X LFE
TE320..	FND DCT SEC3 H2O DRAIN TEMP	492-711		X	B14RI
TE435W.	FSG SG1 STM DSCHG T1	492-2707			

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
TE059..FND	DCT SEC3 RT CLG H2O OTLT	492-711	X X LF
TE060..FND	DCT SEC2 RT LWR H2O OTLT	492-711	X
TE061..FND	DCT SEC2 RT UPR H2O OTLT	492-711	X
TE066..FND	DCT SEC1 LFT H2O OTLT	492-711	X X LF
TE067..FND	DCT SEC2 LFT H2O OTLT	492-711	X X LF
TE068..FND	DCT SEC3 LFT H2O OTLT	492-711	X X LF
TE075..FND	DCT SEC2 STA529 H2O	492-711	X B5 RI
TE076..FND	DCT SEC2 STA539 H2O	492-711	X B6 RI
TE077..FND	DCT SEC2 STA554 H2O	492-711	X X LF
TE078..FND	DCT SEC2 STA563 H2O	492-711	X B7 RI
TE079..FND	DCT SEC2 STA579 H2O	492-711	X B8 RI
TE083..FND	DCT SEC2 STA596 H2O	492-711	X B11RI
TE084..FND	DCT SEC2 STA598 H2O	492-711	X B12RI
TE085..FND	DCT SEC2 STA588 H2O	492-711	X B9RI
TE086..FND	DCT SEC2 STA590 H2O	492-711	X B10RI
TE087..FND	DCT SEC1 STA63 H2O	492-711	X B1 RI
TE088..FND	DCT SEC1 STA280 H2O	492-711	X B2 RI
TE089..FND	DCT SEC1 STA358 H2O	492-711	X B3 RI
TE090..FND	DCT SEC1 STA422 H2O	492-711	X B4 RI

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL *	CHANNEL TITLE	* MEAS	*01*02*03*	*R*R*R*R*R*R*R*R	*R	*D*D*D*F*F*S	*S*L*M*CON-	*
* NUMBER *		* RANGE	* * *	*A*B*C*D*E*F*FC*CS*L*M*H*	* * *	*W*	* * *	*SOLE *
PT797..	FPF 50 FE 427 RRG/LKG STAT PRE	0-300PSIA	2			X	X	
PT800..	FSS ETC DELTA P TOP-BTM SHLD	0-5 PSID			R6	X		
PT801..	FPF PRESS UPSTRM 50-R0-45	0-300 PSIG	4			X		X TN29
PT802W.	FPF PRESS PURGE RING A	0-300 PSIA				X		X TN26
PT802X.	FPF PRESS PURGE RING B	0-300 PSIA				X		
PT802Y.	FPF PRESS PURGE RING C	0-300 PSIA				X		
.PT813..	RLC PCV449 HYD ACT SPLY PRESS	3000PSG				X		X TN11
PT901..	FND TURB EXHST CHMBR PTC-1	0-100 PSIA			R4	X	X	X TN33
PT902..	FND TURB EXHST NOZ-1 PTF-1	0-5 PSIA				X X	X	
PT903..	FND TURB EXHST NOZ-2 PTF-2	0-5 PSIA				X	X	
PT904..	FND PRI GAS SPLY LINE PS	0-3000PSIG	3			X	X	
PT905..	FND PRI CHMBR-1	0-500PSA			R5	X X	X	X TN16
PT906..	FND PRI CHMBR-2 PPC-2	0-500 PSIA	2			X	X	X TN15
PT909..	FND PRI NOZ EXIT-1 PE-1	0-30 PSIA			R8	X	X	
PT910..	FND PRI NOZ EXIT-2 PE-2	0-5 PSIA				X	X	X TN21
PT911..	FND PRI NOZ EXIT-3 PE-3	0-30 PSIA			R7	X	X	X TN22
PT912..	FND PRI NOZ EXIT-4 PE-4	0-5 PSIA				X	X	
TE057..	FND DCT SEC1 RT H2O OTLT TEMP	492-711				X		X LF
TE058..	FND DCT SEC2 LT LWR H2O OTLT	492-711				X		X LF

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MFAS * RANGE	*01*02*03*R*R*R*R*R*R*R * * * *A*R*C*D*E*F*FC*CS*L*M*H* * *	*R *D*D*D*E*F*S * * * *W* * *	*S*L*M*CON- * * * *SOLE *
PT438Y.FSG	SG3 LWR 3RD STG PRESS PR	0-250PSIG	X	4	X TC8FL
PT439..FSG	RMT LDR PRO TANK PRESS	0-500PSIG			X FL
PT440..FSG	RMT LDR LOZ TANK PRESS	0-500PSIG			X FL
PT441..FGF	GF V-3207 TNK PRESS	0-4000PSIG			X GF
PT442..FGF	GF V-3208 TNK PRESS	0-4000PSIG			X GF
PT443..FGF	GF V-3209 TNK PRESS	0-4000PSIG			X GF
PT474..FPF	PRESS DWNSTRM CHV-1722	0-300 PSIG		3	X
PT484..RLC	LH CD SYS PRESS	0-1500PSIG		L6	X X TS
PT574..FSG	150LB GN SPLY PRESS	0-250PSIG			X FL
PT596..FWS	DCT CLNT OLT-PRESS	0-300 PSIG		4	X LF
PT597..FWS	DCT CLNT INLT-PRESS	0-300 PSIG		7	X LF
PT600..FWS	DCT CLNT FCV OTLT-PRESS	0-30 PSIA			X
PT601..RLC	50FE012 DELTA PRESS	0-25 PSID		R3	X
PT602W.FPT	DELTA PRESS-FE426	0-50PSID		1	1 X
PT602X.FPT	DELTA PRESS - FE426 COMP	0-50PSID			
PT603W.FPF	DELTA PRESS - FE427	0-50 PSID			X X
PT603X.FPF	DELTA PRESS - FE427 COMP	0-50PSID			
PT787..FSG	SG PLENJM CLNT H2O DRF DP	0-100PSID			X
PT796..FPF	50 FE 426 PRG/LKG STAT PRS	0-300PSIA		2	X X

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*	*R*R*R*R*R*R*R*	*R	*D*D*D*E*F*S	*S*L*M*CON-	* *W* * *SOLE *
PT408X.FSG	SG2 2ND STG PRO VNTR IN PR	0-500PSIG		X	2		X	
PT408Y.FSG	SG3 2ND STG PRO VNTR IN PR	0-500PSIG		X	2		X	
PT410W.FSG	SG1 CHBR JKT H2O DSCH PR	0-200PSIG					X	
PT410X.FSG	SG2 CHBR JKT H2O DSCH PR	0-200PSIG					X	
PT410Y.FSG	SG3 CHBR JKT H2O DSCH PR	0-200PSIG					X	
PT416W.FSG	SG1 1ST STAGE IG PRESS	0-250PSIG		X			X	FL
PT416X.FSG	SG2 1ST STAGE IG PRESS	0-250PSIG		X			X	FL
PT416Y.FSG	SG3 1ST STAGE IG PRESS	0-250PSIG		X			X	FL
PT417W.FSG	SG1 2ND STAGE IG PRESS	0-250PSIG		X			X	FL
PT417X.FSG	SG2 2ND STAGE IG PRESS	0-250PSIG		X			X	FL
PT417Y.FSG	SG3 2ND STAGE IG PRESS	0-250PSIG		X			X	FL
PT420..FSG	SG PRO IN PRESS	0-500PSIG		X	7		X	FLTC1
PT421..FSG	SG LO MN FLD PRESS	0-500PSIG		X	7		X	TC5FL
PT425..FSG	SG PLEN STM NO.1 PR	0-250PSIG		X		L2	X	FL
PT426..FSG	SG PLEN STM NO2 PR	0-250PSIG		X			X	TC9FL
PT427..FSG	SG MN H2O MN FLD PRESS	0-300PSIG		X	7		X	FL
PT428..FSG	SG GN PRG SPLY PRESS	0-500PSIG					X	FL
PT438W.FSG	SG1 LWR 3RD STG PRESS PR	0-250PSIG		X	4		X	TC6FL
PT438X.FSG	SG2SLWR 3RD STG PRESS	0-250PSIG		X	4		X	TC7FL

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R	*R	*D*D*D*E*F*S	*S*L*M*CON-	*
			* * *	*A*B*C*D*E*F*FC*CS*L*M*H*	* * *	*W* * *	*SOLE *
PT221..FND DCT SEC1 LT H2O IN PRESS	0-250 PSIG						X
PT223..FND DCT SEC 1 RT H2O OTLT PRES	0-100PSIG						X B22RI
PT224..FND DCT SEC2 LT H2O IN PRESS	0-250 PSIG						X
PT225..FND DCT SEC3 LT H2O IN PRESS	0-300 PSIG						X
PT226..FND DCT SEC2 LT LWR H2O OUTLT	0-100PSIG						X B25RI
PT239..FND DCT STM ADR PRESS	0-250PSIG	X		L3	X		X LF
PT258..FSS S2 BOT SEAL BLD PRG PRESS	0-15 PSIG				X	X X X	RIC
PT260..FSS S1 SIDE-BOT SEAL PRG PRESS	0-5 PSIG				X	X X X	RIC
PT290..FSS ETC PRESS - TOP SHLD	0-20 PSIA				X		X TN23
PT291..FSS TOP CHBR PRESS IND	0-10PSA				X		
PT292..FSS BOT CHBR PRESS	0-20 PSIA			L5	X		
PT293..FSS BOT CHBR PRESS	0-10PSA				X		
PT340..FSS TOP SHLD BLWS PRESS	0-25 PSIG				X	X X X	RIC
PT342..FSS BOT SEAL BLADE PRG PRESS	0-5 PSIG				X	X X X	RIC
PT348..FSS TOP SHLD BLADE PRG PRESS	0-5 PSIG				X	X X X	RIC
PT40/W.FSG SG1 1ST STG PRO INJTN PRES	0-500PSIG		X	1	X		
PT407X.FSG SG2 1ST STG PRO INJTN PRES	0-500PSIG		X	1	X		
PT40/Y.FSG SG3 1ST STG PRO INJTN PRES	0-500PSIG		X	1	X		
PT408W.FSG SG1 2ND STG PRO VNTR IN PR	0-500PSIG		X	2	X		

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- *	*A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
LT011..FSG PRO V3401 TNK LVL	0-10PSID			X FL
LT015..FWS PROCESS H2O SPLY TNK-LVL	0-50 FEET		X	X LF
PT001..FGF GF V3201 TNK PR	0-3000PSIG		X	X GF
PT002..FGS GS DIST HDR (1-GN) PR	0-3000PSIG		X	X GF
PT003..FGS GS DISTR HDR (1-GH) PR	0-3000PSIG		X	X GF
PT004..FGF GF V3202 TNK PR	0-3000PSIG		X	X GF
PT005..FSG GS DISTB HDR ,106HE. PR	0-3000PSG		X	X GF
PT007..FGF GF V3203 TNK PR	0-3000PSIG		X	X GF
PT049..FSG LO V2801 TNK PRESS	0-500PSIG		X	X FL
PT097..RLC V5002 HP LH DEWR PR	0-2000PSIG	1	X	X AC10
PT101..RLC LH CD SPLY PRESS	0-2000PSIG	X	X	X TS
PT118..FSG PRO V3401 TNK PRESS	0-500PSIG		X	X FL
PT168..FWS PROCESS H2O HDR PRESS	0-300PSIG	4	X	X LF
PT191..RGN GN2 CD PRE-MIX PRESS	0-500PSIG		X	X TS
PT203..FND DCT SEC1 RT H2O IN PRESS	0-250 PSIG		X	
PT204..FND DCT SEC 1 LTH2O OTLT PRESS	0-100PSIG		X	B21RI
PT206..FND DCT SEC2 RT H2O IN PRESS	0-250-PSIG		X	
PT207..FND DCT SEC3 RT H2O IN PRESS	0-250 PSIG		X	
PT209..FND DCT SEC 2 RT LWR H2O OTLT	0-100PSIG		X	B26RI

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
TT484..FGF GAS V3207 TNK TEMP	360-610R	X	X GF
TT485..FGF GAS V3208 TNK TEMP	360-610R	X	X GF
TT486..FGF GAS V3209 TNK TEMP	360-610R	X	X GF
TT489..FGF V3201 TNK TEMP	360-610	X	X GF
TT490..FGF V-3202 TNK TEMP	360-610	X	X GF
TT491..FGF V-3203 TNK TEMP	360-610	X	X GF
* TT901..FPF TEMP OF FE426	492-711R	X	

NUMBER OF CHANNELS LISTED IS 367.
THE END

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR VES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R*R * * * *A*B*C*D*E*F*FC*CS*L*M*H* * *	*R *D*D*D*E*F*S *S*L*M*CON- * *W* * *SOLE *
TE823..FND	TEMP DCT CL BTWN PURP POTS	492-1460R		X
TE824..FND	TEMP DCT VLT LF ORGE POTS	492-1460R		X
TE825..FND	TEMP DCT VLT RT ORGE POTS	492-1460R		X
TE829W.FSG	MOD LO2 BLEED TEMP SG1	65-655R		X AC9
TE829W.FSG	MOD LO2 BLEED TEMP SG1	65-655R		X AC9
TE829X.FSG	MOD LO2 BLEFD TEMP SG2	65-655R		X AC8
TE829Y.FSG	MOD LO2 BLEED TEMP SG3	65-655R		X AC7
TE902..FND	TURB EXHST CHMBR TTC	65-654		X X
TE903..FND	PRI CHMBR TPC	492-771		X X
TT028..RLC	LH CD SPLY TEMP	135-610		X X
TT047..FWS	DCT CLNT INLT-TEMP	460-560		X X LF
TT048..FWS	DCT CLNT OTLT-TEMP	460-560		X X LF
TT431..FSG	SG PLEN H2O JKT TEMP	460-610		X X TC3FL
TT434W.FSG	SG1 CHBR JKT H2O DSCHG T	460-610		X
TT434X.FSG	SG2 CHBR JKT H2O DSCHG T	460-610		X
TT434Y.FSG	SG3 CHBR JKT H2O DSCHG T	460-610		X
TT478..FSG	SG FUEL MNFLD TEMP	460-560	X	8 X X TC2FL
TT479..FSG	LO2 MNFLD TEMP	35-325		8 X X TC4FL
TT483..FSG	PRO V3401 TANK TEMP	460-560		X X FL

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL * NUMBER	* CHANNEL TITLE	* MEAS * RANGE	*01*02*03*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON- * * * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
TE804..	FND RAD-150 FT DCT CL	0-60B/F25	X
TE805..	FND CAL-MID VAULT DOOR	0-60B/F25	X
TE806..	FND CAL-FWD DUCT STRUCTURE RGT	0-60B/F25	X
TE807..	FND CAL-FWD DUCT STRUCTURE LFT	0-60B/F25	X
TE808..	FMS CAL-BOT WEATHER DOOR	0-60B/F25	X
TE809..	FSS CAL-TEST STD-NW COL	0-15B/F25	X
TE810..	FND TEMP ETC-T1	400-600R	X
TE811..	FND TEMP ETC-T2	400-600R	X
TE812..	FND TEMP ETC-T3	400-600R	X
TE813..	FND TEMP ETC-T4	400-600R	X
TE814..	FND TEMP ETC-T5	400-600R	X
TE815..	FND TEMP ETC-T6	400-600R	X
TE816..	FND DUCT EXIT STRUCTURE	400-600R	X
TE817..	FND DUCT EXIT STRUCTURE	492-1460R	X
TE818..	FND DUCT EXIT STRUCTURE	492-1460R	X
TE819..	FND DUCT EXIT STRUCTURE	492-1460R	X
TE820..	FND TEMP LF WHITE POT DITCH SID	492-1460R	X
TE821..	FND TEMP RT WHITE POT DITCH SID	492-1460R	X
TE822..	FND TEMP DCT CL BTWN GRV POTS	492-1460R	X

APPENDIX A MEASUREMENT + CONTROL REQUIREMENTS FOR NES DESIGN

DEMONSTRATION TESTS PHASE

* CHANNEL *	CHANNEL TITLE	* MEAS *	*01*02*03*R*R*R*R*R*R*R*R *R *D*D*D*E*F*S *S*L*M*CON~ *
* NUMBER *		* RANGE *	* * * *A*B*C*D*E*F*FC*CS*L*M*H* * * *W* * *SOLE *
TE782..FSS	HORZ SHLD CAR TEMP-VE1	460-1000R	X
TE783..FSS	HORZ SHLD CAR TEMP-VE2	460-1000R	X
TE784..FSS	HORZ SHLD CAR TEMP-NW1	460-1000R	X
TE785..FSS	HORZ SHLD CAR TEMP-NW2	460-1000R	X
TE786..FSS	TEST STD NE COL-TEMP	460-1000R	X
TE787..FSS	TEST STD SE COL-TEMP	460-1000R	X
TE788..FSS	TEST STD SW COL-TEMP	460-1000R	X
TE789..FSS	TEST STD NW COL-TEMP	460-1000R	X
TE790..FND	DCT VLT DOOR T1	460-1000R	X
TE791..FND	DCT VLT DOOR T2	460-1000R	X
TE792..FND	DCT VLT DOOR T3	460-1000R	X
TE793..FMS	TS WEATHER DOOR T1	460-1000R	X
TE794..FMS	TS WEATHER DOOR T2	460-1000R	X
TE795..FND	DCT VLT AREA T1	460-1000R	X
TE796..FND	DCT VLT AREA T2	460-1000R	X
TE797..FND	DCT VLT AREA T3	460-1000R	X
TE798..FND	RAD-DITCH BNTH PLUGF	0-60 B/F25	X
TE799..FND	RAD-TOP DUCT VLT	0-15 B/F25	X
TE800..FND	CAL-TOP WEATHER DOOR	0-15 B/F25	X